SECTION 4
SURFACE WATER MANAGEMENT
DESIGN AND CONSTRUCTION REQUIREMENTS

SECTION 4
SURFACE WATER MANAGEMENT
DESIGN AND CONSTRUCTION REQUIREMENTS

4-1 INTRODUCTION

City of Vancouver Surface Water Management Section reviews new development and redevelopment activities and ensures compliance with federal, state and local codes and ordinances to provide water quality treatment and control of stormwater run-off, while also working to protect riparian areas and water bodies within the City limits. To that end, the program provides technical guidance, comprehensive planning, and sound engineering to safely move flood waters and drainage in a manner that prevents negative water quality impacts, provides fish passage and habitat, promotes recreation opportunities, and enhances community aesthetics.

These goals are met through planning and prioritizing capital improvements, acquiring wetland and flood plain properties where needed, developing regional water quality and detention facilities, working with the development community to meet requirements through use of best management practices and best available technology.

Proper design of catch basins, pipes, curbs and other surface water conveyance infrastructure as well as use of water quality and control structures can prevent flooding, reduce maintenance costs and protect the environment. Additionally, erosion prevention, in and adjacent to construction sites, has a great impact on the quality of surface water runoff and protects the long term viability of infiltration systems.

Storm sewer systems and on-site drainage systems are designed to handle surface water from various sources including street, roof and footing drainage. Storm drains in the City of Vancouver are separate from the sanitary sewer system.

This section provides requirements and details for surface water conveyance, water quality and quantity systems, and erosion prevention and sediment control in the City of Vancouver. All requirements and specifications are subject to revision. Standard specification drawings follow the narrative section.

These General Requirements are intended to supplement and clarify the Stormwater Management Manual for Western Washington (*Stormwater Manual)* to provide guidance for and tailor to local conditions. The General Requirements may also adopt measures that are deemed equivalent by the Washington State Department of Ecology.

The General Requirements have been developed to provide engineers with minimum criteria for developing stand alone plans for the construction of required improvements and are not intended to be all inclusive. The following criteria, outlined in this document, will assist engineers in the design of drainage infrastructure per the requirements of the City of Vancouver. If a topic or standard is not addressed in these General Requirements, refer to the *Stormwater Manual* for guidance.

The Washington State Department of Transportation *Highway Runoff Manual* may be used to design stormwater systems for City of Vancouver Transportation and Washington State Department of Transportation projects.

Additional criteria and information is available in the Vancouver Municipal Code (VMC); specifically ordinances VMC 14.24, 14.25, and 14.26, the Western Washington Phase II Municipal Stormwater Permit (Phase II Permit) issued by the Washington State Department of Ecology, Ecology's *Stormwater Manual*, and the Underground Injection Control Program (WAC 173-218 and Section I-4 of the *Stormwater Manual*). See References in Appendix D.

The Vancouver Municipal Code is available on the City's website:
http://www.cityofvancouver.us/vmc

The *Stormwater Manual*, NPDES Phase II Permit and UIC Program Information are available on Washington State Department of Ecology Water Quality Program website:
http://www.ecy.wa.gov/programs/wq/wqhome.html

4-1.01 APPLICABILITY OF VMC 14.24, VMC 14.25, and VMC 14.26

All new development and redevelopment activities shall refer to Figure 3.2 and Figure 3.3 to determine which stormwater requirements will apply to the project. Figure 3.2 and Figure 3.3 from pages 9 and 10 of Appendix 1 of the Phase II Permit are in Appendix A of this document or Figures 2.4.1 and 2.4.2 in Volume I of the Stormwater Manual pages 2-10 and 2-11.

Minimum Requirements that may apply to a new development or redevelopment activity:

1. Preparation of Stormwater Site Plans
2. Construction Stormwater Pollution Prevention Plan
3. Source Control of Pollution
4. Preservation of Natural Drainage Systems & Outfalls
5. On-site Stormwater Management
6. Runoff Treatment
7. Flow Control
8. Wetlands Protection
9. Operation and Maintenance

In addition to the applicable Minimum Requirements, all new underground injection control wells shall meet the requirements of Washington State Department of Ecology Underground Injection Control (UIC) Program. Information regarding Ecology's requirements can be found on their website:
http://www.ecy.wa.gov/programs/wq/grndwtr/uic/

4-2 STORMWATER SITE PLAN SUBMITTALS

4-2.01 Introduction

A Stormwater Site Plan is a comprehensive plan and report containing all the technical information and analyses necessary for the City to evaluate proposed new development or redevelopment activities for compliance with stormwater requirements. The contents of the Stormwater Site Plan will vary with the type and size of the project and the individual site characteristics.

Project applicants shall fill out and submit a "Stormwater Applicability Application" which will be utilized to determine the required elements of the stormwater submittal.

This section describes the submittal package that is required for projects within the City of Vancouver. Additional guidance on preparing a Stormwater Site Plan is contained in Vol. I, Ch. 3 of the *Stormwater Manual*.

4-02.02 Preliminary Stormwater Site Plan

In accordance with Minimum Requirement #1, a preliminary stormwater site plan is required for all new development and redevelopment projects that are not exempt from all Minimum Requirements (as described in Section 4-1.01). The purpose of the preliminary stormwater site plan is to allow the City to determine whether a proposal can meet the requirements of Vancouver Municipal Code Chapters 14.24, 14.25, and 14.26.

The preliminary stormwater site plan shall be submitted with the land use application.

The preliminary stormwater plan submittal shall consist of:

1. A preliminary development plan.
2. A preliminary Stormwater Report prepared in the standardized format described in the sections below.

The preliminary stormwater site plan shall identify how stormwater runoff that originates on the site or flows through the site is currently controlled and how this will change with the proposed development or redevelopment project. If the site is within a region covered by a basin plan, the information needed in the preliminary stormwater site plan may be reduced.

The project engineer shall include a statement that all the required information is included in the preliminary stormwater site plan and that the proposed stormwater facilities are feasible. All plans, studies, and reports that are part of the preliminary and final stormwater site plans shall be stamped, signed and dated by the professional civil engineer(s), registered in the state of Washington, responsible for preparation of the report.

The City may waive some or all of the content requirements in the preliminary stormwater site plan if:

1. The development project is included in an approved final stormwater plan that meets the requirements of VMC 14.24, 14.25, and 14.26; or

2. A basin plan exists that makes some of the information irrelevant; or

3. The City determines, upon receipt of a letter of request from the applicant, that less information is required to accomplish the purposes of this chapter.

The waiver of some or the entire preliminary stormwater site plan does not relieve the applicant of the requirement to prepare a final stormwater site plan.

Preliminary Development Plan

The preliminary development plan shall consist of 22-inch x 34-inch or 24-inch x 36-inch drawings for existing and proposed conditions. The preliminary development plan shall show the character of the existing site and proposed features, including but not limited to:

1. Existing and proposed property boundaries, easements, and rights-of-way.

2. Existing and proposed contours with a 2-foot maximum contour interval, unless the City determines a lesser interval is sufficient to show drainage patterns and basin boundaries.

3. Offsite areas contributing runoff to the site.

4. Natural and manmade drainage features on and adjacent to the site, including existing and proposed stormwater facilities.

5. Existing on-site water wells, areas of potential slope instability, structures, utilities, and septic tanks and drain fields.

6. Location of the 100-year floodplain and floodways and shoreline management area limits on and adjacent to the site.

7. Existing water resource features on and adjacent to the site, including streams, wetlands, springs, and sinks.

8. Existing and proposed drainage flow routes for each Threshold Discharge Area (TDA) to and from the site, including bypass flows.

9. Proposed location of structural source control BMPs implemented in accordance with Minimum Requirement #3 – Source Control of Pollution, Section 4-9 and VMC14.26, where applicable.

10. Point of discharge locations from the proposed project site that preserve the natural drainage patterns and existing outfall locations in accordance with Minimum Requirement #4 – Preservation of Natural Drainage Systems and Outfalls.

11. Areas of the project site where on-site stormwater management BMPs will be effectively implemented, in accordance with Minimum Requirement #5 – On-site Stormwater Management), including low impact development BMPs. The plan must show the areas of retained native vegetation, required flow lengths, and vegetated flow paths for proper implementation of these BMPs.

12. All existing drainage facilities, including structural water quality or flow control BMPs and conveyance systems.

13. Existing and proposed Pollution-Generating Pervious Surfaces (PGPS), including lawn, landscaped areas, and pasture areas.

14. Existing areas of the site predominantly covered by native vegetation (i.e., native trees, shrubs, and herbaceous plants as defined by the Washington State Department of Ecology) and areas of native vegetation to be preserved under proposed conditions.

15. Approximate location and size of proposed runoff treatment and flow control facilities implemented in accordance with Minimum Requirements #6 – Runoff Treatment and #7 – Flow Control, and Sections 4-5 and 4-6.

16. The wetland boundary for sites that discharge stormwater to a wetland, either directly or indirectly through a conveyance system.

17. A conceptual grading plan that verifies the constructability of a stormwater facility.

18. A conceptual erosion prevention and sediment control plan showing proposed measures.

The City may require additional site or vicinity information if needed to determine the feasibility of the stormwater proposal.

Preliminary Stormwater Report

The preliminary Stormwater Report is a comprehensive supplemental report that contains all technical information and analyses necessary to determine that the proposed stormwater facilities are feasible. The required contents of the preliminary Stormwater Report are identified below.

A project which triggers only Minimum Requirements #1 through #5 may elect to submit a "Minor Project Narrative" instead of a full Stormwater Report. This document can be found on the City of Vancouver Surface Water website.

Table of Contents

1. List of section headings and their respective page numbers
2. List of tables with page numbers
3. List of figures with page numbers
4. List of attachments, numbered
5. List of references

Map Submittals

All maps shall contain a scale and north arrow.

1. Vicinity Map: All vicinity maps shall clearly show the project site.

2. Soils Map: The soils map shall show soils within the contributing area that drains to the site itself. Soils maps may be obtained from the following sources:
   a. Updated version of the Soil Survey of Clark County, Washington, originally published in 1972, and updated by the Natural Resources Conservation Service (NRCS)
   b. Geographic information system (GIS) maps of soils from Clark County GIS: http://gis.clark.wa.gov/mapsonline/?site=SoilsWetlands&ext=1

c. Washington soil survey data as available on the NRCS website: http://websoilsurvey.nrcs.usda.gov

If the maps do not appear to accurately represent the soils for the site, the applicant is responsible for verifying the actual soils for the site.

3. Other Maps: The following additional maps shall be required in these situations:

a. Wellhead Protection. If the site lies within a 1900' radius of a public water supply well it is in a Special Protection Area (SPA). A map showing the site in relationship to the SPA is required.

b. Floodplains. If a floodplain mapped by the Federal Emergency Management Agency (FEMA) exists on or adjacent to the site, a map showing the floodplain is required.

c. Shoreline Management Area. If the site contains or is adjacent to a stream or lake regulated under the Washington Shorelines Management Act, a map showing the boundary of the shoreline management area in relation to the site is required.

d. Historic Prairie Conditions. If the site utilizes historic prairie conditions for the pre-developed condition for flow control, provide a map showing the site in relationship to the pre-settlement prairie delineations.

Wellhead Special Protection Areas - Water Resources Protection Program
http://www.cityofvancouver.us/waterprotection

Flood Maps and Shorelines - Clark County MapsOnLine
http://gis.clark.wa.gov/mapsonline/?site=SoilsWetlands&ext=1

Pre-Settlement Prairie Areas in Vancouver, WA
http://www.cityofvancouver.us/publicworks/page/surface-waterstormwater-design-construction-requirements

Section A – Project Overview

1. Describe the site location.

2. Describe the topography, natural drainage patterns, vegetative ground cover, and presence of critical areas (VMC Chapter 20.740).

3. Identify and discuss existing on-site stormwater systems and their functions.

4. Identify and discuss site parameters that influence stormwater system design.

5. Describe drainage to and from adjacent properties.

6. Describe adjacent areas, including streams, lakes, wetland areas, residential areas, and roads that might be affected by the construction project.

7. Generally describe proposed site construction, size of improvements, and proposed methods of mitigating stormwater runoff quantity and quality impacts.

Section B – Minimum Requirements

A. Describe the land-disturbing activity and document the applicable Minimum Requirements for the project site (See Section 4-1.01 and 4-1.02). Include the following information in table format:

1. The amount of existing impervious surface.
2. The amount of new impervious surface.
3. The amount of replaced impervious surface.
4. The amount of native vegetation converted to lawn or landscaping.
5. The total amount of land-disturbing activity.

B. Provide a statement that confirms the Minimum Requirements that will apply to the development activity. For land-disturbing activities where Minimum Requirements #1 through #9 must be met:

1. Provide the amount of effective impervious area in each Threshold Discharge Area (TDA), and document through an approved continuous runoff simulation model (e.g., the Western Washington Hydrologic Model [WWHM]) the increase in the 100-year flood frequency from pre-developed to developed conditions for each TDA.

2. List the TDAs that must meet the runoff treatment requirements listed in Minimum Requirement #6 and Section 4-6.

3. List the TDAs that must meet the flow control requirements listed in Minimum Requirement #7 and Section 4-5.

4. List the TDAs that must meet the wetlands protection requirements listed in Minimum Requirement #8 and VMC 20.740.

Section C – Preliminary Soils Evaluation

The Preliminary Soils Evaluation shall be prepared by a registered professional engineer or engineering geologist proficient in geotechnical engineering or by a registered soil scientist, and shall address (as a minimum) items 1 through 5 outlined in section 4.2 Infiltration Investigation Report of "A Review of Infiltration Standards and Practices in Clark County"(*SWWASCE Infiltration Standards*) SWWASCE 2009. (See Appendix B)

A preliminary report shall be prepared that outlines the findings of the Preliminary Soils Evaluation, discusses the feasibility of the use of infiltration facilities or LID practices which rely upon infiltration, and provides preliminary recommendations for the design and construction of infiltration facilities. The report shall include relevant portions of the soils map from *NRCS National Soil Survey Handbook* (NRCS 2007), the *Soil Survey Manual* (NRCS 1972) or the NRCS Web Soil Survey, and other geologic maps as appropriate. Deviations from this submittal requirement will need City approval.

Section D – Source Control

1. All development activities shall apply the Minimum Standards of VMC 14.26.120.

2. Industrial zoned sites and industrial activities shall the Applicable Source Control BMPs from Vol. IV of the *Stormwater Manual.*

3. Any development activity that includes operations Classified under VMC 14.26.125 shall implement the appropriate Greater Standards of VMC 14.26.130.

Section E – On-site Stormwater Management BMPs

1. On the preliminary development plan or other maps, show the site areas where on-site stormwater management BMPs will be effectively implemented. (See Vol. III, Ch. 3 and Vol. V, Ch. 5 of the *Stormwater Manual*) The plan must show the areas of retained native vegetation and required flow lengths and vegetated flow paths, as required for proper implementation of each on-site stormwater BMP. Arrows must show the stormwater flow path to each BMP.

2. Identify and describe geotechnical studies or other information used to complete the analysis and design of each on-site stormwater BMP.

3. Identify the criteria (and their sources) used to complete analyses for each on-site stormwater BMP.

4. Describe how design criteria will be met for each proposed on-site stormwater management BMP.

5. Describe any on-site application of LID measures planned for the project. Provide a plan that shows the proposed location and approximate size of each LID facility.

6. Identify and describe any assumptions used to complete the analysis.

7. Describe site suitability, including hydrologic soil groups, slopes, areas of native vegetation, and adequate location of each BMP.

Section F – Runoff Treatment Analysis and Design

For land-disturbing activities where the thresholds within Minimum Requirement #6, Section 4-1.01 and Section 4-1.02 indicate that runoff treatment facilities are required:

1. Document the level of treatment required (basic, enhanced, phosphorus, oil/water separation) based on procedures in Vol. V, Ch. 2 of the *Stormwater Manual*.

2. Provide background and description to support the selection of the treatment BMPs being proposed.

3. Identify geotechnical or soils studies or other information used to complete the analysis and design.

4. Identify the BMPs used in the design, and their sources.

5. Summarize the results of the runoff treatment design, and describe how the proposed design meets the requirements of Section 4-6 and the *Stormwater Manual*.

6. Provide a table that lists the areas of Pollution-Generating Pervious Surfaces (PGPS) and Pollution-Generating Impervious Surfaces (PGIS) for each Threshold Discharge Area (TDA).

Section G – Flow Control Analysis and Design

For land-disturbing activities where the thresholds within Minimum Requirement #7, Section 4-1.01 and Section 4-1.02 indicate that flow control facilities are required:

1. Describe the site's suitability for stormwater infiltration for flow control, including tested infiltration rates, logs of soil borings, and other information as available.

2. Identify and describe geotechnical or other studies used to complete the analysis and design.

3. If infiltration cannot be utilized for flow control, provide the following additional information:

   a. Identify the areas where flow control credits can be obtained for dispersion, LID or other measures, per the requirements in the *Stormwater Manual.*

   b. Provide the approximate size and location of flow control facilities for each Threshold Discharge Area (TDA) per Vol. III of the *Stormwater Manual*.

   c. Identify the criteria (and their sources) used to complete the analyses, including historic pre-developed and post-developed land use characteristics.

   d. Complete a hydrologic analysis for historic pre-developed and developed site conditions in accordance with the requirements of Section 4-5 and Ch. 2 in Vol. III of the *Stormwater Manual*, using an approved continuous runoff simulation model. Compute pre-developed and post-development flow durations for all subbasins. Provide an output table from the continuous flow model.

   e. Include and reference all hydrologic computations, equations, graphs, and any other aids necessary to clearly show the methodology and results.

   f. Include all maps, exhibits, graphics, and references used to determine existing and developed site hydrology.

4. Submit electronic copies of the WWHM (.wdm, .prj, .usi) ~~or MGS Flood~~ project files upon request.

Section H – Wetlands Protection

For projects where stormwater discharges to a wetland, either directly or indirectly through a conveyance system, describe wetland protection measures to be implemented in accordance with Minimum Requirement #8 and VMC 20.740. This narrative shall describe the measures that will maintain the hydrologic conditions, hydrophytic vegetation, and substrate characteristics necessary to support existing and designated uses.

4-2.03 Final Stormwater Site Plan

In accordance with Minimum Requirement #1, the final stormwater site plan provides final engineering design and construction drawings for the stormwater aspects of a proposed new development or redevelopment project. The final stormwater site plan shall be submitted to and approved by the City prior to clearing, grading and/or construction. Approval is only for conformance with VMC 14.24, 14.25, and 14.26.

The City may waive some or all of the content requirements in the final stormwater site plan if:

1. The development project is included in an approved final stormwater site plan that meets the requirements of VMC 14.24, 14.25, and 14.26; or
2. A basin plan exists that makes some of the information irrelevant.

Final Stormwater Site Plan Submittal

The final stormwater site plan shall be submitted to obtain civil plan approval once the final decision has been issued for the land use application. The final stormwater site plan shall also be submitted with streamlined applications.

The final stormwater site plan submittal shall include the following:

1. Any easements, covenants, or agreements necessary to allow construction.
2. Final engineering plans that provide sufficient detail to construct the stormwater facilities. The plans shall show all utilities to ensure that conflicts between utility lines do not exist. These plans shall be stamped, signed and dated by the engineer(s), registered in the State of Washington, responsible for hydrologic, hydraulic, geotechnical, structural and general civil engineering design, and by the project engineer responsible for the preparation of the final stormwater plan.
3. The approved preliminary stormwater site plan, with an explanation of any differences between the design concepts included in the preliminary and final stormwater plans.
4. A final development plan (which may be a part of the final engineering plans or a separate plan). See the requirements identified below.
5. A final stormwater report. See the requirements identified below.
6. A Construction Stormwater Pollution Prevention Plan (SWPPP) or an Erosion Prevention and Sediment Control Plan. See Section 4-8.

Final Development Plan Requirements

The final development plan shall be consistent with the preliminary development plan and may be combined with the final engineering plans. In addition to the information required in the preliminary development plan, the final plan requires the following information:

1. Threshold Discharge Area (TDA) delineations, and total impervious and pervious area delineations and acreages by TDA.

2. The acreage of Pollution-Generating Pervious Surfaces (PGPS) and Pollution-Generating Impervious Surfaces (PGIS) used in the hydraulic-hydrologic calculations both on-site and offsite that contribute surface runoff.

3. Directions and lengths of overland, pipe, and channel flow.

4. Outfall points from each TDA and overflow routes for the 100-year storm.

5. On-site conveyance systems, including pipes, catch basins, channels, ditches, swales, and culverts.

6. Primary flow path arrows for drainage under developed conditions, with the calculated flow rates. Cross-reference the flow rates to the hydrological model output file used to calculate the flow rates.

7. The City may require additional site or vicinity information if needed to determine the feasibility of the stormwater proposal.

Final Stormwater Report Requirements

The final Stormwater Report shall be a comprehensive report, supplemental to the final engineering plans, that contains all technical information and analyses necessary to complete the final engineering plans based on sound engineering practices and appropriate geotechnical, hydrologic, hydraulic, and water quality design.

The final Stormwater Report shall be stamped, signed and dated by the professional engineer(s), registered in the State of Washington, responsible for hydrologic, hydraulic, geotechnical, structural and general civil engineering design.

The required contents of the final Stormwater Report, which is part of the final stormwater site plan, are identified below.

Table of Contents

Same as the preliminary Stormwater Report requirements.

Map Submittals

Same as the preliminary Stormwater Report requirements.

Section A – Project Overview

Provide the information from the preliminary Stormwater Report with the following additional elements:

1. Reference the conceptual design proposed in the preliminary stormwater plan.

2. Identify revisions to the conceptual design contained within the final engineering plans.

Section B – Minimum Requirements

Provide the information from Section B of the preliminary Stormwater Report, revised as necessary for the final design. Confirm the applicable minimum requirements identified in the preliminary Stormwater Report. For land-disturbing activities where Minimum Requirements #1 through #9 must be met, provide the required information listed in Section B of the preliminary Stormwater Report, revised to reflect the final design.

Section C – Final Soils Evaluation

The Final Soils Evaluation shall be prepared by a registered professional engineer or engineering geologist proficient in geotechnical engineering and be conducted in conformance with the recommendations outlined in Section 4-5.05 Infiltration Evaluation of these General Requirements and section 4.1 Field Test Method of *SWWASCE Infiltration Standards*. A final report shall be prepared in conformance with section 4.2 Infiltration Investigation Report of *SWWASCE Infiltration Standards*.

Section D – Source Control

Same as the preliminary Stormwater Report requirements.

Section E – On-site Stormwater Management BMPs

Provide the information from the preliminary Stormwater Report with the following additional elements:

1. Reference the conceptual design proposed in the preliminary stormwater plan.

2. Identify revisions to the conceptual design contained within the final engineering plans.

3. For bioretention systems, provide the following:
    a. The proposed soil matrix for the facility.
    b. The planting plan, listing proposed plant types and locations.
    c. Detail drawings, including the following:
        i. If an underdrain is used, show drain rock, pipe, and filter fabric specifications.
        ii. All stormwater piping associated with the facility, including catch basin, pipe materials, sizes, slopes, and invert elevations.
        iii. Bioretention width, length, side slopes, and maximum design water depth.
        iv. Irrigation system, if installed.
        v. Designs for any retaining walls proposed. Structural walls shall meet City building permit requirements.

4. For permeable pavements, provide the following:
    a. Supporting design calculations showing adequate infiltration rates to accommodate flows from all impervious surfaces directed onto any permeable pavement.
    b. Geotextile specification.
    c. Base material gradation.
    d. Mix design.
    e. Acceptance test procedures.
    f. Detail drawings, including the following:
        i. Geotextile
        ii. Base material
        iii. Wearing layer

5. For reversed slope sidewalks, show the following:

a. Details on the vegetated surface receiving water from reversed slope sidewalks.

Section F – Runoff Treatment Analysis and Design

For land-disturbing activities where the thresholds within Minimum Requirement #6, Section 4-1.01 and Section 4-1.02 indicate that runoff treatment facilities are required, provide the information from the preliminary Stormwater Report with the following additional elements:

1. Reference the conceptual runoff treatment design proposed in the preliminary stormwater site plan.

2. Identify revisions to the conceptual runoff treatment design contained in the preliminary stormwater site plan.

3. Complete a detailed analysis and design of all proposed runoff treatment system elements in accordance with Section 4-6, Vol.V of the *Stormwater Manual* and the Underground Injection Control Program. Reference runoff treatment system elements to labeled points shown on the site location map or final development plan.

4. Include and reference all computations, equations, charts, nomographs, detail drawings, and other tabular or graphic aids used to design water quality system elements in the technical appendix.

5. Summarize the results of the runoff treatment design, and describe how the proposed design meets the requirements of Section 4-6, the *Stormwater Manual* and the UIC Program.

Section G - Flow Control Analysis and Design

For land-disturbing activities where the thresholds within Minimum Requirement #7, Section 4-1.01 and Section 4-1.02 indicate that flow control facilities are required:

1. Identify revisions to the conceptual design proposed in the preliminary stormwater site plan.

2. Identify pre-developed conditions, including stream base flows, water surface elevations, hydraulic or energy grade lines, storage volumes, and other data or assumptions used to complete the analyses of pre-developed conditions. Reference the sources of information.

3. Describe any assumptions used to complete the analyses, including flow credits through the use of on-site stormwater BMPs or LID measures.

4. Complete a detailed hydrologic analysis for pre-developed and developed site conditions, in accordance with the requirements of Section 4-5 and Ch. 2 of Vol. III of the *Stormwater Manual*, using an approved continuous runoff simulation model. Compute pre-developed and developed flow durations for all subbasins. Provide an output table from the continuous flow model, including the following:

a. A table listing the pass/fail rates for each flow level where duration statistics were calculated.

b. A graph showing the flow rate on the y axis and percent time exceeding on the x axis for pre-developed conditions and post-developed mitigated conditions, from 50 percent of the 2-year flow rate through the 50-year flow rate.

5. Provide a hydraulic analysis of the outlet control structure including any orifices, weirs, elbows, risers and connected pipes. The structure shall also be analyzed for backwater conditions if needed. All calculations used to determine stage-storage-discharge tables used in the WWHM shall be included.

6. Submit electronic copies of the WWHM (.wdm, .prj, .usi) ~~or MGS Flood~~ project files to allow reviewers to run the model and confirm the model results.

7. Refer to labeled points shown on the site location map and development plan.

8. Include and reference all hydrologic and hydraulic computations, equations, rating curves, stage-storage-discharge tables, graphs, and any other aids necessary to clearly show the methodology and results.

9. Include all maps, exhibits, graphics and references used to determine existing and developed site hydrology.

Flow Control System Plan

1. Provide an illustrative sketch of the flow control facility and its appurtenances.

2. Show basic measurements necessary to confirm storage volumes.

3. Show all orifice, weir and flow restrictor dimensions and elevations.

4. The sketch shall correspond with final engineering plans. Alternatively, a final site grading plan that incorporates the above information may be included as an attachment to the final stormwater plan.

5. Provide electronic copies of the drawings used for analysis, measurement, and design inputs for the hydrologic analysis submitted with the final drawing in one of the following approved file formats: Portable Document Format (.pdf), AutoCAD (.dwg, .dxf).

Section H – Wetlands Protection

Same as the preliminary Stormwater Report requirements.

Section I – Other Permits

Construction of roads and stormwater facilities may require additional permits from other agencies. These permits may contain requirements that affect the design of the stormwater system. Approved permits that are critical to the feasibility of the stormwater facility design shall be included in this section.

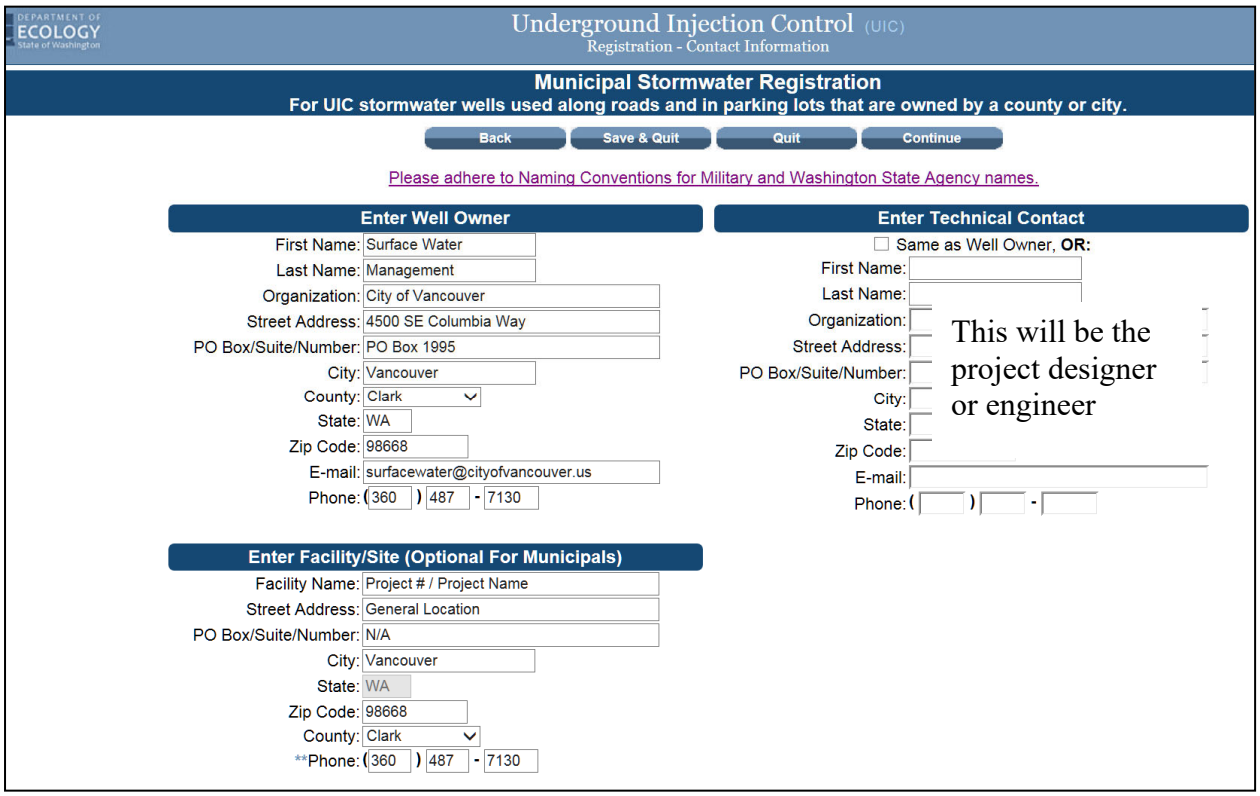
Underground Injection Control (UIC) Regulation (WAC 173-218)

1. Compliance - Provide a narrative demonstrating how the project complies with UIC rules per section I-4 of the *Stormwater Manual*.

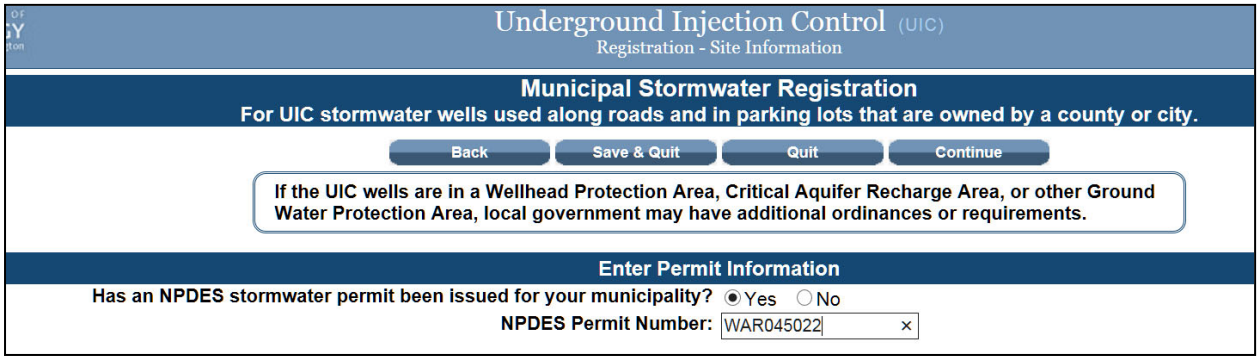
~~1.~~2. Well Registration - All UIC wells are required to be registered with Washington State Department of Ecology. Proposed *public* UIC wells shall

receive Washington State Department of Ecology UIC Program rule authorization *prior* to civil plan approval. Provide a copy of the authorization in the Final Stormwater Report during the plan review process. A copy of the registration application will be accepted if rule authorization notification has not been received from Ecology within 60 days of application for well registration. Registration forms shall include the following ownership, facility/site information, and NPDES number for proposed *public* UICs.

Ownership, Technical Contact and Project Information:



Municipal NPDES Permit Number:



Section J – Conveyance Systems Analysis and Design

1. Reference the conceptual drainage design proposed in the preliminary stormwater site plan.

2. Identify revisions to the conceptual drainage design contained in the preliminary stormwater site plan.

3. Identify the criteria used to complete the analyses and their sources.

4. Identify and discuss initial conditions, including stream base flows, beginning water surface elevations, hydraulic or energy grade lines, beginning storage elevations, and other data or assumptions used to complete the analyses of initial conditions. Reference the sources of information.

5. Describe any assumptions used to complete the analyses.

6. Complete a detailed hydraulic analysis of all proposed collection and conveyance system elements and existing collection and conveyance elements, including outfall structures and outlet protection, which influence the design or are affected by the proposal. Compute and tabulate the following:

   a. Identify design flows and velocities and conveyance element capacities for all conveyance elements within the development.

   b. Identify the 10-year recurrence interval stage for detention facility outfalls. Provide stage-frequency documentation from WWHM.

   c. Compute existing 100-year floodplain elevations and lateral limits for all channels, and verify no net loss of conveyance or storage capacity from development.

   d. Reference conveyance system elements to labeled points shown on the site location map or development plan.

   e. Verify the capacity of each conveyance system element to convey design flow and discharge at non-erosive velocities. Verify the capacity of the on-site conveyance system to convey design flows that result from ultimate build-out of upstream areas.

   f. Include and reference all hydraulic computations, equations, pipe flow tables, flow profile computations, charts, nomographs, detail drawings, and other tabular or graphic aids used to design and confirm the performance of conveyance systems.

   g. Summarize the results of system analyses, and describe how the proposed design meets the requirements.

Section K – Special Reports and Studies

Where site-specific characteristics (such as steep slopes, wetlands, and sites located in wellhead protection areas) present difficult drainage and water quality design problems, the City may require additional information or the preparation of special reports and studies that further address the specific site characteristics, the potential for impacts associated with the development, and the measures that would be implemented to mitigate impacts. Special reports shall be prepared by professionals with expertise in the particular area of analysis, who shall date, sign, stamp, and otherwise certify the report. Subjects of special reports may include but are not limited to:

1. Geotechnical

2. Wetlands
3. Floodplains and floodways
4. Groundwater
5. Structural design
6. Fluvial geomorphology (erosion and deposition)

All special reports and studies shall be included in the technical appendix.

Section L – Operations and Maintenance Manual

The project engineer shall prepare a site-specific operations and maintenance manual for each stormwater control and/or treatment facility to be privately maintained and for those that constitute an experimental system to be maintained by the City following Vol. V Ch. 4 of the *Stormwater Manual* or specified by the City. The manual objective is to provide long-term guidance for each stormwater facility to preserve engineering function and performance. The manual shall adequately relay information to site owners or those actually providing maintenance to implement effective maintenance programs and identify system components.

The manual (included as a technical appendix) shall be written in an orderly and concise format that clearly describes the design and operation of the facility. The manual shall also provide an outline of required maintenance tasks, with recommended frequencies at which each task should be performed. The manual shall contain or reference procedures from the *Stormwater Manual*.

The manual shall include the following information.

1. Narrative for operations and management of the site including description of stormwater system and receiving waters if runoff leaves the site.
2. Itemized list of stormwater facilities and components found on site (e.g. quantity of catch basins, pipe, treatment vaults, ponds, etc)
3. Project specific site map including access for maintenance and location of stormwater facilities including native soil and vegetation protection areas.
4. Specify the ownership of the proposed facilities and clearly indicate long-term maintenance responsibility
5. Outline maintenance funding mechanism guidelines such as 10-15% of capital construction cost is average for routine maintenance including higher costs during plant establishment and media filter replacements. Best practices like street sweeping and catch basin cleaning improve system performance and lower maintenance costs. Indicate life expectancy of facility and estimated costs for eventual replacement.
6. Facility inspection checklists for the specific types of facilities for the site.
7. Special instructions or attachments will be included for emerging technologies not in the *Stormwater Manual* such as proprietary media filters or experimental technologies on public projects.
8. Designate areas for stormwater flow dispersion delineated on site map and locations of easements or separate tracts.

9. Include inspection and maintenance log forms including dates, facility components inspected or maintained as well as proprietary system inspection reports and disposal of waste must be included.
10. Disposal of sediments from stormwater facilities considering activities and pollutants onsite must be included. Facilities in areas used for chemical or hazardous material storage, material handling or equipment maintenance may collect chemicals used in these activities or material from spills and stormwater runoff. Outline indicators (odor, sheen, discoloration) for testing or specialty contractor assessment.

Technical Appendix

All Stormwater Reports shall contain ~~a~~ technical appendices that include~~s~~ all computations completed in the preparation of the Stormwater Report, together with copies of referenced data, charts, graphs, nomographs, hydrographs, stage-storage discharge tables, maps, exhibits, and all other information required to clearly describe the stormwater flow control and runoff treatment design for the proposed development activity. The Operations and Maintenance Manual for private stormwater facilities shall be included in the appendix. The format of the technical appendix shall follow as closely as possible the section format of the Stormwater Report and shall be adequately cross-referenced to ensure that the design may be easily followed, checked and verified. The technical appendix shall also contain all special reports and studies, other than those included as attachments to the Stormwater Report.

Stormwater Site Plan Changes

If the designer must make changes or revisions to the final stormwater plan after final approval, the proposed revisions shall be submitted to the City of Vancouver prior to construction. The submittals shall include the following:

1. Substitute pages for the originally approved final stormwater site plan identifying the proposed changes.
2. Revised drawings, showing any structural changes.
3. Any other supporting information that explains and supports the reason for the change. All revisions shall be stamped, signed and dated by the professional engineer(s), registered in the State of Washington, responsible for hydrologic, hydraulic, geotechnical, structural and general civil engineering design.

4-2.04 Erosion Prevention and Sediment Control Plan Submittal – For project sites below the regulatory threshold

An Erosion Prevention & Sediment Control Plan (EPSCP) is required for any land disturbing activity unless the site is required to prepare a Construction Stormwater Pollution Prevention Plan (SWPPP) as determined by Appendix 1, Section 3 of the most current version of the City!'s National Pollutant Discharge Elimination System Western Washington Phase II Municipal Stormwater Permit

The plan shall be submitted to and approved by the City prior to demolition, street cuts, clearing, grading, filling or issuance of City permits. Items that are to be included in an EPSCP:

1. Existing and proposed contours for the site and adjacent properties
2. Location of all existing drainage facilities and water resource features
3. Identification of all sensitive lands including wetlands and steep slopes
4. Volumes of cuts and fills
5. Proposed erosion prevention and sediment control BMPs

4-2.05 Site Development/Grading Permit Requirements

Civil plans requesting approval for grading only may be considered for approval based upon the determination of the City's review staff, including the Case Manager, Engineering, Transportation and Building. Grading only civil plans require signature approval from Transportation, Building, Planning, and Surface Water Management. Review and approval by Surface Water Management will only address erosion prevention and sediment control.

No stormwater facilities will be approved with grading only plans. Therefore, not all stormwater facilities need to be shown on the grading only plans. If the plans include a pond or swale the following statement will be placed on the cover and grading sheet of the plans:

> *"This approval is for grading only. No stormwater facilities or drainage structures are approved at this time. Grading of a swale or pond is subject to change with final civil plan approval."*

4-2.06 Easements

Public stormwater facilities that are not located in the public right-of-way shall be in an easement or tract dedicated to the City of Vancouver. The easement shall allow unobstructed access for maintenance by City staff. Buildings, structures and fences are not permitted within public easements. Fences crossing an easement shall provide gates for access by maintenance vehicles.

Public stormwater facilities requiring easements across or on private property include, but are not limited to, storm drain pipes, culverts, ditches, manholes, drywells, infiltration devices, and catch basins. Swales, ponds, and/or water quality and/or quantity structures (vaults) shall be located on a separate parcel or tract dedicated to the City of Vancouver.

Stormwater facilities shall be located next to the public right-of-way where practicable. Easements shall be required from the facility to a public right-of-way for access to facilities by standard maintenance equipment and/or vehicles. Easements may also be required from the facility to the public right-of-way for future connections to the facility.

Public easements shall be a minimum of 15 feet in width. Pipe diameters greater than 36 inches will require an easement width of at least 20 feet. Pipes shall be located at least five (5) feet from the edge of the easement.

Easements shall be provided to the City for access and maintenance of all streams and channels within a development site. Easements shall be a minimum of top width plus 15 feet on one side. Deviations from this requirement will need City approval.

Private stormwater facilities shall have an access and inspection easement dedicated to the City of Vancouver in the form of a "covenant running with the land." Access and

inspection easements shall be a minimum width of 15 feet and extend to an accessible public right-of-way. A covenant encompassing the entire site is also acceptable with City approval. The easement is intended to allow access for inspection and verification of maintenance frequency and practices. Private stormwater facilities requiring access and inspection easements include, but are not limited to, storm drain pipes, culverts, ditches, manholes, drywells, infiltration devices, catch basins, swales, ponds, permeable pavements, bioretention facilities, rain gardens, and runoff treatment and flow control facilities.

All existing and proposed stormwater easements shall be shown, noted and specified on civil plans, site plans and plats. All easements and dedications shall be provided to the City prior to final acceptance of the project. Easements shall be of standard form and include a legal description and map. Information regarding easements can be obtained from Community and Economic Development Department located at 415 W. 6th Street (360- 487-7800).

Refer to the Sewer Design section within this manual for specific requirements regarding locating bioretention facilities, biofiltration swales and other surface water facilities within sanitary sewer easements.

Approved language for CIVIL PLANS, SITE PLANS and PLATS:

1. A covenant encompassing the entire site will be dedicated to the City of Vancouver for access and inspection of private storm systems. (Replaces the "Blanket Easement" term.)
2. A (insert Size of Easement) access and inspection easement will be dedicated to the City of Vancouver.
3. An access and inspection easement for the private storm facility will be dedicated to the City of Vancouver. (Use when a private storm facility is on private property.)
4. A (insert Size of Easement) private storm easement (clarify who owns it and who is responsible for it). Example: A 15' private storm easement dedicated to Lots 1-9 will be owned and maintained by each homeowner.
5. A (insert Size of Easement) public storm easement will be dedicated to the City of Vancouver. (Use when public storm is on private property.)

4-2.07 Railroad Crossings and Other Jurisdictions

The developer shall obtain and make full payment for any permits required from the Washington Department of Transportation, Clark County, or railroad prior to City approval for constructing storm sewer under any highway, railroad track or within another jurisdiction's right-of-way. The permit should be on behalf of the City of Vancouver. All requirements of the permit shall be met prior to acceptance of any construction. Requirements usually include boring with a steel casing for installation of the storm sewer.

4-3 STORM SEWER SYSTEMS

4-3.01 Public and Private Systems and Facilities

Stormwater systems and facilities which collect, convey, treat and/or infiltrate runoff from public rights-of-way will be publicly owned and maintained, unless it is demonstrated to the satisfaction of the City that the stormwater facility can be adequately maintained by private parties.

Minimum criteria for a private facility accepting runoff from public rights-of-way include but are not limited to the following:

1. The facility is a pond or swale
2. The facility is contained within an exclusive separate tract or parcel
3. An access and inspection easement is dedicated to the City
4. A single party or group, such as a homeowners association, owns and is responsible for the maintenance of the facility

For single family residential developments (specifically high density), on-site shared lot and roof drainage systems must be designed and incorporated into the civil plans for approval.

Private stormwater systems may not be designed to flow into adjacent parcels. Discharge to public right-of-way will only be allowed on a case by case basis upon approval from the City.

4-3.02 Location of Stormwater Facilities

Typical location of storm drain lines in the public right-of-way is three (3) feet north or east of center line. Deviations from this standard need approval by the City.

Detention structures such as pipes, vaults and ponds are not allowed within the public right-of-way. These facilities shall be located in a tract dedicated to the City of Vancouver. Private stormwater facilities shall be located next to the public right-of-way where practicable. Approval from Water and/or Sewer Engineering is required for detention facilities that are proposed to be within ten (10) feet of public water and/or sanitary sewer mains.

4-3.03 Capacity and Conveyance

The flow capacity of a storm sewer main is calculated from Manning's formula for open channel flow. See the sanitary sewer design section for the equation. A roughness coefficient of n=0.012 for storm sewer design is acceptable when using flexible pipe. For other pipe types (i.e. concrete, ductile iron) a roughness coefficient of n=0.013 is required for capacity calculations.

Table D-1: Storm Sewer Pipe Capacity and Minimum Slopes

Inside Pipe Diameter (inches)	Minimum Pipe Slope (n=0.012)		Design Capacity n=0.012 (cfs)	Minimum Pipe Slope (n=0.013)		Design Capacity n=0.013 (cfs)
	Design	As-Built		Design	As-Built	
8	0.0034	0.0029	0.70	0.0039	0.0034	0.70
10	0.0027	0.0022	1.11	0.0030	0.0025	1.10
12	0.0022	0.0017	1.59	0.0025	0.0020	1.59
15	0.0018	0.0013	2.52	0.0020	0.0015	2.50
18	0.0015	0.0010	3.60	0.0017	0.0012	3.64
24	0.0010	0.0007	6.48	0.0011	0.0008	6.40
30	0.0008	0.0005	9.94	0.00088	0.00058	9.88
36	0.0006	0.0004	14.45	0.00065	0.00045	14.15
42	0.0005	0.00035	20.39	0.0005	0.00037	19.35
48	0.0004	0.00026	25.09	0.00045	0.00031	25.29

The Santa Barbara Urban Hydrograph (SBUH) method shall be used to determine peak flow rates for sizing conveyance systems. The peak runoff rate from the design storms to be used for design of stormwater conveyance systems shall be as follows:

1. The 10-year, 24-hour storm: Contributing drainage areas less than 40 acres.
2. The 25-year, 24-hour storm: Contributing drainage areas of 40 acres or more.
3. The 100-year, 24-hour storm:
    a. Culverts with contributing drainage areas greater than 200 acres.
    b. Culverts in areas of flood hazard, as described in FEMA Flood Insurance Rate Maps (FIRM) and reports prepared for the City of Vancouver.

The design storm shall be applied to the entire contributing drainage area projected under full build-out conditions.

Culverts shall be designed in accordance with the "Washington State Department of Transportation Hydraulics Manual" (WSDOT 2013).

Fish passage culverts shall meet the design criteria specified in the "Washington State Department of Fish and Wildlife Fish Passage Design at Road Culverts" (WDFW 2003).

For sites that discharge to a Flow Control-Exempt Surface Water (see Appendix I-E of the *Stormwater Manual*) via a closed channel conveyance, the engineer shall demonstrate that sufficient downstream conveyance capacity exists to accommodate the increased flows from the project. Hydrologic and hydraulic analysis is required when sufficient capacity has not been established.

4-3.04 Pipe Slope

Engineers shall design systems using the minimum design slope in most cases. Minimum as-built slopes are based on slopes required to produce a mean velocity (when flowing

full or half full) of at least two (2) feet per second (fps), based upon Manning's "n" valued at not less than 0.012.

The differences between design slopes and as-built slopes represent an allowable tolerance of 0.0005 on pipe diameters of 18 inches or less. Mains installed at a flatter slope than the as-built minimum shall be re-laid by the contractor.

Laterals to inlets and catch basins shall have a minimum slope of 0.02. If shallow storm mains require flatter slopes on laterals, then invert elevations and pipe slopes shall be listed on the stormwater plan and pipe flow capacity calculations shall be included in the Stormwater Report.

4-3.05 Pipe Materials

The following table lists approved pipe materials and their specifications for public storm sewers.

Table D-2: Type of Pipe Material and Specifications

Approved Type of Pipe	Specifications
Corrugated Polyethylene (CPE)	AASHTO M252 or M294 Type S
Concrete Pipe (CP)	C14 Class II or III
Reinforced Concrete Pipe (RCP)	ASTM C76 Class IV or V
Ductile Iron Pipe (DIP)	ANSI A21.51 or AWWA C151
Polyvinyl Chloride (PVC)	AWWA C900, AWWAC905

Notes:
1. CP and RCP are considered rigid pipe. See rigid pipe bedding details.
2. CPE and DIP are considered flexible pipe. See flexible pipe bedding details.
3. Transitions in pipe sizes are only allowed at structures.
4. DIP and PVC Only allowed when pipe cover is less than 4-feet.

4-3.06 Pipe Diameter

Public mainline storm sewers shall be a minimum of twelve (12) inches inside diameter. Downstream pipe diameters shall not be reduced except when approved by the City.

Public storm sewer laterals shall be eight (8) or ten (10) inches inside diameter. Larger pipe diameter may be used with large capacity catch basins and when approved by the City.

4-3.07 Pipe Construction Standards

All pipe materials, joints, manholes, and other products associated with conveyance systems shall be designed and constructed in accordance with the latest edition of the Washington State Department of Transportation Standard Specifications for Road, Bridge, and Municipal Construction (WSDOT).

Water settling of backfill material is prohibited.

The Contractor shall provide a television report, tape and tabular as-built of all public storm mains and laterals prior to paving. This TV information shall be submitted to the City Inspector for review. TV inspection shall demonstrate no manufacturing or installation defects, or any debris in the lines, for approval and acceptance by the City.

4-3.08 Depth and Cover

Public storm sewer main lines (including perforated main in infiltration trenches) laid in areas subject to wheel loads shall have a minimum cover of four (4) feet measured from top of pipe to finished grade or be otherwise protected from damage by traffic. This minimum cover may be reduced to three (3) feet if ductile iron or C900 PVC pipe is used.

In addition, if the storm sewer main is in a roadway, right of way or other paved area, the ductile iron pipe must be deep enough so that any installed, or future, laterals will have a minimum clearance between the top of the lateral and the bottom of the roadway section of at least six (6) inches.

4-3.09 Separation

Storm sewers will be designed to provide six (6) inches minimum vertical and three (3) feet minimum horizontal clearance (outside surfaces) between storm drain pipes and other utility pipes and conduits. For crossings of sanitary sewers lines, Washington State Department of Ecology criteria applies.

4-3.10 Manholes

Public manholes are required at the following locations:

1. At every change in grade or alignment of sewer
2. At every point of change in size of sewer or pipe material
3. At each intersection or junction of sewer
4. At intervals of 400 feet or less in developed areas, unless otherwise approved by the City
5. At the end of a main or infiltration pipe system, unless another structure is approved by the City

Manhole spacing may be increased to 600 feet for sewers in excess of 36 inches diameter, subject to approval by the City. Whenever feasible, permanent vehicular access shall be provided to manholes located in easements.

Manholes outside of public right-of-way shall have locking frame and covers (i.e. Camlock). This requirement may be waived for manholes located in paved easements or fenced in areas.

The key consideration in designing and constructing a manhole is to provide safe, convenient access for observations and maintenance.

1. The minimum required inside diameter for a manhole is 48 inches. Manholes built over large diameter pipes, those greater than 24 inches, require a special construction detail.
2. For construction of the mainline, provide a 0.2 foot minimum and 0.4 foot maximum drop in flow line elevation through manholes. Where grade considerations are considered critical, the design engineer may request a waiver. In such cases, the drop may be reduced to 0.1 foot for straight through manholes or to no drop if the pipe is laid through the manhole.

4-4 DRAINAGE OF ROADWAY IMPERVIOUS PAVEMENTS

Drainage design for roadways shall be in accordance with "Hydraulic Engineering Circular No. 22, Urban Drainage Design Manual" (FHWA and NHI 2001). The Santa Barbara Urban Hydrograph (SBUH) method shall be used to determine peak flow rates for sizing collection systems (catch basins and inlets).

Roadway drainage 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 for the ten-year storm. The travel lane shall remain open to emergency vehicles and the flow depth of any storm event, up to the one hundred-year storm event, will not exceed 0.5 feet. Flooding in parking lots shall not exceed 1.0 feet.

4-4.01 Catch Basin Locations

Catch basins and inlets are required at the following locations:

1. At any low point in the roadway or curb returns at intersections.

2. Where any roadway transitions from a crown section to a shed section to prevent gutter flow from flowing across the roadway.

3. Such that a maximum of 400 linear feet of paved street is collected by a single catch basin.

4. Inlets shall be used at intersections to prevent street cross flow which could cause pedestrian or vehicular hazards. It is desirable to intercept 100 percent of any potential street cross flow under these conditions. Intersection inlets should be placed on tangent curb sections near corners. Catch basins and inlets shall be placed so that water will not accumulate on walking surfaces per ADA guidelines.

5. In sag vertical curves, where significant ponding may occur, flanking inlets should be placed so that they will limit spread on low gradient approaches to the level point. The flanking inlets are intended to provide relief if the inlet at the low point becomes clogged or if the design spread is exceeded.

6. Grate inlets alone are not recommended for use in sag locations because of the tendency of grates to become clogged. Combination inlets or curb opening inlets are recommended for use in these locations.

7. Combination curb inlets are required on slopes greater than 10 percent or when necessary to prevent bypass flow from crossing an ADA ramp, an intersection or a crown to shed section transition. Curb ramps and their approaches shall be designed so that water will not accumulate on walking surfaces per ADA guidelines.

8. Catch basins should not be placed in areas of expected pedestrian traffic. The engineer should design the roadway low points to avoid placing a catch basin in crosswalks, adjacent to curb ramps, or in the gutter of a driveway. Care should be taken on the part of the engineer to assure that the catch basin will not be in conflict with any existing or proposed utilities.

4-4.02 Catch Basin Construction Standards

All pipe materials, joints, manholes, and other products associated with conveyance systems shall be designed and constructed in accordance with the latest edition of the "Washington State Department of Transportation Standard Specifications for Road, Bridge, and Municipal Construction" (WSDOT).

All catch basins and inlets (city standard or proprietary) specified for city owned public roadways, shall be concrete and must be H-20 loading traffic rated.

Public catch basin laterals shall be connected to a manhole or other accessible structure. Catch basin laterals shall not be connected to the storm main by tee or wye, unless specifically approved by the City. All connections to catch basins shall be water tight.

Catch basin laterals shall be constructed to connect to the basin perpendicular to the basin wall. The lateral shall connect only at the front or side of the basin with no laterals allowed to connect to the catch basin at the corners. If needed, a bend may be used as the first section of pipe outside the basin wall. The maximum bend allowed is 45 degrees.

4-4.03 Catch Basin Traps

Catch basin traps shall be installed on each outlet pipe from any catch basin or curb inlet as shown in Detail D-1.8. The elbow section shall be removable using a bell and spigot joint.

4-5 FLOW CONTROL AND INFILTRATION SYSTEMS

4-5.01 Applicability

Projects must provide flow control to reduce the impacts of stormwater runoff from impervious surfaces and land cover conversions per the applicability thresholds in Section 4-1. That portion of any development project in which the thresholds are not exceeded in a Threshold Discharge Area shall apply On-site Stormwater Management BMPs in accordance with Minimum Requirement #5.

4-5.02 Flow Control

Refer to Vol. I, Ch. 2.5.7 of the *Stormwater Manual* to fulfill Minimum Requirement #7. Flow control facilities shall use Vol. III of the *Stormwater Manual* for design requirements.

The Western Washington Hydrology Model (WWHM) ~~and MGS Flood are~~ is currently the only continuous simulation hydrologic models approved for use by the City of Vancouver.

4-5.04 Retrofit of Existing Flow Control Facilities

The Western Washington Hydrology Model (WWHM) procedure may be used for a new project site where flow control requirements are to be met using a pond that was originally designed using a peak flow standard and single event methodology. The original flow control release rates for the existing pond are to be added to the flow control

targets for the new project. If the existing detention facility is not sized sufficiently for the new flow targets, the pond size will need to be revised.

4-5.05 Infiltration Systems

Stormwater infiltration systems can be used for flow control and runoff treatment where appropriate. Infiltration facilities for flow control are used to convey stormwater runoff into the ground after appropriate treatment. Infiltration facilities for treatment purposes rely on the soil profile to provide treatment.

The following sections describe applicable regulations, soil testing requirements, and general design methodology for new infiltration facilities in Vancouver. Refer to the *Stormwater Manual* and the latest edition of Ecology's "Guidance for UIC Wells that Manage Stormwater" for additional information and requirements for infiltration facilities.

4-5.06 Other Applicable Regulations

Washington State Department of Ecology Underground Injection Control Program
Some infiltration facilities are classified as Underground Injection Control (UIC) wells. UIC wells include drywells and perforated pipes and are regulated under Department of Ecology's UIC Program (WAC 173-218).

The two basic requirements of the UIC Program are registration of new UIC wells with the Washington State Department of Ecology and protection of groundwater from pollution associated with stormwater runoff.

1. Registration: UIC wells are required to be registered with Washington State Department of Ecology. Registration information can be found on Ecology's website: http://www.ecy.wa.gov/programs/wq/grndwtr/uic/registration/reginfo.html

2. Non-endangerment Standard: New UIC wells are required to meet a non-endangerment standard ensuring discharges from a UIC well will not contaminate groundwater. Department of Ecology's guidelines for meeting this standard are found in "Guidance for UIC Wells that Manage Stormwater". This guidance shall be followed for UIC installation. The guidance has requirements for minimum depth to groundwater (five feet), as well as siting and installation requirements. It also lists activities that are prohibited from using UIC wells. http://www.ecy.wa.gov/pubs/0510067.pdf

Proposed public UIC wells shall receive Washington State Department of Ecology UIC Program rule authorization prior to civil plan approval. Provide a copy of the rule authorization during the plan review process. A copy of the registration application will be accepted if rule authorization notification has not been received from Ecology within 60 days of application for well registration.

Private UIC wells are also required to meet WAC 173-218 and register with Ecology prior to construction. In some cases, prior to civil plan approval, the City may require verification of Ecology's authorization of a proposed private infiltration facility or a demonstration by the applicant that the UIC facility will meet Ecology's water quality standards.

When UIC regulations conflict with City of Vancouver requirements, the more stringent of the regulations shall apply.

Special Protection Areas - Vancouver Municipal Code 14.26 (VMC 14.26)
The City's Water Resources Protection Ordinance specifies that infiltration facilities for Class I and Class II commercial/industrial operations (as defined in VMC 14.26) are not allowed in Special Protection Areas (SPAs). The applicant may petition for relief from this requirement provided no other alternative exists and groundwater protection can be ensured.

If a non-classified commercial or residential facility proposes to infiltrate in an SPA, the City will evaluate proximity and potential impact to the water station and may then require additional stormwater treatment measures. Examples of more stringent water quality measures in an SPA could include a cartridge media filter system, low impact development, a biofiltration swale, or a sand filter.

4-5.07 Infiltration Investigation

Proper evaluation of soils is critical to the placement and design of infiltration facilities. A detailed soils report is required where infiltration systems, or LID practices that utilize infiltration, are proposed to accurately characterize the infiltration rate of the soil and the depth to ground water.

The "Alternative Single-Ring Falling Head Infiltration Test" outlined in 4.1.4 Field Test Method of *SWWASCE Infiltration Standards* is the preferred method for determining infiltration rates in Vancouver. The coefficient of permeability "*k"* shall be calculated using test results per Darcy's Law. Other acceptable test methods include:

- The Pilot Infiltration Test (PIT) outlined in Vol. III, Ch. 3 of the *Stormwater Manual*. The Small-Scale test may be used for sites the meet the criteria for the test.
- The USDA Soil Textural Classification and the ASTM Gradation Testing correlations provided in Ch. 3 of Vol. III of the *Stormwater Manual.* In general these correlations provide conservative long-term infiltration rates, however, the presence of cemented, lithified, or indurated materials may make the use of these correlations unconservative. Therefore, these correlations should only be used if a registered professional engineer or engineering geologist proficient in geotechnical engineering has evaluated the site soils and deemed these correlations appropriate for the site.
- The "Alternative Auger Borehole Falling-Head Infiltration Test Method" outlined in 4.1.6 Alternative Test Methods of *SWWASCE Infiltration Standards* may be used where explorations are conducted by advancing borings, as opposed to test pits. The coefficient of permeability "*k"* shall be calculated when using this method.
- Field test methods, such as the open test pit method discussed in 4.1.6 Specialized Testing for Unique Sites of *SWWASCE Infiltration Standards,* may be used only if the other test methods described above are not feasible or practical.

Regardless of the test methodology utilized, the Infiltration Investigation shall follow the guidelines outlined in 4.1 Field Test Method of *SWWASCE Infiltration Standards* regarding frequency, location, and depth of testing; soil classification and testing; high groundwater characterization; and groundwater mounding analysis.

The City may require additional testing, monitoring or groundwater mounding analysis in areas of known high groundwater or poor infiltration rates.

A final report shall be prepared in conformance with section 4.2 Infiltration Investigation Report of *SWWASCE Infiltration Standards.*

Projects triggering only Minimum Requirements #1 through #5 may have one of the following prepare a soils report to determine if soils suitable for infiltration are present on the site:

- A professional soil scientist certified by the Soil Science Society of America (or an equivalent national program)
- A locally licensed on-site sewage designer
- A suitably trained person working under the supervision of a professional engineer, geologist, hydrogeologist, or engineering geologist registered in the State of Washington.

Projects triggering Minimum Requirements #1 through #9 must have one of the following prepare a soils report to determine if soils suitable for infiltration are present on the site:

- A licensed geologist, hydrogeologist, or engineering geologist registered in the State of Washington.

4-5.08 Infiltration Design Rates

The design infiltration rate shall be determined by dividing the calculated coefficient of permeability or tested infiltration rate (depending on the testing method) by the appropriate correction factor.

The following table (Table D-3) shall be used to determine the total correction factors to obtain design infiltration rates for infiltration facilities. The maximum allowed design infiltration rate is 250 inches/hour.

Table D-3: Infiltration Rate Correction Factors

Design Condition	Correction Factor (CF)
Base Correction Factor	
The base correction factor is meant to account for soil variability and long-term system degradation due to siltation, crusting, or other factors.	2
Soils Correction Factor	
Additive correction factor recommended by a geotechnical professional as a result of soil or groundwater conditions	As recommended by geotechnical professional
System Design Correction Factors	
If the infiltration facility serves a basin with an impervious area greater than 2 acres and less than 5 acres	Add ½
If the infiltration facility serves a basin with an impervious area greater than 5 acres	Add 1

Infiltration facilities in closed depressions	Add 2
If a sacrificial system is provided and left operational following permanent site stabilization	Subtract ½

Total CF = Base CF + Soils CF + System Design CF
When using WWHM, the Infiltration Reduction Factor is 1/CF.

4-5.09 Infiltration Design Guidelines

UIC's shall be modeled with WWHM ~~or MGS Flood~~, meet the applicable Flow Control requirements and achieve the LID performance standard. An overflow route must be identified in the event that capacity is exceeded.

Infiltration calculations for drywells and perforated pipe trench systems shall follow the recommendations outlined in 5.3 of Infiltration Calculations for Selected Facilities of *SWWASCE Infiltration Standards.*

Public infiltration trenches shall have structures for access and maintenance on both ends of infiltration piping systems, with a minimum of either a drywell or manhole on one pipe end.

4-5.10 Infiltration Facility Setbacks

The base of infiltration facilities shall be a minimum of five (5) feet above seasonal high water or an impermeable layer and meet Washington State Department of Ecology Underground Injection Control Rules water quality standards. A separation down to three (3) feet may be considered if the groundwater mounding analysis, the volumetric water holding capacity, and the design of an overflow and/or bypass structure is adequate to prevent overtopping and meet the site suitability criteria specified in the *Stormwater Manual.*

Infiltration facilities shall be set back a minimum of:

1. 50 feet from the top of any slope greater than 15 percent
2. 20 feet down slope or 100 feet up slope from a building foundation
3. 10 feet from neighboring property line
4. 100 feet from a septic drain field
5. 1,900 feet from a municipal water station (unless prior approval is obtained from the City)

Written justification from an appropriate qualified professional shall be submitted to and approved by the City to reduce these setbacks. Setback reductions shall also meet other applicable local, state and federal requirements.

Refer to the *Stormwater Manual* and the local building code for residential roof downspout systems.

Where infiltration facilities are proposed within 25 feet of the property line, additional topography will be required to be shown on plans outside of the project site.

4-5.11 Construction Observation and Confirmation Testing

A registered professional engineer, engineering geologist proficient in geotechnical engineering, or a designated representative working under their direct supervision, shall observe the construction of the infiltration facility and conduct confirmation infiltration testing on soils exposed at the base of the facility. The purpose of the confirmation infiltration testing is to verify that the infiltration rate and exposed soil conditions are consistent with the assumptions, recommendations, and conclusions presented in the Final Soils Evaluation report. Confirmation testing shall take place prior to installation of the facility (e.g. placement of drain rock, perforated pipe, drywells, etc.) and shall be conducted in accordance with the recommendations outlined in 6.2 Construction Observation and Testing of *SWWASCE Infiltration Standards*.

4-6 RUNOFF TREATMENT

4-6.01 Treatment Facility Sizing

Water Quality Design Storm Volume: The volume of runoff predicted from a 24-hour storm with a 6-month return frequency (a.k.a., 6-month, 24-hour storm). Wetpool facilities are sized based upon the volume of runoff predicted through use of the Natural Resource Conservation Service curve number equations in Vol. III, Ch. 2 of the *Stormwater Manual* for the 6-month, 24- hour storm. Alternatively, the 91st percentile, 24-hour runoff volume indicated by an approved continuous runoff model may be used.

Flows Requiring Treatment

Runoff from Pollution Generating Impervious Surfaces (PGIS) or Pollution Generating Pervious Surfaces (PGPS) shall be treated per the applicability thresholds in Section 4-1. That portion of any development project in which the above PGIS or PGPS thresholds are not exceeded in a threshold discharge area shall apply On-site Stormwater Management BMPs in accordance with Minimum Requirement #5.

Pollution Generating Impervious Surfaces (PGIS) are impervious surfaces considered to be a significant source of pollutants in stormwater runoff. Such surfaces include those which are subject to: vehicular use; industrial activities (as further defined in the *Stormwater Manual*); or storage of erodible or leachable materials, wastes, or chemicals, and which receive direct rainfall or the run-on or blow-in of rainfall. Erodible or leachable materials, wastes, or chemicals are those substances which, when exposed to rainfall, measurably alter the physical or chemical characteristics of the rainfall runoff. Examples include erodible soils that are stockpiled, uncovered process wastes, manure, fertilizers, oily substances, ashes, kiln dust, and garbage dumpster leakage. Metal roofs are also considered to be PGIS unless they are coated with an inert, non-leachable material (e.g., baked-on enamel coating).

A surface, whether paved or not, shall be considered subject to vehicular use if it is regularly used by motor vehicles. The following are considered regularly-used surfaces: roads, unvegetated road shoulders, bike lanes within the traveled lane of a roadway, driveways, parking lots, unfenced fire lanes, vehicular equipment storage yards, and airport runways.

The following are not considered regularly-used surfaces: paved bicycle pathways separated from and not subject to drainage from roads for motor vehicles, fenced fire lanes, and infrequently used maintenance access roads.

Pollution-Generating Pervious Surfaces (PGPS) are any non-impervious surface subject to vehicular use, industrial activities or storage of erodible or leachable materials, wastes or chemicals, and that receive direct rainfall or run-on or blow-in of rainfall, the use of pesticides and fertilizers or loss of soil. Typical PGPS include permeable pavements subject to vehicular use, lawns, landscaped areas, golf courses, parks, cemeteries, and sports fields.

Water Quality Design Flow Rate

1. Preceding Detention Facilities or when Detention Facilities are not required:
The flow rate at or below which 91% of the runoff volume, as estimated by an approved continuous runoff model, shall be treated. Design criteria for treatment facilities are assigned to achieve the applicable performance goal at the water quality design flow rate (e.g., 80% TSS removal).

2. Downstream of Detention Facilities:
The water quality design flow rate shall be the full 2-year release rate from the detention facility.

3. Alternative methods may be used if they identify volumes and flow rates that are at least equivalent.

Treatment Facility Selection, Design, and Maintenance
Stormwater treatment facilities shall be:

1. Selected in accordance with the process identified in Vol. I, Ch. 4 of the *Stormwater Manual*,

2. Designed in accordance with the design criteria in Vol. V of the *Stormwater Manual*, and

3. Maintained in accordance with the maintenance schedule in Vol. V of the *Stormwater Manual*.

Additional Requirements
The discharge of untreated stormwater from pollution-generating impervious surfaces to ground water is not allowed, except for the discharge achieved by infiltration or dispersion of runoff from residential sites through use of On-site Stormwater Management BMPs.

Treatment-Type Thresholds
Oil Control: Treatment to achieve Oil Control applies to projects that have "high-use sites." High-use sites are those that typically generate high concentrations of oil due to high traffic turnover or the frequent transfer of oil. High-use sites include:

1. An area of a commercial or industrial site subject to an expected Average Daily Traffic (ADT) count equal to or greater than 100 vehicles per 1,000 square feet of gross building area;

2. An area of a commercial or industrial site subject to petroleum storage and transfer in excess of 1,500 gallons per year, not including routinely delivered heating oil;

3. An area of a commercial or industrial site subject to parking, storage or maintenance of 25 or more vehicles that are over 10 tons gross weight (trucks, buses, trains, heavy equipment, etc.);

4. A road intersection with a measured ADT count of 25,000 vehicles or more on the main roadway and 15,000 vehicles or more on any intersecting roadway, excluding projects proposing primarily pedestrian or bicycle use improvements.

Phosphorus Treatment: The requirement to provide phosphorous control is determined by the local government with jurisdiction (e.g., through a lake management plan), or the Washington State Department of Ecology (e.g., through a waste load allocation).

Phosphorous treatment is required in the Lacamas watershed above the dam at the south end of Round Lake for all project sites that meet applicability thresholds for runoff treatment.

Enhanced Treatment: Enhanced treatment for reduction in dissolved metals is required for the following project sites that discharge to or infiltrate within ¼ of a mile of fish-bearing streams, lakes, or to waters or conveyance systems tributary to fish-bearing streams or lakes:

1. Industrial project sites,
2. Commercial project sites,
3. Multi-family project sites, and
4. High AADT roads as follows:
    a. Fully controlled and partially controlled limited access highways with Annual Average Daily Traffic (AADT) counts of 15,000 or more
    b. All other roads with an AADT of 7,500 or greater

However, such sites listed above that discharge directly (or, indirectly through a municipal storm sewer system) to Basic Treatment Receiving Waters as specified in Vol. I, Appendix I-C of the *Stormwater Manual*, and areas of the above-listed project sites that are identified as subject to Basic Treatment requirements, are also not subject to Enhanced Treatment requirements.

For developments with a mix of land use types, the Enhanced Treatment requirement shall apply when the runoff from the areas subject to the Enhanced Treatment requirement comprises 50% or more of the total runoff within a threshold discharge area.

Basic Treatment: Basic Treatment generally applies to:

1. Project sites that discharge to the ground, UNLESS:
    a. The soil suitability criteria for infiltration treatment are met; (see Vol. III, Ch. 3 of the *Stormwater Manual* for soil suitability criteria), or
    b. The project uses infiltration strictly for flow control – not treatment - and the discharge is within ¼-mile of a phosphorus sensitive lake (use a

Phosphorus Treatment facility), or within ¼ mile of a fish-bearing stream, or a lake (use an Enhanced Treatment facility).

2. Residential projects not otherwise needing phosphorus control as designated by the US Environmental Protection Agency, the Washington State Department of Ecology, or by the City of Vancouver; and

3. Project sites discharging directly to salt waters, river segments, and lakes listed in Vol. I, Appendix I-C of the *Stormwater Manual*; and

4. Project sites that drain to streams that are not fish-bearing, or to waters not tributary to fish-bearing streams;

5. Landscaped areas of industrial, commercial, and multi-family project sites, and parking lots of industrial and commercial project sites that do not involve pollution-generating sources (e.g., industrial activities, customer parking, storage of erodible or leachable material, wastes or chemicals) other than parking of employees' private vehicles.

For developments with a mix of land use types, the Basic Treatment requirement shall apply when the runoff from the areas subject to the Basic Treatment requirement comprises 50% or more of the total runoff within a threshold discharge area.

4-6.02 Additional Requirements for Public Facilities

Fencing Requirements – Some swale, pond or facility locations may require fencing. Fencing shall be required along the top of vertical wall sections and as specified through Surface Water Management site review. Fencing shall be vinyl coated black, green or brown as best blends into the surroundings. Fence height shall be 48 inches unless otherwise approved.

Aesthetics – The City encourages creativity to design swales and filter strips to reflect a natural setting and add visual appeal to the development. While the swale must remain functional, accessible and maintainable, consider options to make the facility more aesthetically pleasing such as the use of perimeter plant material and meander of the flow line.

Maintenance Accessibility - Public facilities require adequate space to provide for safe maintenance operations. All aspects related to the safe operation and maintenance of facilities (i.e. access roads, vehicle parking and maneuvering space, traffic constraints, etc.) will be reviewed and approved with the design of the facility. Vaults used for public drainage will require hatch access doors; manhole access ports are not allowed on vaults.

4-6.03 Emerging Technologies

For privately owned and maintained systems, the City allows use of all Ecology Technology Assessment Protocol (TAPE) approved technologies that have General Use Level Designation (GULD) and Conditional Use Level Designation (CULD).

For publicly owned and maintained systems the City has conditionally approved alternative methods for stormwater quality treatment for public impervious areas. Those currently approved are Contech StormFilter (StormFilter manholes may be allowed on a case by case basis) and Filterra. Design must meet Ecology's General Use Level Designation (GULD) criteria and standards.

StormFilters using zeolite-perlite-granulated carbon media (ZPG) when designed downstream of a detention facility shall be designed based on the 2-year release rate and with mass loading considerations. Whichever design yields the higher number of cartridges shall be used.

4-6.04 Oil/Water Separators

The following development activities shall require spill control (SC) type oil/water separators (Pre-Sedimentation Manholes - Standard Plan D-2.1):

1. Restaurants,
2. Multifamily residential projects creating parking spaces for twenty-five or more vehicles,
3. Other activities where the risk of oil spill or illegal dumping of oil or grease is significant.

If a commercial or industrial site has a risk of discharging high concentrations of free oil, an API or coalescing plate oil/water separator will be required to provide treatment, spill protection, and grit removal. Facilities that would be candidates for an oil/water separator include petroleum storage yards, automotive maintenance facilities, manufacturing areas, and fueling operations. A schematic of an API type 3-stage separator is shown in the Sanitary Sewer section, Standard Plan S-4.3.

For inflows from small drainage areas, such as maintenance shops, a coalescing plate type separator offers a smaller footprint for the same treatment capacity and may be preferred due to space limitations. Oil/water separators shall be designed in accordance with the *Stormwater Manual*.

4-7 ON-SITE STORMWATER MANAGEMENT (LOW IMPACT DEVELOPMENT)

Project Thresholds

Projects triggering only Minimum Requirements #1 through #5 shall either:

a. Use On-site Stormwater Management BMPs from List #1 for all surfaces within each type of surface in List #1; or

~~b. Demonstrate compliance with the LID Performance Standard. Projects selecting this option cannot use Rain Gardens. They may choose to use Bioretention BMPs as described in Chapter 7 of Volume V to achieve the LID Performance Standard.~~

b. Use any Flow Control BMP(s) desired to achieve the LID Performance Standard, and apply BMP T5.13: Post-Construction Soil Quality and Depth.

Projects triggering Minimum Requirements #1 through #9 shall either:

a. ~~Use On-site Stormwater Management BMPs from List #2~~ Use the LID BMPs from List #2 for all surfaces within each type of surface in List #2; or Use any Flow Control BMPs desired to achieve the LID Performance Standard, and apply BMP T5.13: Post-Construction Soil Quality and Depth

~~b. Demonstrate compliance with the LID Performance Standard and BMP T5.13.~~

Flow Control Exempt Projects
Projects qualifying as Flow Control exempt in accordance with the TDA Exemption in 4.7 Minimum Requirement #7: Flow Control shall either:
• Use the LID BMPs from List #3 for all surfaces within each type of surface in List #3; or
• Use any Flow Control BMP(s) desired to achieve the LID Performance Standard and apply BMP T5.13: Post-Construction Soil Quality and Depth.

LID practices shall be designed to the *Stormwater Manual.* The most current edition of the Low Impact Development Technical Guidance Manual for Puget Sound (*LID Manual*) may be used for design guidance. All uses of LID practices shall meet applicable regulations and requirements, and may require specific approval from other City departments (for example Urban Forestry, Transportation or Building).

4-7.01 Bioretention Areas

Bioretention areas in City of Vancouver right-of-way require specific approval by the City of Vancouver Transportation department.

Bioretention systems may meet the requirements for basic and enhanced treatment when soil is designed in accordance with the requirements below and at least 91% of the influent runoff volume, as estimated by an approved continuous runoff model, is infiltrated.

All bioretention facilities must be modeled using the bioretention element in WWHM2012.

An assumed twelve (12) inches per hour infiltration rate may be used for bioretention soil mixes (BSM) that follow the general guidelines below.

The aggregate portion of the BSM should be well-graded and meet the gradation in table D-5. According to ASTM D 2487-98 (Classification of Soils for Engineering Purposes (Unified Soil Classification System)), well-graded sand should have the following gradation coefficients:

- Coefficient of Uniformity (Cu = D60/D10) equal to or greater than 4, and
- Coefficient of Curve (Cc = (D30)2/D60 x D10) greater than or equal to 1 and less than or equal to 3.

Bioretention Soil Mix safety factors must be applied per Vol. V Ch. 7 of the *Stormwater Manual.*

Bioretention soil mixes must contain 35 % - 40% compost by volume.

Table D-5: Guideline for Bioretention Soil Mix Mineral Aggregate Gradation

Sieve Size	Percent Passing
3/8”	100
#4	95-100
#10	75-90
#40	25-40

#100	4-10
#200	2-5

Compost must meet the definition of "composted material" in WAC 173-350-100 and complies with testing parameters and other standards in WAC 173-350-220 and be produced at a composting facility that is permitted by the jurisdictional health authority.

Compost for bioretention facilities must meet requirements in in the Stormwater Manual Volume V.

Compost used in bioretention areas should be stable, mature and derived from organic waste materials including yard debris, wood wastes or other organic materials that meet the intent of the organic soil amendment specification. Biosolids and manure composts can be higher in bio-available phosphorus than compost derived from yard or plant waste and therefore are not allowed in bioretention areas due to the possibility of exporting bio-available phosphorus in effluent.

Bioretention soil mix shall be placed on top of the native soil for public facilities unless an underdrain is required per the SWMMWW.

Filter fabric is not allowed in public bioretention facilities unless it is an impermeable liner required to protect groundwater, basements, etc. Filter fabrics may clog due to the downward migration of fines from the bioretention soil mix (BSM).

Infiltration trenches shall not be placed under the bioretention facility for public facilities.

Street trees planted in bioretention facilities must be approved by the City's Urban Forester.

All bioretention facilities (public and private) must have mulch per City details B-7.0 and B-7.1 to prevent weed growth and retain moisture.

City bioretention detail notes B-1.0, B-7.0, B-7.1 must be added to the plans when bioretention facilities are proposed.

Maximum ponding level in all facilities is 1 foot.

Infiltration facility setback requirements in Section 4-5.10 must be met if the bioretention facility contributing area exceeds 5000 square feet of impervious area.

If the catchment area exceeds 2,000 square feet or the bioretention area is on a roadway classified as an arterial and flow is concentrated, bioretention must ~~may be required to~~ be preceded by a presettling technique per City detail B-2.1 or B-2.2. ~~(e.g., presettling catch basin, or vault)~~. The presettling is intended to remove larger solids, but not expected to meet water quality treatment goals or sizing guidelines for pretreatment facilities.

If concentrated flows are entering the cell, engineered flow energy dissipation (e.g., rock pad or flow dispersion weir) must be incorporated.

A minimum two ~~one~~-inch grade change between the edge of a contributing impervious surface and the vegetated flow entrance is required.

Until the upstream catchment area is thoroughly stabilized, flow diversion and erosion control measures must be installed to protect the bioretention area from sedimentation.

Private rain gardens are not permitted within five (5) feet from property lines (excluding the property line abutting the right-of-way) ~~without agreement from neighboring property owner~~.

4-7.02 Permeable Pavements

Permeable pavement systems may be applied to privately owned and maintained driveways, parking areas, sidewalks and roads.

Permeable pavement in City of Vancouver right of ways requires specific approval by City of Vancouver Public Works Pavement Management Division. Permeable pavement systems proposed as storm water facilities within the public right of way will need to submit for a road modification as outlined in VMC 11.80.160. Approval of the road modification for permeable pavements will be required prior to project submittal. Road modification requests will only be considered for proposals in non-arterial roadways with Average Daily Traffic (ADT) of fewer than 400 vehicles.

The road modification application must be stamped by an engineer with experience in surface water and permeable pavement. The application must demonstrate that site conditions or constraints preclude the use of other LID practices to meet *Stormwater Manual* requirements and *UIC* regulations. The application must include a traffic count conducted within one year of the date of the application.

The proposed permeable pavement design must meet the design life requirements for the classification of roadway. Permeable cement concrete is currently the only acceptable permeable pavement that is approved in the public right of way. ACI 522.113 is the current national standard for specification of pervious concrete pavement. Proposals for permeable asphalt designs shall utilize the current WSDOT / APWA local region guidelines for materials and construction.

Modeling runoff from areas of permeable pavement surfaces must conform to requirements in the *Stormwater Manual*; or subsequent Ecology and City of Vancouver approved revisions.

Basic, phosphorous and enhanced water quality treatment requirements may also be met with permeable pavement facilities when the underlying soil meets the treatment soil requirements outlined in Vol. III of the *Stormwater Manual*, or an 18 inch sand layer or engineered amended soil layer is added. It must be shown that at least 91% of the runoff volume (the water quality design storm), as estimated by an approved continuous runoff model is infiltrated.

Permeable pavements installed on slopes have an increased potential for lateral flows through the storage reservoir aggregate. This reduces the storage and infiltration capacity of the pavement system. For longitudinal slopes greater than two (2) percent, the subbase must be designed to create subsurface ponding to detain subsurface flow and increase infiltration. Ponding may be provided using design features such as terracing berms (check dams). The berms must not extend to the elevation of the surrounding ground. They must also be designed to provide sufficient space to pass water from upgradient to lower gradient basins without causing flows to surface.

4-8 EROSION PREVENTION & SEDIMENT CONTROL

The Erosion Prevention & Sediment Control Ordinance (VMC 14.24) contains the requirements for all land disturbing activities and Title 22 of the Vancouver Municipal Code contains the administrative enforcement ordinance applicable to all erosion control measures and best management practices.

The current *Stormwater Manual,* Vol. II – Construction Stormwater Pollution Prevention, shall be the BMP manual used when preparing and implementing a Construction Stormwater Pollution Prevention Plan (SWPPP) or Erosion Prevention & Sediment Control Plan (EPSCP).

An Erosion Prevention & Sediment Control Plan (EPSCP) is required for any land disturbing activity unless the site is required to prepare a Construction Stormwater Pollution Prevention Plan (SWPPP) as determined by Appendix 1 – Section 3 of the most current version of the City's National Pollutant Discharge Elimination System (NPDES) Western Washington Phase II Municipal Stormwater Permit. (See Appendix A)

A City of Vancouver Abbreviated Construction SWPPP is required for sites that disturb less than an acre.

Washington State Department of Ecology regulatory requirements are the responsibility of the Developer, Engineer, Contractor and/or Owner. Construction projects must apply for coverage under the NPDES Construction Stormwater General Permit through the Washington State Department of Ecology if:

1. The project disturbs one (1) or more acres of land through clearing, grading, excavating, or stockpiling of fill material including the cumulative acreage of the entire project whether in a single or in a multiphase project, and
2. There is any possibility that stormwater could run off the site during construction and into surface waters or conveyance systems leading to surface waters of the state.

Construction site operators must apply for a permit 60 days prior to discharging stormwater. Information about the permit requirements is available at Ecology's website: http://www.ecy.wa.gov/programs/wq/stormwater/construction/index.html

4-9 WATER RESOURCES PROTECTION

4-9.01 General Protections

All operations are required to observe the Minimum Standards of the City's Water Resources Protection Ordinance, VMC 14.26. The Minimum Standards are:

1. Precautions to prevent accidental releases of hazardous materials
2. Hazardous Materials Management protective of human health and the environment

3. Leaks and Spills containment, proper clean-up, and notification to the City of Vancouver

4. Oil/Water Separator inspection, cleaning and maintenance according to the Applicable Operational BMPs in the *Stormwater Manual*

5. Pesticide and Fertilizer Management application and management according to the Applicable Operational BMPs in the *Stormwater Manual*

6. Stormwater Treatment Systems cleaning and maintenance according to the Applicable Operational BMPs in the *Stormwater Manual*

7. Decommissioning Water Wells in accordance with Washington Administrative Code WAC 173-160-381

8. Operation Closure shall include removal and proper disposal of all hazardous materials

9. Mobile Washing and Pressure Cleaning shall be performed according to the Applicable Operational BMPs in the *Stormwater Manual*. Wastewater from such operations shall be captured and directed to an approved discharge location.

If an operation will manage materials that could be hazardous to ground or surface waters, it will be considered a "Classified" facility subject to the Greater Standards and Best Management Practices of the City's Water Resources Protection Ordinance, VMC 14.26. The ordinance is available on the City's website: http://www.cityofvancouver.us/vmc/502/30211/1426100-purpose?throbber=1

Floor drains inside work areas will not be permitted unless approved by City of Vancouver Pretreatment for connection to sanitary sewer. For a Pretreatment application call (360) 487-7130.

Washington State Department of Ecology regulatory requirements are the responsibility of the Developer, Engineer, Contractor and/or Owner. Facilities conducting industrial activities that discharge stormwater to a surface waterbody or to a storm sewer system that drains to a surface waterbody shall apply for coverage under the Industrial Stormwater General Permit through the Washington State Department of Ecology. Information about the permit requirements is available at Ecology's website: https://ecology.wa.gov/regulations-permits/permits-certifications/stormwater-general-permits/industrial-stormwater-permit

4-9.02 Special Protection Areas

The Water Resources Protection Ordinance designates all areas within 1900 feet of Vancouver's municipal water wells as Special Protection Areas. The City will not approve the following development projects within a Special Protection Area:

1. Bulk petroleum fuel operations, such as gas stations.

2. Class II operations which are those operations which store or manage over 2200 lbs of 86 hazardous chemicals defined in the Ordinance.

3. Septic systems, unless a sewer connection is not available *and* the septic design poses no significant risk of groundwater contamination.

4. Heating oil tanks, unless a connection to another source of fuel or energy is impracticable *and* the tank poses no significant risk of groundwater contamination.

5. Direct infiltration facilities such as drywells, ponds, trenches and perforated pipe (as defined in VMC 14.26) unless no reasonable alternative exists *and* the facility poses no significant risk of groundwater contamination. This restriction does not apply to infiltration of residential roof runoff.

The applicant may seek relief from the prohibition for new septic systems, heating oil tanks or infiltration facilities by filing with the City a request for relief accompanied by an analysis prepared by a qualified professional the meets to the City's satisfaction ~~of~~ the lack of potential for groundwater contamination at the site. This analysis may include a soils and groundwater evaluation if deemed necessary by the City.

Refer to the City water protection website for the most current Water Protection Critical Area and Special Protection map.

4-9.03 Storm Drain Markers

New storm drains shall be labeled with circular metal medallions which say "PROTECT WATER * ONLY RAIN IN DRAIN". Medallions shall be affixed to dry surfaces with rivets and a high quality polyurethane sealant. Medallion kits with installation instructions are available for purchase at the City's Permit Counter located at 415 W. 6th Street (360-487-7800).

4-9.04 Fueling Islands

Fueling areas must be designed to capture potential petroleum spills and to minimize or eliminate stormwater on the fueling pad. The concrete fueling area should be sloped to allow spills to flow toward a below-ground solid wall vault which serves as a dead-end sump. The fueling island shall be covered by a canopy which extends beyond the edges of the sloping fuel pad to prevent rain and snow from collecting on the pad.

Canopied fueling islands are **not permitted** to drain their pads to either the storm system or to sanitary sewer. For fueling island requirements and dead-end sump details see Standard Plan D-4.0.

If a fueling area serves vehicles over 10 feet in height, a canopy may not be practical. At those facilities the storm system shall be equipped with emergency spill control which shall include an easily-accessible shutoff valve in the drainage area piping. Only uncontaminated stormwater can be discharged to the storm system.

4-9.05 Sole Source Aquifer

The Environmental Protection Agency has designated the Troutdale Aquifer, which underlies Vancouver and Portland, a "Sole Source Aquifer" (SSA). The designation protects an area's groundwater by requiring EPA to review federally funded projects to ensure that they will not endanger the water source.

Any development project in the City incorporating federal funding requires an SSA report to be prepared and submitted to the EPA for review. Such projects are also

required to comply with the City's Water Resources Protection ordinance, VMC 14.26. For a copy of an SSA report checklist contact Water Protection at (360) 487-7130.

4-9.07 Fleet Washing Facilities

Equipment and vehicle washing facilities shall be designed to discharge the wash and rinse waters directly to sanitary sewer. Washwater discharges shall not be directed to the storm system. For a Pretreatment application to discharge to sanitary sewer call (360) 487-7130.

4-9.08 Above-Ground Storage Tanks

Above-ground Storage Tanks (ASTs) shall be designed with a secondary containment area that contains spills and allows leaks to be more easily detected. The containment area surrounding the tank shall hold 110% of the contents of the largest tank. Secondary containment for ASTs shall be impermeable to the materials being stored. Methods include berms, dikes, liners, vaults, and double-walled tanks. A manually controlled sump pump or a manually activated valve shall be installed to control discharges of rain water accumulating in the secondary containment area. Any discharge shall be inspected for petroleum or chemicals prior to being dispensed. *(Federal AST Requirements under 40 CFR Part 112.)*

ASTs shall be designed with corrosion protection for the tank. Options include elevating tanks, resting tanks on continuous concrete slabs, installing double-walled tanks, cathodically protecting the tanks, internally lining tanks, inspecting tanks according to American Petroleum Institute standard, or a combination of the options listed above. All underground piping to the tank shall be double-walled and/or located above ground and/or cathodically protected to allow for inspections to identify potential for failure. To maximize system safety, the floors, containment area, and sump pump pit shall be sealed with a coating appropriate for the materials being stored (e.g., petroleum resistant coating).

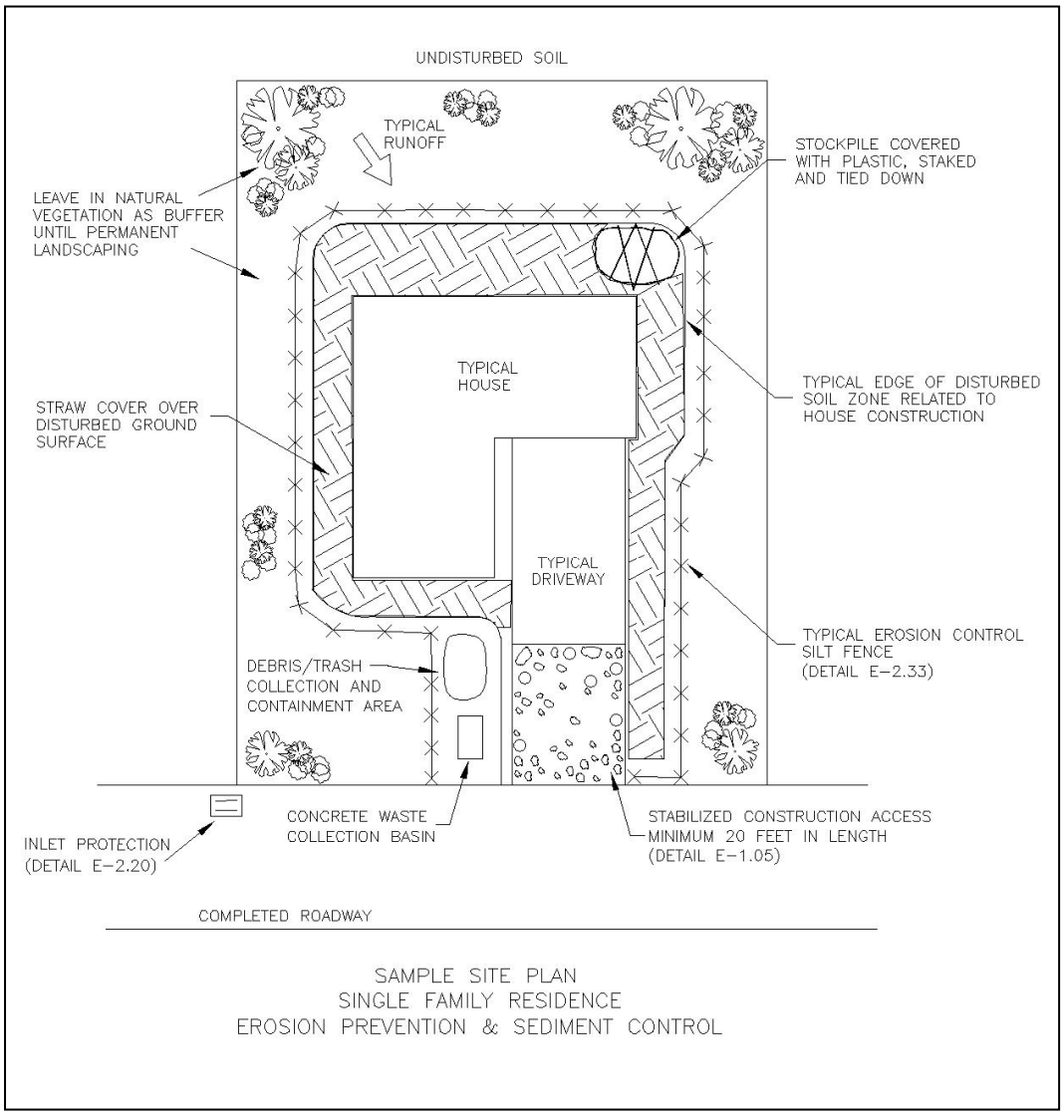
ASTs shall be routinely monitored to ensure they are not leaking. An audit of a newly installed tank system by a professional engineer can identify and correct problems such as loose fittings, poor welding, and poorly fit gaskets. After installation, the tank system shall be inspected monthly to ensure it is in good condition. Depending on the permeability of the secondary containment area, more frequent containment area checks may be necessary. Areas to inspect include tank foundations, connections, coatings, tank walls, and the piping system. Integrity testing should be done periodically by a qualified professional and in accordance with applicable standards.

4-9.09 Trash Dumpster/Compactor Enclosures/Areas

Catch basins located within trash enclosure areas shall not connect to storm water systems ~~but may drain to sanitary sewer if they are hydraulically isolated from the remainder of the hard surfaces (i.e. bermed and/or curbed). BMP S427 from Vol. IV of the *Stormwater Manual* shall be used for guidance~~.

4-10 SMALL PROJECTS~~SITE SINGLE FAMILY RESIDENCES~~ – LESS THAN 2,000 SQUARE FEET NEW HARD SURFACE AREA

Infiltration Systems: The City requires that all roof run-off be infiltrated on site except for areas of poor infiltration, high groundwater, steep slopes or lots with more than three (3) feet of fill. A template that is based on the size of the roof, rainfall and the infiltration rate of the soil has been developed to determine the size of the infiltration system. In areas with marginal infiltration rates (less than 2"/hour), the infiltration system shall be designed by a Professional Engineer. Below is a sample site plan for erosion prevention and sediment control for a small site or single family residence which creates or replaces less than 2,000 square feet.



SAMPLE SITE PLAN
SINGLE FAMILY RESIDENCE
EROSION PREVENTION & SEDIMENT CONTROL

4-11 DEFINITION OF TERMS

The following terms are a sub-set of the terms defined in Section 1 and are included below for convenience.

Area Drain/Field Inlet: A structure used to collect storm water in ditches, swales or lawns often with an angled grate to prevent clogging with debris.

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

Catch Basin/Curb Inlet/Combination Curb Inlet: A structure used to collect surface water runoff from streets and paved areas, having a sump base designed to retain grit, sediment and debris, before flowing into the storm sewer. A catch basin has a grate level with the pavement, a curb inlet has an opening in the curb and gutter and a combination curb inlet incorporates the features of both.

Categorical Industry: An industry which has been defined as categorical by the definitions provided in the Clean Water Act's Code of Federal Regulations (40 CFR). These are typically required to sample for pollutants specific to the nature of the industry and to maintain compliance with the categorical guidelines.

Culvert: A pipe or concrete box which permits the natural flow of water from creeks, open channels or ditches under a roadway or embankment.

Design Storm: A prescribed hyetograph and total precipitation amount (for a specific duration recurrence frequency) used to estimate runoff for a hypothetical storm of interest or concern for the purposes of analyzing existing drainage, designing new drainage facilities or assessing other impacts of a proposed project on the flow of surface water. (A hyetograph is a graph of percentages of total precipitation for a series of time steps representing the total time during which the precipitation occurs.)

Detention Facility: A facility (e.g. pond, vault, pipe) in which surface and stormwater is temporarily stored and released at a controlled rate.

Drywell: Precast concrete manhole with perforations and installed with drain rock for exfiltration of surface water runoff or other drainage to the subsurface.

Effective Impervious Surface: Those impervious surfaces that are connected via sheet flow or discrete conveyance to a drainage system. Impervious surfaces on residential development sites are considered ineffective if the runoff is dispersed through at least one hundred feet of native vegetation.

Emerging Technologies: Treatment technologies that have not been evaluated with approved protocols, but for which preliminary data indicate that they may provide a necessary function(s) in a stormwater treatment system. Emerging technologies need additional evaluation to define design criteria to achieve, or to contribute to achieving, state performance goals, and to define the limits of their use.

Erosion and Sediment Control: Any temporary or permanent measures taken to reduce erosion, control siltation and sedimentation, and ensure that sediment-laden water does not leave the site and/or enter the stormwater system.

Flow control BMP or Facility: A drainage facility designed to mitigate the impacts of increased surface and stormwater runoff flow rates generated by development. Flow control facilities are designed either to hold water for a considerable length of time and then release it by evaporation, plant transpiration, and/or infiltration into the ground, or to hold runoff for a short period of time, releasing it to the conveyance system at a controlled rate.

Grading: Excavating, filling or embanking of earth materials.

Hard Surface: An impervious surface, a permeable pavement, or a vegetated roof.

Impervious Surface: A non-vegetated surface area which either prevents or retards the entry of water into the soil mantle as under natural conditions prior to development, and/or a non-vegetated surface area which causes water to run off the surface in greater quantities or at an increased rate of flow than the flow present under natural conditions prior to development. Common impervious surfaces include, but are not limited to, roof tops, walkways, patios, driveways, parking lots or storage areas, concrete or asphalt paving, gravel roads, gravel parking lots, packed earthen materials, and oiled, macadam or other surfaces which similarly impede the natural infiltration or stormwater. Open, uncovered retention/detention facilities shall not be considered as impervious surfaces for the purposes of determining whether the thresholds for application of minimum requirements are exceeded. Open, uncovered retention/detention facilities shall be considered impervious surfaces for purposes of runoff modeling.

Land-disturbing Activity: Any activity that results in a movement of earth or a change in the existing soil cover (both vegetative and nonvegetative) and/or existing soil topography. Land-disturbing activities include, but are not limited to, demolition, reconstruction, construction, clearing, grading, filling excavation and related activities. Compaction that is associated with stabilization of structures and road construction shall also be considered a land disturbing activity. Vegetation maintenance practices are not considered land-disturbing activity.

Low Impact Development (LID): A stormwater and land use management strategy that strives to mimic pre-disturbance hydrologic processes of infiltration, filtration, storage, evaporation and transpiration by emphasizing conservation, use of on-site natural features, site planning, and distributed stormwater management practices that are integrated into a project design.

Low Impact Development (LID) Best Management Practices: The distributed stormwater management practices, integrated into a project design, that emphasize pre-disturbance hydrologic processes of infiltration, filtration, storage, evaporation and transpiration. LID BMPs include, but are not limited to, bioretention, rain gardens, permeable pavements, roof downspout controls, dispersion, soil quality and depth, vegetated roofs, minimum excavation foundations, and water re-use.

National Pollutant Discharge Elimination System (NPDES): The national program for issuing, modifying, revoking, and reissuing, terminating, monitoring and enforcing

permits, and imposing and enforcing pretreatment requirements, under sections 307, 402, 318, and 405 of the Federal Clean Water Act, for the discharge of pollutants to surface waters of the state from point sources. These permits are referred to as NPDES permits and, in Washington State, are administered by the Washington State Department of Ecology.

New Development: Land disturbing activities, including Class IV General Forest Practices that are conversions from timber land to other uses; structural development, including construction or installation of a building or other structure; creation of hard surfaces; and subdivision, short subdivision and binding site plans, as defined and applied in chapter 58.17 RCW. Projects meeting the definition of redevelopment shall not be considered new development.

New Impervious Surface: Impervious surface created on or added to a site or structural development including construction, installation, or expansion of a building or other structure. New impervious surfaces may also include existing impervious surface that is removed and replaced. To be considered new, the removal and replacement activity must result in significant changes in impervious surface locations, grade, and/or drainage system features, and/or must involve construction, installation, or expansion of a building or structure after complete or substantial intentional demolition.

Operations and Maintenance Manual: A document prepared to explain the proper specific operational and maintenance details of facilities installed as required by the Stormwater Manual.

Outfall: The point where water flows from a manmade conduit, channel, or drain into a water body or other natural drainage feature.

Pervious Surface: A surface material that allows stormwater to infiltrate into the ground. Examples include lawn, landscape, pasture, native vegetation areas, and permeable pavements.

Pollution/Pollutants: Such contamination, or other alteration of the physical, chemical or biological properties, of any waters of the state, including change in temperature, taste, color, turbidity, or odor of the waters, or such discharge of any liquid, gaseous, solid, radioactive, or other substance into any waters of the state as will or is likely to create a nuisance or render such waters harmful, detrimental or injurious to the public health, safety or welfare, or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or to livestock, wild animals, birds, fish or other aquatic life.

Pollution-generating Hard Surface/PGHS: Those hard surfaces considered to be a significant source of pollutants in stormwater runoff. See the listing of surfaces under pollution-generating impervious surface.

Pollution-generating Impervious Surface/PGIS: Those impervious surfaces considered to be a significant source of pollutants in stormwater runoff. Such surfaces include those which are subject to: vehicular use; industrial activities or storage of erodible or leachable materials, wastes, or chemicals, and which receive direct rainfall or the run-on or blow-in of rainfall; metal roofs unless they are coated with an inert, non-leachable material (e.g., baked-on enamel coating); or roofs that are subject to venting

significant amounts of dusts, mists, or fumes from manufacturing, commercial, or other indoor activities.

Pollution-generating Pervious Surface/PGPS: Any non-impervious surface subject to vehicular use, industrial activities or storage of erodible or leachable materials, wastes or chemicals, and that receive direct rainfall or run-on or blow-in of rainfall, use of pesticides and fertilizers, or loss of soil. Typical PGPS include permeable pavement subject to vehicular use, lawns and landscaped areas including: golf courses, parks, cemeteries, and sports fields (natural and artificial turf).

Predevelopment Condition: The native vegetation and soils that existed at a site prior to the influence of Euro-American settlement. The pre-developed condition shall be assumed to be forested land cover unless reasonable, historic information is provided that indicates the site was prairie prior to settlement.

Redevelopment: On a site that is already substantially developed (i.e., has 35% or more of existing impervious surface coverage), the creation or addition of hard surfaces; the expansion of a building footprint or addition or replacement of a structure; structural development including construction, installation or expansion of a building or other structure; replacement of hard surface that is not part of routine maintenance activity; and land disturbing activities.

Regional Facility: A city owned, designed, and constructed facility used for detention, retention and/or water quality of stormwater runoff from large areas of land or basins.

Replaced Hard Surface: For structures, the removal and replacement of hard surfaces down to the foundation. For other hard surfaces, the removal down to bare soil or base course and replacement.

Replaced Impervious Surface: For structures, the removal and replacement of any exterior impervious surfaces or foundation. For other impervious surfaces, the removal down to bare soil or base course and replacement.

Source Control BMP – A structure or operation that is intended to prevent pollutants from coming into contact with stormwater through physical separation of areas or careful management of activities that are sources of pollutants. The *Stormwater Manual* separates source control BMPs into two types. Structural Source Control BMPs are physical, structural, or mechanical devices, or facilities that are intended to prevent pollutants from entering stormwater. Operational BMPs are non-structural practices that prevent or reduce pollutants from entering stormwater. See Vol. IV of the Stormwater Manual for details.

Storm Sewer: A sewer that is designed to carry stormwater and surface water runoff or drainage, but typically excludes domestic wastewater and industrial wastes. Storm drains are enclosed conduits that transport surface and stormwater runoff toward points of discharge.

Stormwater Facility: A constructed component of a stormwater drainage system, designed or constructed to perform a particular function, or multiple functions. Stormwater facilities include, but are not limited to, pipes, swales, ditches, culverts, street gutters, detention ponds, retention ponds, constructed wetlands, infiltration devices, catch basins, oil/water separators, and biofiltration swales, bioretention, vegetated roofs and permeable pavements.

Stormwater Manual: Stormwater Management Manual for Western Washington prepared by the Washington State Department of Ecology Water Quality Program, December 2019~~94~~, Publication No. 19-10-021 ~~14-10-055 (a revision of Publication No. 12-10-030)~~, 5 volumes, and as hereafter amended.

Stormwater Permit: The of the City of Vancouver's National Pollutant Discharge Elimination System (NPDES) Western Washington Phase II Municipal Stormwater Permit issued August 1, 2019~~93~~, ~~and modified January 16, 2014~~ by the Washington State Department of Ecology.

Stormwater Pollution Prevention Plan (SWPPP): A plan that identifies best management practices to identify, reduce, eliminate and/or prevent stormwater contamination and water pollution.

Stormwater Site Plan: A comprehensive report containing all of the technical information and analyses necessary for regulatory agencies to evaluate a proposed new development or redevelopment project for compliance with stormwater requirements. Contents of the Stormwater Site Plan will vary with the type and size of the project, and individual site characteristics. Guidance on preparing a Stormwater Site Plan is contained in Section 4-2.

Threshold Discharge Area (TDA): An on-site area draining to a single natural discharge location or multiple natural discharge locations that combine within one-quarter mile downstream (as determined by the shortest flowpath).

Treatment BMP or Facility: A BMP that is intended to remove pollutants from stormwater. A few examples of treatment BMPs are wetponds, oil/water separators, biofiltration swales, and constructed wetlands.

Underground Injection Control/UIC: Manmade subsurface fluid distribution system designed to discharge fluids into the ground; consisting of an assemblage of perforated pipes, drain tiles, or other similar mechanisms, or a dug hole that is deeper than the largest surface dimension. Subsurface infiltration systems include drywells, pipe or french drains, drain fields, and other similar devices.

4-12 SURFACE WATER STANDARD PLAN DETAIL SHEETS

Surface Water Standard Plan Numbers and Description

D–1.0	Construction Notes for Storm Sewers
D-1.1	Standard Catch Basin Detail
D-1.2	Standard Curb Inlet Detail
D-1.3	Standard Combination Curb Inlet Detail
D-1.4	G-2 Catch Basin Detail
D-1.5	Sloped Field Inlet Detail
D-1.6	Standard Area Inlet Detail
D-1.7	Standard Grate Detail
D-1.8	Catch Basin Trap Detail
D-2.0	Standard Manhole Detail
D-2.1	Pre-Sedimentation/Separator Manhole Detail
D-2.2	Standard Pre-Cast Drywell
D-2.3	Standard Sewer Cleanout Detail
D-2.4	Manhole Cover and Frame Standard Detail
D-2.5	Storm Stub Detail
D-3.1	Standard Pipe Bedding Detail
D-3.2	Trench Backfill Detail
D-4.0	Standard Fueling Island Detail
~~D-4.1~~	~~Fueling Island Alternative Discharge Detail Surface Biofiltration~~
~~D-4.2~~	~~Fueling Island Alternative Discharge Detail Underground Injection~~

Erosion Prevention Standard Plan Numbers and Description

E-0.10	Symbols
E-0.20	Sample Site Erosion Control Detail
E-1.00	Erosion Prevention & Sediment Control Notes
E-1.05	Stabilized Construction Entrance
E-1.06	Wheel Wash
E-1.22	Nets and Blankets
E-1.23	Plastic Covering
E-1.30	Surface Roughing
E-1.31	Gradient Terraces
E-2.00	Interceptor Dike & Swale
E-2.01	Grass-Lined Channels
E-2.04	Pipe Slope Drains
E-2.06	Level Spreader
E-2.07	Check Dam
E-2.20a	Inlet Protection Details
E-2.20b	Inlet Protection Details
E-2.30	Straw Bale Barrier
E-2.31	Brush Barrier
E-2.33	Silt Fence
E-2.35	Straw Wattles
E-2.40	Sediment Trap
E-2.41	Sediment Pond
E-2.45	Siltation Trench Behind Curb
E-2.46	Sediment Bag Detail