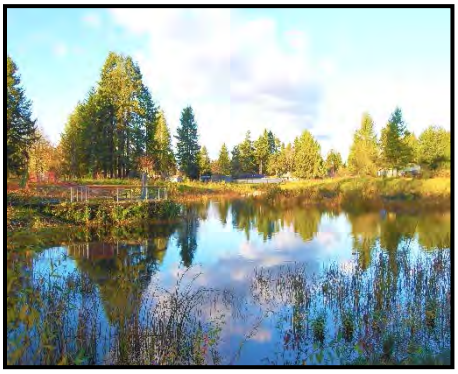
City of Lacey
2016 Stormwater Design Manual





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City of Lacey
2016 Stormwater Design Manual

October 13, 2016

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October 2016

Primary References

Washington State Department of Ecology,
2012 Stormwater Management Manual for Western Washington, as Amended in December 2014
Pierce County, *Stormwater Management and Site Development Manual*, 2015
Low Impact Development Technical Guidance Manual for Puget Sound, 2012

Chapter 1 – Introduction

Table of Contents

Chapter 1 – Introduction

1.1 Background and Authority

This City of Lacey 2016 Stormwater Design Manual (SDM or "this manual") is a completely revised and updated replacement for the 2010 SDM. This 2016 SDM is based on the Washington State Department of Ecology *2012 Stormwater Management Manual for Western Washington, as Amended in December 2014* (2014 Ecology Manual). In creating this 2016 SDM, the City of Lacey Department of Public Works has edited and reorganized Ecology's Manual for ease of use and local application. The reader is referred to the 2014 Ecology Manual for further background information and supporting details, if desired. It is available on Ecology's web site at: <www.ecy.wa.gov/programs/wq/stormwater/manual.html>.

The City of Lacey is required to regulate stormwater discharges to its municipal separate storm sewer system (MS4) and to waters of the state, in compliance with the Western Washington Phase II National Pollutant Discharge Elimination System (NPDES) Municipal Stormwater Permit. Under the NPDES Municipal Stormwater Permit, the city must establish and apply the minimum requirements specified in the permit and provide design guidance for stormwater quality and quantity control for new development and redevelopment projects in Lacey. Through this manual, the city is complying with the Clean Water Act and the NPDES Municipal Stormwater Permit. Where requirements in this manual are also covered in any other law, ordinance, resolution, rule, or regulation of any kind the more restrictive law shall govern.

This manual has been adopted by local ordinance and has force of law. Failure to comply may trigger administrative or enforcement action, and result in project delays, fines, or penalties. For the purposes of interpreting and using this manual, the words "shall," "will," and "must" are always mandatory; the word "should" is situation-specific and not mandatory but strongly encouraged; and "may" is situation-specific and permissive. The City of Lacey Stormwater Design Manual Administrator (SDM Administrator) is authorized to determine if situation-specific requirements are applicable to any particular project.

The SDM Administrator is also authorized to request information or to impose requirements beyond those specified in this manual, which may occur for various reasons including but not limited to:

- To protect public safety, health, and welfare
- To prevent flooding, erosion, endangerment to property, habitat destruction, or water quality degradation
- To implement regulatory mandates such as a total maximum daily load (TMDL)

- To protect uninterruptible services
- To implement increases in requirements imposed by state or federal agencies or other pertinent factors
- To clarify, correct, augment, or update information in this manual

1.2 Objective

The objective of this manual is to provide guidance and requirements to control the quantity and quality of stormwater produced by new development and redevelopment, such that they comply with water quality standards and contribute to the protection of beneficial uses of the receiving waters. Water quality standards include:

- Chapter 173-200 of the Washington Administrative Code (WAC), Water Quality Standards for Groundwaters of the State of Washington
- Chapter 173-201A WAC, Water Quality Standards for Surface Waters of the State of Washington
- Chapter 173-204 WAC, Sediment Management Standards

This manual establishes the minimum "core requirements" for stormwater control and site development requirements for all new development and redevelopment in the city and applies to all sites as detailed in Chapter 2 – Core Requirements for New Development and Redevelopment, and Chapter 3 – Stormwater Submittals. The core requirements outlined in Chapter 2 are based on the "Minimum Requirements" outlined in the 2014 Ecology Manual, but have been renamed and slightly revised for use in the City of Lacey. Stormwater management requirements are satisfied by the application of best management practices (BMPs) identified in this manual, when they are selected and designed according to the procedures and criteria specified in this manual.

The requirements of this manual are applicable to all types of public and private land development projects in the City of Lacey—including residential, commercial, industrial, and road projects. Stormwater management for road projects shall meet all the core requirements stated in this manual, although federally-funded road projects may be required (per Washington State Department of Transportation [WSDOT] Local Agency Guidelines) to design to WSDOT Highway Runoff Manual standards, at a minimum. In this case, the more stringent stormwater requirements of this manual or the WSDOT Highway Runoff Manual shall apply.

The intent and purpose of this manual is to:

- Establish criteria for submittal, review, and analysis of all development
- Manage stormwater to minimize contact with contaminants

- Mitigate the impacts of increased runoff due to urbanization
- Manage runoff from developed property and property being developed
- Protect the health, safety, and welfare of the public

This manual is not intended to preclude alternative engineering solutions to design situations. It is expected that the professional engineer will bring to each project the best of his/her skills and abilities to see that the project is thoroughly analyzed and designed correctly, accurately, and in compliance with generally accepted engineering practices. Alternatives to the standard plans, specifications, and design details found in this manual may be accepted if they meet or exceed the performance of this manual's standards as determined by the city. Engineers are encouraged to be innovative. The burden of proof, however, is on the engineer to document that his/her innovations meet or exceed the performance of the standards outlined in this manual.

This manual is based on the premise that development and redevelopment shall not negatively impact adjacent and/or downstream property owners nor degrade groundwater or the natural drainage system, including but not limited to streams, ravines, wetlands, potholes, and rivers. Further, development activities shall not impact adjacent and/or downstream property owners in a detrimental manner compared to the predeveloped condition. It is not the intent of this manual to make the City of Lacey a guarantor or protector of public or private property with regard to land development activities.

1.3 Organization of this Manual

1.3.1 Overview of Manual Content

To accomplish the objective described in Section 1.2, this manual includes the following:

- *Core requirements* that cover a range of issues, such as submittal requirements, pollution prevention during the construction phase of a project, control of potential pollutant sources, treatment of runoff, control of stormwater flow volumes, protection of wetlands, and long-term operation and maintenance. The core requirements applicable to a project vary depending on the type and size of the proposed project.

- *Best management practices (BMPs)* that can be used to meet the core requirements. BMPs are schedules of activities, prohibitions of practices, maintenance procedures, managerial practices, or structural features that prevent or reduce pollutants or other adverse impacts to waters of Washington. BMPs are divided into those for short-term control of stormwater from construction sites (Chapter 5), and those addressing long-term management of stormwater at developed sites. Long-term BMPs are further subdivided into those covering management of the volume and timing of stormwater flows (Chapter 7), treatment of runoff to remove sediment and other pollutants (Chapter 8), and prevention of pollution from potential sources (Chapter 9).

- *Requirements for preparing stormwater submittals*. Chapter 3 of this manual covers City of Lacey stormwater-related submittals that may be required depending on the nature of the project or site characteristics.

1.3.2 Organization of this Manual

This manual is organized into nine chapters, briefly described below. See the subsections of each individual chapter for additional details on the contents of each chapter.

Chapter 2 presents the drainage minimum requirements (core requirements) for new development and redevelopment, information on any additional requirements, the project types and thresholds that trigger the various requirements, and information relating to exceptions and variances from these requirements.

Chapter 3 outlines the submittal requirements related to stormwater drainage reviews, including information on site assessment requirements, and submittal documentation requirement for various types of project submittals.

Chapter 4 describes the process for selecting BMPs for long-term management of stormwater flows and quality, in accordance with the core requirements.

Chapter 5 details the erosion and sediment control requirements and BMPs to be implemented during the construction phase of development projects.

Chapter 6 presents the hydraulic and hydrologic analytical methods to be used in developing the drainage design.

Chapter 7 addresses selection and design of BMPs intended to meet flow control requirements.

Chapter 8 addresses selection and design of BMPs intended to meet water quality requirements.

Chapter 9 is devoted to source control of pollution and pollution prevention.

Appendices to the chapters contain definitions, forms, checklists, maps, additional technical guidance, and other information relevant to the chapters and to the application of the core requirements.

Glossary – This chapter concludes with a glossary of terms.

1.4 Site Planning and Layout

The design professional is required to address the issue of stormwater management, both quantity and quality, in the early phases of the site planning process. Consideration of the natural characteristics of a site during the initial stages of project planning will help facilitate the site layout and drainage design. Existing topography, soils, vegetation, and drainage patterns can have a significant effect on the site drainage, and must be

considered in designing the site and stormwater systems. Smart site planning and stormwater design includes adapting to a site's inherent characteristics rather than ignoring or working against them.

The approach to considering and minimizing stormwater impacts at the site layout stage is commonly referred to as low impact development (LID). As described in Section 1.5.4, LID emphasizes protection and use of on-site natural features integrated with small-scale hydrologic controls to manage stormwater and simulate predevelopment watershed hydrologic functions. This is achieved by recognizing and focusing on the relationship among the overland and subsurface flow, infiltration, storage, and evapotranspiration characteristics of the site. LID strategies focus on evaporating, transpiring, and infiltrating stormwater on site through native or amended soils, vegetation, and bioengineering applications to reduce and treat overland flow.

Two primary site design strategies shall be considered in developing the site layout and stormwater drainage systems:

1. Manage stormwater on site. As stated in Chapter 2 under Core Requirement #5, one of this manual's main stormwater requirements is to employ on-site stormwater management BMPs to infiltrate, disperse, and retain stormwater runoff on site to the maximum extent feasible. On an undeveloped (natural) site, stormwater is "managed" near where it falls, mainly by soaking into the ground and by plant interception. Through LID and on-site stormwater management, this approach can be applied on the developed site as well. Preserve large trees and native soils on site to the maximum extent possible. Determine if infiltration is feasible anywhere on the site, and if so, design the site layout to utilize well-drained soils. Keep stormwater dispersed and spread out as much as possible, and use small-scale LID drainage systems, rather than concentrating flows in larger common facilities.

2. Minimize effective impervious areas, vegetation loss, and stormwater runoff. Site planning and layout strategies include: minimizing the use of impervious areas as much as possible (e.g., roofs; and non-permeable roadways, sidewalks, and parking), clustering buildings and preserving larger areas of open space; minimizing directly connected impervious areas (try to separate impervious surfaces and prevent runoff from concentrating by disconnecting them and draining impervious surfaces overland to pervious areas); incorporating low maintenance landscaping that does not need frequent applications of fertilizers, herbicides, and pesticides; and minimizing the impact area and soil compaction during construction.

Additional details on LID approaches and requirements in the City of Lacey are outlined in Chapters 2 and 7.

1.5 Development of BMPs for Stormwater Management

1.5.1 Best Management Practices

BMPs are activities, restrictions, or constructed stormwater facilities that, when used singly or in combination, prevent or reduce the release of pollutants and other adverse impacts to waters of Washington. The types of BMPs include source control, water quality treatment, flow control, and LID (also referred to as on-site stormwater management BMPs). BMPs that involve construction of engineered structures are often referred to as facilities in this manual. For instance, the BMPs referenced in the water quality treatment menus in Chapter 8 are called treatment facilities.

The primary purpose of using BMPs is to protect beneficial uses of water resources through the reduction of pollutant loads and concentrations, through reduction of discharges (volumetric flow rates) causing stream channel erosion, and through reductions in deviations from natural hydrology. If it is found that, after the implementation of BMPs prescribed in this manual, beneficial uses are still threatened or impaired, additional controls may be required.

1.5.2 Construction Stormwater BMPs (Chapter 5)

Construction stormwater BMPs can provide source control, water quality treatment, or flow control. Examples include stabilized construction entrances, silt fences, check dams, and sediment traps. Chapter 5 contains construction stormwater BMPs.

1.5.3 Flow Control BMPs (Chapter 7)

Flow control BMPs typically control the volume, rate, frequency, and duration of stormwater surface runoff. The need to provide flow control BMPs depends on where the development site runoff is discharged to—e.g., a stream system, wetland, or closed depression—either directly or indirectly.

Construction of a detention pond is probably the most common means of meeting flow control requirements. Construction of an infiltration facility is the preferred option but is feasible only where more permeable soils are available.

Previous versions of the City of Lacey and Ecology stormwater design guidelines and requirements (2005 and earlier) focused primarily on controlling the peak flow release rates for recurrence intervals of concern—the 2-, 10-, and 100-year rates. This level of control did not adequately address the increased duration at which those high flows occur because of the increased volume of water from the developed condition as compared to the predeveloped conditions. To protect stream channels from increased erosion, it is necessary to control the durations over which a stream channel experiences geomorphically significant flows such that the energy imparted to the stream channel does not increase significantly. Geomorphically significant flows are those that are capable of moving sediments. This target will translate into lower release rates and will require significantly larger detention ponds than earlier city standards. The required size

of a detention pond can be reduced by changing the extent of disturbance on a site. In addition, engineers and designers are encouraged to look for means to improve or restore natural conditions to complement, or to serve in lieu of, traditional flow control measures. The on-site stormwater management BMPs presented in Chapters 7 and 8 will help accomplish this goal. See also Section 1.5.4.

1.5.4 Low Impact Development BMPs (Chapter 7)

Low impact development is a land use development strategy that emphasizes protection and use of on-site natural features integrated with engineered, small-scale hydrologic controls at the parcel and subdivision scale. LID combines natural and engineered on-site features to infiltrate and/or disperse stormwater runoff on a site as a means to more closely mimic predevelopment watershed hydrologic functions. Certain on-site stormwater management BMPs and LID techniques are required as part of Core Requirement #5 (see Chapter 2), with additional techniques available to supplement or replace traditional stormwater approaches. Chapter 7 presents design guidelines for several of the most common on-site stormwater management (i.e., LID) BMPs. Given the evolving nature of low impact development approaches, the design standards for these BMPs may change before the next update to this manual. Users should check with the city and/or refer to the city's web site for any updates to the design criteria.

1.5.5 Runoff Treatment BMPs (Chapter 8)

Water quality treatment BMPs include facilities that remove pollutants by gravity settling of particulate pollutants, centrifugal separation, filtration, biological uptake, and/or media or soil adsorption. Treatment BMPs can accomplish significant levels of pollutant load reductions if properly designed and maintained.

1.5.6 Source Control BMPs (Chapter 9)

Source control BMPs typically prevent pollution, or other adverse effects of stormwater, from occurring. Source control BMPs are classified as operational or structural. Examples of source control BMPs include methods as various as using mulches and covers on disturbed soil, putting roofs over outside storage areas, and berming areas to prevent stormwater run-on and pollutant runoff.

It is generally more cost-effective to use source controls to prevent pollutants from entering runoff than to treat runoff to remove pollutants. However, since source controls cannot prevent all impacts, some combination of measures will always be needed.

1.6 Maintenance of Stormwater Best Management Practices

The importance of maintenance for the proper functioning of stormwater control facilities cannot be overemphasized. Maintenance is crucial to performance of runoff treatment and flow control BMPs. A substantial portion of failures (clogging of filters, resuspension of sediments, loss of storage capacity, etc.) of such facilities results from inadequate maintenance. In addition, maintenance must be a basic consideration in design and in

determination of cost. Therefore, provisions to facilitate maintenance operations must be built into the project when a BMP is installed.

Likewise, for both private and public facilities, it is important to include maintenance personnel early and throughout the design process. During discussions with maintenance personnel, describe the maintenance procedures that will need to be performed on the BMP. This will help ensure that future maintenance work and potential access needs are clearly understood.

The description of each BMP in subsequent chapters includes a brief section on facility maintenance. Chapter 3, Appendix 3B, includes additional information on stormwater maintenance, including a detailed checklist of maintenance requirements for all drainage facilities. Chapter 3 also outlines the specific elements to be addressed in the Maintenance and Source Control Manual, which is a required project submittal.

1.7 Relationship of this Manual to Federal, State, and Local Regulatory Requirements

This section describes some of the local, state, and federal regulations and permits that may apply to your project, depending on the nature of the project and site characteristics. City of Lacey staff is available to help in determining which permits apply and in helping project applicants through the permitting process.

The City of Lacey's web site has information on the city's permitting process, including online permit information: <www.ci.lacey.wa.us>. Permit information can also be obtained by calling the Community Development Department at (360) 491-5642.

The Joint Aquatic Resources Permit Application (JARPA) is another resource that can help to streamline the environmental permitting process. As noted in the following sections, several of the permits described in this section are included in the JARPA, so they can be covered under a single permit application. Refer to the Access Washington, one-stop e-permitting web site for more information: <epermitting.org/site/alias__resourcecenter/jarpa_introduction/10042/introduction.aspx>.

1.7.1 The Manual's Role as Technical Guidance and Requirements

This manual is to be used for identifying, selecting, and designing BMPs and completing submittal requirements to comply with city permits. The requirements of this manual apply to all areas of the city. These requirements also apply to cross-jurisdictional projects (e.g., county, state, or federal government entity) located totally, or in part, of the city, unless one of the following applies:

- Activity is exempted from submittal requirements (see Chapter 2, Section 2.1.3).
- Development/redevelopment and stormwater activities are conducted in accordance with an approved stormwater management manual consistent with the 2014 Ecology Manual.

This manual provides technical guidance on measures to control the quantity and quality of stormwater runoff from new development and redevelopment projects. These measures are considered to be necessary to achieve compliance with state water quality standards and to contribute to the protection of the beneficial uses of the receiving waters (both surface and groundwater). Stormwater management techniques applied in accordance with this manual are presumed to meet the technology-based treatment requirement of state law to provide all known available and reasonable methods of treatment, prevention, and control (AKART; Revised Code of Washington [RCW] 90.52.040 and RCW 90.48.010).

The state technology-based treatment requirement does not excuse any discharge from the obligation to apply additional stormwater management practices, as necessary, to comply with state water quality standards and to protect groundwater that is used for public drinking water supplies. The state water quality standards include Chapter 173-200 WAC, Water Quality Standards for Ground Waters of the State of Washington; Chapter 173-201A, Water Quality Standards for Surface Waters of the State of Washington; and Chapter 173-204 WAC, Sediment Management Standards. However, compliance with the standards in this manual does not necessarily mitigate all probable and significant environmental impacts to aquatic biota. Thus, compliance with this manual should not be construed as mitigating all probable and significant stormwater impacts on aquatic biota in streams and wetlands; additional mitigation may be required.

In addition, this manual presents the City of Lacey's minimum standards for planning and engineering for stormwater management. While the city believes these standards are appropriate for a wide range of development proposals, compliance solely with these requirements does not relieve the professional submitting stormwater plans of his or her responsibility to ensure drainage facilities provide adequate protection for natural resources and public and private property.

Severability

If any provisions of this manual, or their application to any person or property are amended or held to be invalid, the remainder of the provisions in this manual in their application to other persons or circumstances shall not be affected.

Penalties and Enforcement

Penalties and enforcement shall be per the City of Lacey Stormwater Code, LMC 14.25.

Appeals

Appeals shall be handled per the City of Lacey Stormwater Code, LMC 14.25.

1.7.2 More Stringent Measures

Other stormwater or water quality regulations—such as TMDLs or water cleanup plans—may identify more stringent measures needed to restore water quality in an impaired

water body. For more information, see Chapter 8, Section 8.3.5, as well as the Ecology web site: <www.ecy.wa.gov/PROGRAMS/WQ/tmdl/index.html>.

1.7.3 Retrofitting

This manual is not a retrofit manual, but it can be helpful in identifying options for retrofitting BMPs to existing development. Retrofitting stormwater BMPs into existing developed areas may be necessary to meet federal Clean Water Act and state Water Pollution Control Act (Chapter 90.48 RCW) requirements. The Puget Sound Action Agenda also includes prioritizing and implementing stormwater retrofits as one objective. In retrofit situations, there frequently are site constraints that make the strict application of these BMPs difficult. In such instances, the BMPs presented here can be modified using best professional judgment to provide reasonable improvements in stormwater management.

1.7.4 Presumptive Versus Demonstrative Approaches to Protecting Water Quality

Wherever a discharge permit or other water-quality-based project approval is required, project applicants may be required to document the technical basis for the design criteria used to design their stormwater management BMPs. This includes: how stormwater BMPs were selected; the pollutant removal performance expected from the selected BMPs; the scientific basis, technical studies, and/or modeling that supports the performance claims for the selected BMPs; and an assessment of how the selected BMP will comply with federal technology-based treatment requirements and state water quality standards, and will satisfy "all known available and reasonable methods by industries and others to prevent and control the pollution of the waters of the State of Washington." This statutory requirement is generally known by the acronym AKART.

The BMPs presented in this manual are approved by the city and are *presumed* to protect water quality and instream habitat—and meet the stated environmental objectives of the regulations described in this chapter. Project applicants always have the option of not following the stormwater management practices in this manual. However, if a project applicant chooses not to follow the practices in the manual, then the project applicant will be required to individually *demonstrate* that the project will not adversely impact water quality by collecting and providing appropriate supporting data to show that the alternative approach is protective of water quality and satisfies state and federal water quality laws. Project applicants interested in pursuing the demonstrative approach should contact the City of Lacey Department of Public Works early in the process.

If a project applicant wants to follow the demonstrative approach for a water quality treatment BMP, the 2014 Ecology Manual and Ecology web site have more information on setting up an approved water quality monitoring plan to demonstrate that a project will protect water quality and satisfy state and federal laws. Additional city requirements will also apply. Contact the SDM Administrator for additional information.

1.7.5 Phase II – NPDES and State Waste Discharge Stormwater Permits for Municipalities

Certain municipalities and other entities are subject to permitting under the U.S. Environmental Protection Agency (U.S. EPA) Phase II Stormwater Regulations (40 CFR Part 122). In western Washington, Ecology has issued joint NPDES and state waste discharge permits to regulate the discharges of stormwater from the municipal separate storm sewer systems operated by certain medium- and large-sized cities and counties, including the City of Lacey.

The Phase II NPDES Western Washington Municipal Stormwater Permit was reissued on August 1, 2012 (and subsequently modified on December 17, 2014) and is available on the Ecology web site: <www.ecy.wa.gov/programs/wq/stormwater/municipal/phaseIIww/wwphiipermit>.

1.7.6 Industrial Stormwater General Permit

Facilities covered under Ecology's Industrial Stormwater General Permit (i.e., NPDES and State Waste Discharge General Permit for Stormwater Discharges Associated With Industrial Activities) must manage stormwater in accordance with specific terms and conditions including: the development and implementation of an Industrial Stormwater Pollution Prevention Plan (Industrial SWPPP), monitoring, reporting, and ongoing adaptive management based on sampling and inspections.

The Industrial Stormwater General Permit (ISGP) requires Industrial SWPPPs to include certain mandatory BMPs, including those BMPs identified as "required," for specific industrial activities in Chapters 8 and 9 of this manual. Facilities with new development or redevelopment must evaluate whether flow control BMPs are necessary. BMPs must be consistent with this manual, or other stormwater management guidance documents that are approved by Ecology, and incorporated into the ISGP. Facilities may also use alternative BMPs if their Industrial SWPPP includes documentation that the BMPs selected are demonstrably equivalent to practices contained in stormwater technical manuals approved by Ecology, including the proper selection, implementation, and maintenance of all applicable and appropriate BMPs for on-site pollution control.

Ecology's Industrial Stormwater web page <www.ecy.wa.gov/programs/wq/stormwater/industrial/index.html> has a fill-in-the-blank Industrial SWPPP template for use by industrial facilities.

1.7.7 Construction Stormwater General Permit

Coverage under Ecology's Construction Stormwater General Permit (CSWGP) is generally required for any clearing, grading, or excavating if the project site:

- Discharges stormwater from the site into surface water(s) of the state, or

- Discharges into storm drainage systems that discharge to a surface water(s) of the state. “Surface waters of the state” are broadly defined by state law and include storm drains, ditches, wetlands, creeks, rivers, lakes, and marine waters.

And:

- Disturbs 1 or more acres of land area, or
- Disturbs less than 1 acre of land area, if the project or activity is part of a larger common plan of development or sale.

Any construction activity discharging stormwater that Ecology and/or the city determines to be a significant contributor of pollutants to waters of the state may also require permit coverage, regardless of project size, at the discretion of the agencies.

The CSWGP requires application of stabilization and structural practices to reduce the potential for erosion and the discharge of sediments from the site. The stabilization and structural practices cited in the permit are similar to the requirements for sedimentation and erosion control (Core Requirement #2) in Chapter 2 of this manual. Developers must file a Notice of Intent with Ecology and develop a Construction Stormwater Pollution Prevention Plan (Construction SWPPP) prior to beginning construction. It is the responsibility of the project applicant to contact Ecology to determine if these or other requirements apply to their project. However, to minimize review time and effort by both the project applicant and the city, the Construction SWPPP required by the city has been structured to be consistent with Ecology’s Construction SWPPP requirements.

The permit also requires construction sites within western Washington to implement stormwater BMPs contained in stormwater management manuals published or approved by Ecology, or BMPs that are demonstrably equivalent. Chapter 5 of this manual further describes the requirements and BMPs appropriate for managing construction site stormwater.

1.7.8 Endangered Species Act

With the listing of multiple species of salmon as threatened or endangered across much of Washington State, and the probability of more listings in the future, implementation of the requirements of the Endangered Species Act (ESA) affects many aspects of stormwater management. For example, the Mazama pocket gopher is another ESA-listed species that may affect projects in Lacey and the Lacey Urban Growth Area (UGA). Provisions of the ESA that can apply to stormwater management include the Section 4(d) rules, Section 7 consultations, and Section 10 Habitat Conservation Plans (HCPs).

The ESA can be of particular concern for construction sites because of potential adverse impacts from discharges of sediment, turbidity, or abnormal pH. Specific adverse impacts include:

- Suffocation of eggs or fry
- Displacement and elimination of aquatic invertebrates used for food
- Reduction in the biodiversity of aquatic invertebrates
- Reduction of foraging abilities in turbid water
- Irritation of gill tissue that can lead to disease or death
- Filling of resting or feeding areas, or spawning gravels with sediment

These impacts could be determined to be a "take" under ESA.

The stranding of listed species behind erosion and sediment control features or the impairment of their access into certain areas due to the presence of erosion and sediment control features could also be determined to be a take under ESA.

For more information on ESA and how it affects your project, please contact the National Oceanic and Atmospheric Administration Fisheries Service at: <www.nmfs.noaa.gov/pr/laws/esa/> and the U.S. Fish and Wildlife Service at: <www.fws.gov/endangered/>.

1.7.9 Section 401 Water Quality Certifications (included in JARPA)

For projects that require a fill or dredge permit under Section 404 of the Clean Water Act, Ecology must certify to the permitting agency (the U.S. Army Corps of Engineers) that the proposed project will not violate water quality standards of Section 401 of the Clean Water Act. In order to make such a determination and issue a Section 401 Water Quality Certification, Ecology may do a more specific review of the potential impacts of a stormwater discharge from the construction phase of the project and from the completed project. As a result of that review, Ecology may condition its certification to require application of the core requirements in this manual, or more stringent requirements.

1.7.10 Hydraulic Project Approvals (included in JARPA)

Under Chapter 77.55 RCW, the Hydraulics Act, the Washington Department of Fish and Wildlife (WDFW) has the authority to require actions when stormwater discharges related to a project would change the natural flow or bed of state waters. The implementing mechanism is the issuance of a hydraulic project approval (HPA) permit. In exercising this authority, WDFW may require application of the core requirements in this manual, or more stringent requirements.

1.7.11 Aquatic Lands Use Authorizations (included in JARPA)

The Washington State Department of Natural Resources (WDNR), as the steward of public aquatic lands, may require a stormwater outfall to have a valid use authorization, and to avoid or mitigate resource impacts. Through its use authorizations, which are

issued under authority of Chapter 79.90 through 96, Chapter 79.105-79.140 RCW, and in accordance with Chapter 332-30 WAC, WDNR may require application of the core requirements in this manual, or more stringent requirements.

1.7.12 Requirements Identified through Watershed or Basin Planning

A number of the requirements of this manual can be superseded by the adoption of ordinances and rules to implement the recommendations of watershed plans or basin plans. In accordance with the Watershed Management Act (Chapter 90.82 RCW) or the basin planning option per Chapter 400-12 WAC, the state allows the City of Lacey to initiate its own watershed/basin planning processes to identify more stringent or alternative requirements. As long as the actions or requirements identified in those plans and implemented through local or state ordinances or rules comply with applicable state and federal statutes, they can supersede the requirements in this manual. The decisions concerning whether such locally derived requirements comply with federal and state statutes rest with the regulatory agencies responsible for implementing those statutes.

1.7.13 Underground Injection Control – UIC Authorizations

To implement provisions of the Safe Drinking Water Act (see federal underground injection control [UIC] regulations, 40 CFR, Part 144), Ecology has adopted rules (Chapter 173-218 WAC) for a UIC program. For more information, visit Ecology's home page for the UIC program at <www.ecy.wa.gov/programs/wq/grndwtr/uic/> and "Guidance for UIC Wells that Manage Stormwater" at <www.ecy.wa.gov/pubs/0510067.pdf>.

According to WAC 173-218-030, a UIC well is defined as "a well that is used to discharge fluids into the subsurface. A UIC well is one of the following: 1) a bored, drilled or driven shaft, or dug hole whose depth is greater than the largest surface dimension; 2) an improved sinkhole; or 3) a subsurface fluid distribution system (contains perforated pipe or similar structure)."

Depending upon the manner in which it is accomplished, the discharge of stormwater into the ground can be classified as a UIC well. **UIC wells must be registered with Ecology** with the exception of UIC wells at single-family homes that receive only residential roof runoff (WAC 173-218-070 (1)(e). Additional information on UIC and how it applies to infiltration and stormwater management is included in Chapter 7. For more information and for a listing on potential stormwater facilities that may be classified as a UIC well, refer to the memorandum available at <www.ecy.wa.gov/programs/wq/stormwater/municipal/resources/EPAmemoinfiltrationclassvwells.pdf>.

Chapter 1 References and Information Sources

Novotny, V., and H. Olem, *Water Quality: Prevention, Identification, and Management of Diffuse Pollution*. Van Nostrand-Reinhold, New York, New York, 1994.

Glossary and Abbreviations

Glossary

The following terms are provided for reference and use with this manual.

Term	Definition
2014 Ecology Manual	See Stormwater Management Manual for Western Washington.
Absorption	The penetration of a substance into or through another, such as the dissolving of a soluble gas in a liquid.
Adjustment	A variation in the application of a core requirement to a particular project. Adjustments provide substantially equivalent environmental protection.
Adsorption	The adhesion of a substance to the surface of a solid or liquid often used to extract pollutants by causing them to be attached to such adsorbents as activated carbon or silica gel. Hydrophobic, or water-repulsing adsorbents, are used to extract oil from waterways when oil spills occur. Heavy metals such as zinc and lead often adsorb onto sediment particles.
Aeration	The process of being supplied or impregnated with air. In waste treatment, the process used to foster biological and chemical purification. In soils, the process by which air in the soil is replenished by air from the atmosphere. In a well-aerated soil, the soil air is similar in composition to the atmosphere above the soil. Poorly aerated soils usually contain a much higher percentage of carbon dioxide and a correspondingly lower percentage of oxygen.
Aerobic	Living or active only in the presence of free (dissolved or molecular) oxygen.
AKART	All known, available, and reasonable methods of treatment, prevention, and control. Under the NPDES Municipal Stormwater Permit, jurisdictions are to use AKART to prevent and control pollution of waters of the state of Washington. See also the State Water Pollution Control Act, Chapter 90.48.010 and 90.48.520 RCW.
Algae	Primitive plants, many microscopic, containing chlorophyll and forming the base of the food chain in aquatic environments. Some species may create a nuisance when environmental conditions are suitable for prolific growth.
Algal Bloom	Proliferation of living algae on the surface of lakes, streams, or ponds often stimulated by phosphate over-enrichment. Algal blooms reduce the oxygen available to other aquatic organisms.
American Association of State Highway and Transportation Officials (AASHTO) Classification	The official classification of soil materials and soil aggregate mixtures for highway construction, used by the American Association of State Highway and Transportation Officials.
American Public Works Association (APWA)	The Washington State Chapter of the American Public Works Association.

Term	Definition
Anti-Seep Collar (or Device)	A device constructed around a pipe or other conduit and placed through a dam, levee, or dike for the purpose of reducing seepage losses and piping failures.
Applicable BMPs	As used in this manual and in Volume IV of the 2014 Ecology Manual, applicable BMPs are those source control BMPs that are expected to be required by local governments at new development and redevelopment sites. Applicable BMPs will also be required if they are incorporated into NPDES permits or are included by local governments in a stormwater program for existing facilities.
Applicant	The person who has applied for a development permit or approval.
Appurtenances	Machinery, appliances, or auxiliary structures attached to a main structure, but not considered an integral part thereof, for the purpose of enabling it to function.
Aquifer	A geologic stratum containing groundwater that can be withdrawn and used for human purposes.
Arterial	A road or street primarily for through traffic. Generally, a major arterial connects an interstate highway to cities and counties, a minor arterial connects major arterials to collectors, a collector connects an arterial to a neighborhood, and a local access road connects individual properties to a collector.
As-Built Drawings	As-constructed engineering plans that include all changes made to a project during construction and submitted to the city. All drawing changes shall be made by a professional engineer or land surveyor. Also referred to as record drawings.
Assessed Value	The value of the existing improvements excluding land as listed in current records at the Thurston County Assessor's Office. Alternately, the applicant may provide current appraisal information and request that it be substituted for the Assessor's records.
Average Daily Traffic	Means the general unit of measurement for traffic defined as the total volume during a given time period (in whole days) greater than 1 day and less than 1 year divided by the number of days in that time period.
Average Annual Daily Traffic (AADT)	A measurement representing the total number of vehicles passing a given location, based upon 24-hour counts taken over an entire year. Mechanical counts are adjusted to an estimate of annual average daily traffic figures, taking into account seasonal variance, weekly changes, and other variables.
Backwater	Water upstream from an obstruction that is deeper than it would normally be without the obstruction.
Baffle	A device to check, deflect, or regulate flow.
Base Flow	The portion of stream discharge that is from groundwater seeping into the stream.
Basin	An area from which surface runoff is concentrated, usually to a single point such as the mouth of a stream.

Term	Definition
Basin Plan	A plan that assesses, evaluates, and proposes solutions to existing and potential future impacts to the beneficial uses of, and the physical, chemical, and biological properties of waters of the state within a basin. Basins typically range in size from 1 to 50 square miles. A plan should include but not be limited to recommendations for: • Stormwater requirements for new development and redevelopment; • Capital improvement projects; • Land Use management through identification and protection of critical areas, comprehensive land use and transportation plans, zoning regulations, site development standards, and conservation areas; • Source control activities including public education and involvement, and business programs; • Other targeted stormwater programs and activities, such as maintenance, inspections and enforcement; • Monitoring; and • An implementation schedule and funding strategy. A plan that is "adopted and implemented" must have the following characteristics: • It must be adopted by legislative or regulatory action of jurisdictions with responsibilities under the plan; • Ordinances, regulations, programs, and procedures recommended by the plan should be in effect or on schedule to be in effect; and, • An implementation schedule and funding strategy that are in progress.
Bedrock	The more or less solid rock in place either on or beneath the surface of the Earth. It may be soft, medium, or hard and have a smooth or irregular surface.
Berm	A constructed barrier typically made of compacted earth, rock, or gravel. In a stormwater facility, a berm may serve as a vertical divider and is typically built up from the bottom.
Best Management Practice (BMP)	The schedules of activities, prohibitions of practices, maintenance procedures, and structural and/or managerial practices that, when used singly or in combination, prevent or reduce the release of pollutants and other adverse impacts to waters of Washington State.
Biodegradable	Capable of being readily broken down by biological means, especially by microbial action. Microbial action includes the combined effect of bacteria, fungus, flagellates, amoebae, ciliates, and nematodes. Degradation can be rapid or may take many years depending upon such factors as available oxygen and moisture.
Bioengineering	The combination of biological, mechanical, and ecological concepts (and methods) to control erosion and stabilize soil with vegetation or in combination with natural and synthetic construction materials.
Biofilter	A designed treatment facility using a combined soil and vegetation system for filtration, infiltration, adsorption, and biological uptake of pollutants in stormwater when runoff flows over and through the facility. Vegetation growing in these facilities acts as both a physical filter, which causes gravity settling of particulates by regulating velocity of flow, and as a biological sink when direct uptake of dissolved pollutants occurs. The former mechanism is probably the most important in western Washington where the period of major runoff coincides with the period of lowest biological activity.

Term	Definition
Biofiltration	The process of reducing pollutant concentrations in water by filtering the polluted water through biological materials.
Bioretention Areas	Small-scale, shallow retention/detention facilities dispersed through the development site that utilize specific soil mixes and plant species to infiltrate and filter runoff from developed sites.
Bioretention BMP	Engineered facilities that store and treat stormwater by passing it through a specified soil profile, and either retain or detain the treated stormwater for flow attenuation. Refer to Chapter 7 for bioretention BMP types and design specifications.
Biosolids	Municipal sewage sludge that is a primarily organic, semisolid product resulting from the wastewater treatment process that can be beneficially recycled and meets all applicable requirements under Chapter 173-308 WAC. Biosolids includes a material derived from biosolids and septic tank sludge, also known as septage, that can be beneficially recycled and meets all applicable requirements under Chapter 173-308 WAC. For the purposes of Chapter 173-308 WAC, semisolid products include biosolids or products derived from biosolids ranging in character from mostly liquid to fully dried solids.
Bollard	A post (may or may not be removable) used to prevent vehicular access.
Bond	A surety bond, cash deposit or escrow account, assignment of savings, irrevocable letter of credit or other means acceptable to or required by the manager to guarantee that work is completed in compliance with all City of Lacey requirements.
Borrow Area	A source of earth fill material used in the construction of embankments or other earth fill structures.
Buffer	The zone contiguous with a sensitive area that is required for the continued maintenance, function, and structural stability of the sensitive area. The critical functions of a riparian buffer (those associated with an aquatic system) include shading, input of organic debris and coarse sediments, uptake of nutrients, stabilization of banks, interception of fine sediments, overflow during high water events, protection from disturbance by humans and domestic animals, maintenance of wildlife habitat, and room for variation of aquatic system boundaries over time due to hydrologic or climatic effects. The critical functions of terrestrial buffers include protection of slope stability, attenuation of surface water flows from stormwater runoff and precipitation, and erosion control.
Catch Basin	An inlet box set into the ground, usually rectangular and made of concrete, with a sump in the bottom to catch sediment, and capped with a grate that allows stormwater to enter. Usually set at the curb line of a street, to admit surface runoff water to a sewer or subdrain.
Catch Line	The point where a steeper slope intercepts a different, gentler slope.
Catchment	Surface drainage area or basin.
Cation Exchange Capacity (CEC)	Cations are positively charged ions such as calcium (Ca2+), magnesium (Mg2+), and potassium (K+), sodium (Na+) hydrogen (H+), aluminum (Al3+), iron (Fe2+), manganese (Mn2+), zinc (Zn2+) and copper (Cu2+). The capacity of the soil to hold on to these cations called the cation exchange capacity (CEC). Units are milliequivalents per 100 grams of soil, typically abbreviated as meq.

Term	Definition
Certification	Means a written engineering opinion, stamped, signed, and dated by an engineer, concerning the progress or completion of work.
Certified Erosion and Sediment Control Lead (CESCL)	An individual who has current certification through an approved erosion and sediment control training program that meets the minimum training standards established by Ecology (see BMP C160 in the 2014 Ecology Manual). A CESCL is knowledgeable in the principles and practices of erosion and sediment control. A CESCL must have the skills to assess site conditions and construction activities that could impact the quality of stormwater and the effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges. Certification is obtained through an Ecology-approved erosion and sediment control course. Course listings are provided online at Ecology's web site.
Channel	A feature that conveys surface water and is open to the air.
Channel, Constructed	Channels or ditches constructed (or reconstructed natural channels) to convey surface water.
Channel, Natural	Streams, creeks, or swales that convey surface/groundwater and have existed long enough to establish a stable route and/or biological community.
Channelization	Alteration of a stream channel by widening, deepening, straightening, cleaning, or paving certain areas to change flow characteristics.
Check Dam	Small dam constructed in a channel or other small watercourse to decrease the streamflow velocity, minimize channel scour, and promote deposition of sediment.
Civil Engineer	See Professional Engineer.
Civil Engineering	The application of the knowledge of the forces of nature, principles of mechanics and the properties of materials to the evaluation, design and construction of civil works for the beneficial uses of humankind.
Clearing	The destruction and/or removal of vegetation by manual, mechanical, or chemical methods.
Closed Depression	An area that is low-lying and either has no, or such a limited, surface water outlet that during storm events the area acts as a retention basin.
Cohesion	The capacity of a soil to resist shearing stress, exclusive of functional resistance.
Coliform Bacteria	Microorganisms common in the intestinal tracts of man and other warm-blooded animals; all the aerobic and facultative anaerobic, gram-negative, nonspore-forming, rod-shaped bacteria that ferment lactose with gas formation within 48 hours at 35 degrees Celsius. Used as an indicator of bacterial pollution.
Compaction	The densification, settlement, or packing of soil in such a way that permeability of the soil is reduced. Compaction effectively shifts the performance of a hydrologic group to a lower permeability hydrologic group. For example, a group B hydrologic soil can be compacted and be effectively converted to a group C hydrologic soil in the way it performs in regard to runoff. Compaction may also refer to the densification of a fill by mechanical means.

Term	Definition
Compost	Organic material that has undergone biological degradation and transformation under controlled conditions designed to promote aerobic decomposition at a solid waste facility in compliance with the requirements of Chapter 173-350 WAC, or biosolids composted in compliance with Chapter 173-308 WAC. Composting is a form of organic material recycling. Natural decay of organic solid waste under uncontrolled conditions does not result in composted material. (Note: Various BMPs have restrictions on the percentage of biosolids in compost, or do not allow biosolids in compost.)
Composted Material	Organic solid waste that has undergone biological degradation and transformation under controlled conditions designed to promote aerobic decomposition at a solid waste facility in compliance with the requirements of Chapter 173-350 WAC. Composting is a form of organic material recycling. Natural decay of organic solid waste under controlled conditions does not result in composted material.
Comprehensive Planning	Planning that takes into account all aspects of water, air, and land resources and their uses and limits.
Conservation District	A public organization created under state enabling law as a special-purpose district to develop and carry out a program of soil, water, and related resource conservation, use, and development within its boundaries, usually a subdivision of state government with a local governing body and always with limited authority. Often called a soil conservation district or a soil and water conservation district.
Constructed Wetland	A wetland intentionally created on non-wetland areas for the primary purpose of stormwater treatment and managed as such. Constructed wetlands are normally considered as part of the stormwater collection and treatment system and are subject to maintenance requirements. (These wetlands are not the same as wetlands created for mitigation purposes, which are viewed in the same manner as natural, regulated wetlands.)
Construction Stormwater Pollution Prevention Plan (SWPPP)	A document that describes the potential for pollution problems on a construction project, and explains and illustrates the measures to be taken on the construction site to control those problems.
Contour	An imaginary line on the surface of the Earth connecting points of the same elevation.
Control Structure	A manhole or similar structure with an orifice or weir to control ponding depth and discharge flow rate from a detention facility.
Converted Vegetation Areas	The surfaces on a project site where native vegetation, pasture, scrub/shrub, or unmaintained nonnative vegetation (e.g., Himalayan blackberry, Scotch broom) are converted to lawn or landscaped areas, or where native vegetation is converted to pasture.
Conveyance	A mechanism for transporting water from one point to another, including but not limited to: pipes, ditches, channels, culverts, gutters, manholes, weirs, artificial and natural channels, water quality filtration systems, drywells, etc.
Conveyance System	The drainage facilities, both natural and artificial, that collect, contain, and provide for the flow of surface and stormwater from the highest points on the land down to a receiving water. The natural elements of the conveyance system include swales and small drainage courses, streams, rivers, lakes, and wetlands. The human-made elements of the conveyance system include gutters, ditches, pipes, channels, and most retention/detention facilities.

Term	Definition
Cover	The depth of soil, rock, and paving materials over a utility pipe, vault or structure. The vertical distance between finished grade and the top of the pipe or structure.
Critical Areas	At a minimum, areas that include wetlands; areas with a critical recharging effect on aquifers used for potable water; fish and wildlife habitat conservation areas; frequently flooded areas; geologically hazardous areas, including unstable slopes; and associated areas and ecosystems.
Critical Tree Root Zone	The area surrounding a tree trunk where the roots of the tree should not be disturbed. The radius of the area is usually based on the trunk diameter at breast height and tree species.
CULD	Conditional Use Level Designation, a mid-level approval designation by Ecology for the assessment of new water quality treatment technologies. CULD allows use of a manufactured treatment system during its field testing period, subject to specific conditions.
Culvert	Pipe or concrete box structure that drains open channels, swales, or ditches under a roadway or embankment. Typically has no catch basins or manholes along its length.
Cut	Portion of land surface or area from which earth has been removed or will be removed by excavating; the depth below original ground surface to excavated surface.
Cut Slope	A slope formed by excavating overlying material to connect the original ground surface with a lower ground surface created by the excavation. A cut slope is distinguished from a bermed slope, which is constructed by importing soil to create the slope.
Cut and Fill	Process of earth moving by excavating part of an area and using the excavated material for adjacent embankments or fill areas.
Dead Storage	The volume available in a depression in the ground below any conveyance system, or surface drainage pathway, or outlet invert elevation that could allow the discharge of surface and stormwater runoff.
Dedication (of Land)	Setting aside land for a specific use or function. More specifically, the deliberate appropriation of land by an owner for any general and public uses, reserving to him- or herself no other rights than such as are compatible with the full exercise and enjoyment of the public uses to which the property has been devoted. The intention to dedicate land within a subdivision or short subdivision shall be evidenced by the owner by the presenting for filing a final plat or short plat showing the dedication thereon; and the acceptance by the public shall be evidenced by the approval of such plat for filing by the appropriate governmental unit. See RCW 58.17.020(3).
Degradation	The breakdown (biological or chemical) of complex organic or other chemical compounds into simpler substances, usually less harmful than the original compound, as with the degradation of a persistent pesticide. The (geological) wearing down by erosion. The lowering of the water quality of a watercourse by an increase in the pollutant loading.

Term	Definition
Degraded (Disturbed) Wetland (Community)	A wetland (community) in which the vegetation, soils, and/or hydrology have been adversely altered, resulting in lost or reduced functions and values. Generally, implies topographic isolation; hydrologic alterations such as hydroperiod alteration (increased or decreased quantity of water), diking, channelization, and/or outlet modification; soils alterations such as presence of fill, soil removal, and/or compaction; accumulation of toxicants in the biotic or abiotic components of the wetland; and/or low plant species richness with dominance by invasive weedy species.
Denitrification	The biochemical reduction of nitrates or nitrites in the soil or organic deposits to ammonia or free nitrogen.
Design Engineer	The professional civil engineer licensed in Washington State who prepares the analysis, design, and engineering plans for an applicant's permit or approval submittal.
Design Storm Frequency	The anticipated period in years that will elapse, based on average probability of storms in the design region, before a storm of a given intensity and/or total volume will recur; thus a 10-year recurrence interval storm can be expected to occur on the average once every 10 years. Conveyances designed to handle flows that occur under such storm conditions would be expected to be surcharged by any storms of greater amount or intensity.
Design Storm (Design Event)	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.)
Design Year Average Daily Traffic	The planned average daily traffic 5 years after the road is scheduled to be built.
Detention	The release of stormwater runoff from the site at a slower rate than it is collected by the stormwater facility system, the difference being held (detained) in temporary storage.
Detention Facility	An above or below ground facility, such as a pond or tank, that temporarily stores stormwater runoff and subsequently releases it at a slower rate than it is collected by the drainage facility system. There is little or no infiltration of stored stormwater.
Detention Pond	A detention facility in the form of an open pond.
Detention Time	The theoretical time required to displace the contents of a stormwater treatment facility at a given rate of discharge (volume divided by rate of discharge).
Developer	The person or legal entity who holds title to the property or has a sufficient interest in the project to propose the project. The developer of the project.
Development	New development, redevelopment, or both. See definitions for each.
Director	The Director of City of Lacey Public Works, or designee, as necessary to ensure compliance with the requirements of this manual (or its technical equivalent) unless explicitly referenced otherwise.

Term	Definition
Discharge	Runoff leaving a new development or redevelopment via overland flow, built conveyance systems, or infiltration facilities. A hydraulic rate of flow, specifically fluid flow; a volume of fluid passing a point, per unit of time, commonly expressed as cubic feet per second, cubic meters per second, gallons per minute, gallons per day, or millions of gallons per day.
Dispersion	The release of surface and stormwater runoff such that the flow spreads over a wide area and is located so as not to allow flow to concentrate anywhere upstream of a drainage channel with erodible, underlying, granular soils.
Disturbed Area	An area inside project boundaries altered from its natural state.
Disturbed Soils	An area inside the project boundaries where the soils have reduced infiltration, retention, and soil permeability, compared to what would be present in a forested or prairie state, due to previous development or land use.
Ditch	A long narrow excavation dug in the earth for drainage with its top width less than 10 feet at design flow.
Drain	A buried pipe or other conduit (closed drain). A ditch (open drain) for carrying off surplus surface water or groundwater.
(To) Drain	To provide channels, such as open ditches or closed drains, so that excess water can be removed by surface flow or by internal flow. To lose water (from the soil) by percolation.
Drainage	Refers to the collection, conveyance, containment, and/or discharge of surface and stormwater runoff.
Drainage Basin	A geographic and hydrologic subunit of a watershed.
Drainage Channel	A drainage pathway with a well-defined bed and banks indicating frequent conveyance of surface and stormwater runoff.
Drainage Course	A pathway for watershed drainage characterized by wet soil vegetation; often intermittent in flow.
Drainage Easement	A legal encumbrance that is placed against a property's title to reserve specified privileges for the users and beneficiaries of the drainage facilities contained within the boundaries of the easement.
Drainage Path	The route that surface and stormwater runoff follows downslope as it leaves any part of the site.
Drainage Review	An evaluation by City of Lacey staff of a proposed project's compliance with the drainage requirements in this manual (or its technical equivalent) and other applicable criteria.
Drainage System	Refers to the combination of BMPs, collection, conveyance, retention, detention, treatment, and outfall features or structures on a project.
Drawdown	Lowering of the water surface (in basins or open channel flow), water table, or piezometric surface (in groundwater flow) resulting from a withdrawal of water.
Driveway	A vehicle driving surface within a single lot or parcel that connects a building or structure with a road, shared access facility, alley, or vehicle driving surface within an ingress/egress easement (or tract). A driveway begins at the right-of-way line, private road easement (or tract) line, shared access easement (or tract) line, alley easement (or tract) line, or ingress/egress easement (or tract) line, and extends to the building or structure.

Term	Definition
Driveway Approach	A privately maintained vehicle driving surface that provides a transition between a road and a driveway, a road and a shared access facility, or a road and an alley.
Earth/Earth Material	Any rock, natural soil or fill and/or any combination thereof. Earth material shall not be considered topsoil used for landscape purposes. Topsoil used for landscaped purposes shall comply with ASTM D5268 specifications. See also Engineered Soil.
Earthwork	Means any operation involving the excavation, grading, filling, or moving of earth materials.
Easement	The legal right to use a described parcel of land for a particular purpose. It does not include fee ownership, but may restrict the owner's use of the land.
Ecology	Washington State Department of Ecology.
Effective Impervious Surface	Those impervious surfaces that are connected via sheet flow or discrete conveyance to a drainage system. See also Ineffective Impervious Surface.
Embankment	A structure of earth, gravel, or similar material raised to form a pond bank or foundation for a road, building pad, or similar fill for a particular use.
Emergency Spillway	A channel used to safely convey flood discharges in excess of the capacity of the principal outlet, or in the event of a failure of the outlet to function as designed, e.g., a blockage.
Emergent Plants/ Vegetation	Aquatic plants that are rooted in the sediment but whose leaves are at or above the water surface. These wetland plants often have high habitat value for wildlife and waterfowl, and can aid in pollutant uptake.
Emerging Technology	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.
Energy Dissipater	Any means by which the total energy of flowing water is reduced. In stormwater design, they are usually mechanisms that reduce velocity prior to, or at, discharge from an outfall in order to prevent erosion. They include rock splash pads, drop manholes, concrete stilling basins or baffles, and check dams.
Energy Gradient	The slope of the specific energy line (i.e., the sum of the potential and velocity heads).
Engineer	A professional engineer currently licensed in Washington State in civil engineering, retained by and acting on behalf of the applicant. The term "engineer" also means design engineer and project engineer.

Term	Definition
Engineered Soil	A self-sustaining soil and plant system that simultaneously supports plant growth, soil microbes, water infiltration, nutrient and pollutant adsorption, sediment and pollutant biofiltration, water interflow, and pollution decomposition. The system shall be protected from compaction and erosion, and shall be planted and/or mulched as part of the installation. The engineered soil/plant system shall have the following characteristics: a. Be protected from compaction and erosion. b. Have a plant system to support a sustained soil quality. c. Possess permeability characteristics of not less than 6.0, 2.0, and 0.6 inches/hour for hydrologic soil groups A, B, and C, respectively (per ASTM D3385). D is less than 0.6 inch/hour. d. Possess minimum percent organic matter of 12, 14, 16, and 18 percent (dry-weight basis) for hydrologic soil groups A, B, C, and D, respectively (per ASTM D2974).
Engineering Geologist	A geologist who, by reason of his or her knowledge of engineering geology, acquired by education and practical experience, is qualified to engage in the practice of engineering geology, has met the qualifications in engineering geology established under Chapter 18.220 RCW, and has been issued a license in engineering geology (L.E.G.) by the Washington State geologist licensing board.
Engineering Plan	A plan prepared and stamped by a professional civil engineer.
Environmental Impact Statement	A document that discusses the likely significant adverse impacts of a proposal, ways to lessen the impacts, and alternatives to the proposal. They are required by the national and state environmental policy acts when projects are determined to have significant environmental impact.
Environmentally Sensitive Area (Sensitive Area)	See LMC 16.54.
Erodible Soils	Soil materials that are easily eroded and transported by running water, typically fine or medium grained sand with minor gravel, silt, or clay content. Such soils are commonly described as Everett or Indianola series soil types in the NRCS classification. Also included are any soils showing examples of existing severe stream channel incision as indicated by unvegetated stream banks standing over 2 feet high above the base of the channel.
Erodible or Leachable Materials	Wastes, chemicals, or other substances that measurably alter the physical or chemical characteristics of runoff when exposed to rainfall. Examples include erodible soils that are stockpiled, uncovered process wastes, manure, fertilizers, oily substances, ashes, kiln dust, and garbage dumpster leakage.

Term	Definition
Erosion	The wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep. Also, detachment and movement of soil or rock fragments by water, wind, ice, or gravity. The following terms are used to describe different types of water erosion: • Accelerated erosion – Erosion much more rapid than normal or geologic erosion, primarily from the influence of the activities of man or, in some cases, of the animals or natural catastrophes that expose bare surfaces (e.g., fires). • Geological erosion – The normal or natural erosion caused by geological processes acting over long geologic periods and resulting in the wearing of mountains, the building up of floodplains, coastal plains, etc. Synonymous with natural erosion. • Gully erosion – The erosion process whereby water accumulates in narrow channels and, over short periods, removes the soil from this narrow area to considerable depths, ranging from 1 to 2 feet to as much as 75 to 100 feet. • Natural erosion – Wearing away of the Earth's surface by water, ice, or other natural agents under natural environmental conditions of climate, vegetation, etc., undisturbed by man. Synonymous with geological erosion. • Normal erosion – The gradual erosion of land used by man that does not greatly exceed natural erosion. • Rill erosion – An erosion process in which numerous small channels only several inches deep are formed; occurs mainly on recently disturbed and exposed soils. See Rill. • Sheet erosion – The removal of a fairly uniform layer of soil from the land surface by runoff. • Splash erosion – The spattering of small soil particles caused by the impact of raindrops on wet soils. The loosened and spattered particles may or may not be subsequently removed by surface runoff.
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.
Erosive	To permit or cause erosion; tending to erode.
Eutrophication	Refers to the process where nutrient over-enrichment of water leads to excessive growth of aquatic plants, especially algae.
Evapotranspiration	The collective term for the processes of evaporation and plant transpiration by which water is returned to the atmosphere.
Excavation	The mechanical removal of earth material.
Exception	Relief from the application of a core requirement to a project.
Exfiltration	The downward movement of runoff through the bottom of an infiltration BMP into the soil layer or the downward movement of water through soil.

Term	Definition
Existing Site Conditions	Existing site conditions may be described as follows: • For previously developed sites with stormwater facilities that have been constructed to meet the standards of this manual, this shall mean the current conditions on the site. • For previously developed sites that do not have stormwater facilities that meet the standards of this manual, existing site conditions shall be considered under redevelopment regulations • For undeveloped sites, this shall mean the condition of the site prior to the influence of Euro-American settlement. The predeveloped condition shall be assumed to be forested land cover unless reasonable, historical information is provided that indicates the site was prairie prior to settlement. • Exception: If the site is located in a critical and/or sensitive area that affects drainage as defined by city ordinances, the Director may require that a more restrictive definition of existing site conditions be utilized for calculating runoff characteristics.
Fertilizer	Any material or mixture used to supply one or more of the essential plant nutrient elements.
Fill	“Fill or fill material” means the deposit of organic or inorganic material by human or mechanical means.
Filter Fabric	A woven or non-woven, water-permeable material generally made of synthetic products, such as polypropylene, and used in stormwater management and erosion and sedimentation control applications to trap sediment or prevent the clogging of aggregates by fine soil particles.
Filter Strip	A grassy area with gentle slopes that treats stormwater runoff from adjacent paved areas before it concentrates into a discrete channel.
Flocculation	The process by which suspended colloidal or very fine particles are assembled into larger masses or floccules that eventually settle out of suspension. This process occurs naturally but can also be caused by such chemicals as alum.
Flood	“Flood” or “flooding” means a general and temporary condition of partial or complete inundation of normally dry land areas from: 1) the overflow of inland or tidal waters, and/or 2) the unusual and rapid accumulation of runoff of surface waters from any source.
Flood Control	Methods or facilities for reducing flood risks and the extent of flooding.
Flood Hazard Areas	Those areas subject to inundation by the base flood. Includes, but is not limited to streams, lakes, wetlands, and closed depressions. Also referred to as special flood hazard areas.
Flood Protection Facility	Any levee, berm, wall, enclosure, raise bank, revetment, constructed bank stabilization, or armoring, that is commonly recognized by the community as providing significant protection to a property from inundation by flood waters.
Flood Stage	The stage at which overflow of the natural banks of a stream begins.
Floodplain	The total area subject to inundation by a flood including the flood fringe and floodway.

Term	Definition
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.
Flow Duration	The aggregate time that peak flows are at or above a particular flow rate of interest. For example, the amount of time that peak flows are at or above 50 percent of the 2-year recurrence interval peak flow rate for a period of record.
Flow Frequency	The inverse of the probability that the flow will be equaled or exceeded in any given year (the exceedance probability). For example, if the exceedance probability is 0.01 or 1 in 100, that flow is referred to as the 100-year recurrence interval flow.
Flow Path	The route that surface water follows between two points of interest.
Forebay	An easily maintained, extra storage area provided near an inlet of a BMP to trap incoming sediments before they accumulate in a pond or wetland BMP.
Forest Practice	Any activity conducted on or directly pertaining to forest land and relating to growing, harvesting, or processing timber, including but not limited to: road and trail construction, harvesting, final and intermediate, precommercial thinning, reforestation, fertilization, prevention and suppression of diseases and insects, salvage of trees, brush control.
Freeboard	The vertical distance between the highest designed water surface elevation and the elevation of the crest of the facility. For example, in pond design, freeboard is the vertical distance between the emergency overflow water surface and the crest of the facility.
Functions (Wetland)	The ecological (physical, chemical, and biological) processes or attributes of a wetland. Functions are often defined in terms of the processes that provide value to society, but they can be defined on processes that are not value based. Wetland functions include food chain support, provision of ecosystem diversity and fish and wildlife habitat, flood flow alteration, groundwater recharge and discharge, water quality improvement, and soil stabilization.
Gabion	A rectangular or cylindrical wire mesh cage filled with rock and used as a protecting agent, revetment, etc., against erosion. Soft gabions, often used in stream bank stabilization, are made of geotextiles filled with dirt, in between which cuttings are placed.
Gauge	A measure of the thickness of metal. Also, a measuring device for registering precipitation, water level, discharge, velocity, pressure, temperature, etc.
Geologist	A person who has earned a degree in geology from an accredited college or university or who has equivalent educational training and has at least 5 years of experience as a practicing geologist or 4 years of experience and at least 2 years of post-graduate study, research, or teaching. The practical experience shall include at least 3 years of work in applied geology and landslide evaluation, in close association with qualified practicing geologists or geotechnical professional/civil engineers. Per RCW 18.220.010, a “geologist” is a person who, by reason of his or her knowledge of geology, mathematics, the environment, and the supporting physical and life sciences, acquired by education and practical experience, has met the qualifications established under Chapter 18.220 RCW, and has been issued a certificate of licensing as a geologist (L.G.) by the Washington State geologist licensing board.

Term	Definition
Geology	The science of the Earth's physical properties, composition, history, and processes by which it evolves. The science of geology includes: the origin and history of the Earth; the investigation of the Earth's constituent rocks, minerals, solids, and fluids, including surface and underground waters, gases, and other materials; and the study of the natural agents, forces and processes that cause changes in the Earth.
Geometrics	The mathematical relationships between points, lines, angles, and surfaces used to measure and identify areas of land.
Geotechnical Professional	A person with experience and training in analyzing, evaluating, and mitigating any of the following: landslide, erosion, seismic, and/or mine hazards, or fluvial geomorphology and river dynamics. A geotechnical professional shall be licensed in Washington State as an engineering geologist or professional engineer. Per WAC 308-15-140 and 196-27-020, engineering geologists and professional engineers shall affix their signatures or seals only to plans or documents dealing with subject matter in which they are qualified by training or experience.
Geotechnical Engineer	A civil engineer who has specialized in the design and construction aspects of earth materials. A practicing geotechnical/civil engineer licensed as a professional civil engineer with Washington State who has at least 4 years of professional employment as a geotechnical engineer in responsible charge, including experience with landslide evaluation.
Glacial Till	A glacial deposit consisting of a poorly-sorted, unstratified mixture of clay, silt, sand, gravel, and cobbles that has been deposited under glacial ice. As "basal till," compressed under glacial weight, and commonly found in the Lacey area as a shallow subsurface layer having an extremely low permeability. See also Hardpan.
Grade	The slope of a road, channel, or natural ground. The finished surface of a canal bed, roadbed, top of embankment, or bottom of excavation; any surface prepared for the support of construction such as paving or the laying of a conduit.
(To) Grade	To finish the surface of a ditch, roadbed, top of embankment or bottom of excavation.
Gradient Terrace	An earth embankment or a ridge-and-channel constructed with suitable spacing and an acceptable grade to reduce erosion damage by intercepting surface runoff and conducting it to a stable outlet at a stable nonerosive velocity.
Grading	Any excavating, filling, clearing, or creating of hard surfaces or combination thereof.
Grassed Waterway	A natural or constructed waterway, usually broad and shallow, covered with erosion-resistant grasses, used to conduct surface water from an area at a reduced flow rate. See also Biofilter.
Groundwater	Water in a saturated zone or stratum beneath the land surface or a surface water body.
Groundwater Recharge	Inflow to a groundwater reservoir.

Term	Definition
Groundwater Table	The free surface of the groundwater, that surface subject to atmospheric pressure under the ground, generally rising and falling with the season, the rate of withdrawal, the rate of restoration, and other conditions. It is seldom static.
Grubbing	Means the removal and disposing of all unwanted vegetative matter from underground, such as sod, stumps, roots, buried logs, or other debris.
GULD	General Use Level Designation, the highest-level approval designation by Ecology for the assessment of new water quality treatment technologies. GULD allows use of a manufactured treatment system under specific conditions of approval.
Gully	A channel caused by the concentrated flow of surface and stormwater runoff over unprotected, erodible land.
Habitat	The specific area or environment in which a particular type of plant or animal lives. An organism's habitat must provide all of the basic requirements for life and should be protected from harmful biological, chemical, and physical alterations.
Hard Surface	An impervious surface, a permeable pavement, or a vegetated roof.
Hardpan	A layer of soil that has become relatively hard and impermeable, and impenetrable by roots, usually through the decomposition of minerals. Sometimes used in casual reference to glacial till.
Head (Hydraulics)	The height of water above any plane of reference. The energy, either kinetic or potential, possessed by each unit weight of a liquid, expressed as the vertical height through which a unit weight would have to fall to release the average energy possessed. Used in various compound terms such as pressure head, velocity head, and head loss.
Head Loss	Energy loss due to friction, eddies, changes in velocity, or direction of flow.
Heavy Metals	Metals of high specific gravity, present in municipal and industrial wastes that pose long-term environmental hazards. Examples include cadmium, chromium, cobalt, copper, lead, mercury, nickel, and zinc.
High-Use Site	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: • An area of a commercial or industrial site subject to an expected average daily traffic count equal to or greater than 100 vehicles per 1,000 square feet of gross building area; • 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; • 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.); • A road intersection with a measured 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.
Highway	A main public road connecting towns and cities.
Hog Fuel	See Wood-Based Mulch.

Term	Definition
Hydraulic Conductivity	The quality of saturated soil that enables water or air to move through it; a permeability coefficient, related to the fluid density and viscosity, describing the rate at which water can move through a permeable medium. The coefficient, K, has units of length/time, or velocity.
Hydraulic Gradient	Slope of the potential head relative to a fixed datum. The change in total head per change in distance, in the direction of decreasing head. Also referred to as the hydraulic grade line.
Hydrogeology	The study of the interrelationships of geologic materials and processes with water, especially groundwater. Hydrogeology is a science that involves the study of the waters of the Earth, including the occurrence, circulation, distribution, chemistry, and quality of water, and its role as a natural agent that causes changes in the Earth, and the collection of data concerning waters and their interaction with other materials in the atmosphere, on the Earth's surface, or in the interior of the Earth.
Hydrograph	A graph of runoff rate, inflow rate or discharge rate, past a specific point over time.
Hydrologic Cycle	The circuit of water movement from the atmosphere to the Earth and return to the atmosphere through various stages or processes as precipitation, interception, runoff, infiltration, percolation, storage, evaporation, and transpiration.
Hydrologic Soil Groups	A soil characteristic classification system defined by the NRCS in which a soil may be categorized into one of four soil groups (A, B, C, or D) based upon infiltration rate and other properties. • Type A: Low runoff potential. Soils having high infiltration rates, even when thoroughly wetted, and consisting chiefly of deep, well drained to excessively drained sands or gravels. These soils have a high rate of water transmission • Type B: Moderately low runoff potential. Soils having moderate infiltration rates when thoroughly wetted, and consisting chiefly of moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission. • Type C: Moderately high runoff potential. Soils having slow infiltration rates when thoroughly wetted, and consisting chiefly of soils with a layer that impedes downward movement of water, or soils with moderately fine to fine textures. These soils have a slow rate of water transmission. • Type D: High runoff potential. Soils having very slow infiltration rates when thoroughly wetted, and consisting chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a hardpan, till, or clay layer at or near the surface, soils with a compacted subgrade at or near the surface, and shallow soils or nearly impervious material. These soils have a very slow rate of water transmission (Novotny and Olem 1994).
Hydrological Simulation Program—Fortran (HSPF)	A continuous simulation hydrologic model that transforms an uninterrupted rainfall record into a concurrent series of runoff or flow data by means of a set of mathematical algorithms that represent the rainfall-runoff process at some conceptual level.
Hydrology	The science of the behavior of water in the atmosphere, on the surface of the earth, and underground.

Term	Definition
Hydroperiod	A seasonal occurrence of flooding and/or soil saturation, generally used in reference to wetlands; it encompasses depth, frequency, duration, and seasonal pattern of inundation.
Hyetograph	A graph of rainfall intensity (often in inches per hour) over time at a single point.
Illicit Connection	Any infrastructure connection to the MS4 that is not intended, permitted, or used for collecting and conveying stormwater or non-stormwater discharges allowed as specified in the city's NPDES Municipal Stormwater Permit.
Illicit Discharge	All non-stormwater discharges to stormwater drainage systems that cause or contribute to a violation of state water quality, sediment quality or groundwater quality standards, including but not limited to sanitary sewer connections, industrial process water, interior floor drains, car washing, and greywater systems.
Impermeable Liner (or Low-Permeability Liner)	A layer of compacted till or clay, or a synthetic geomembrane, intended to restrict infiltration.
Impervious	A surface that cannot be easily penetrated. For instance, rain does not readily penetrate paved surfaces.
Impervious Surface	A non-vegetated surface area that either prevents or retards the entry of water into the soil mantle as under natural conditions prior to development. A non-vegetated surface area that causes water to run off the surface in greater quantities or at an increased rate of flow from the flow present under natural conditions prior to development. Common impervious surfaces include, but are not limited to, rooftops, walkways, patios, driveways, parking lots or storage areas, concrete or asphalt paving, gravel roads, packed earthen materials, and oiled, macadam or other surfaces that similarly impede the natural infiltration of stormwater. Open, uncovered retention/detention facilities shall not be considered as impervious surfaces for the purposes of determining whether the thresholds for application of core requirements are exceeded. Open, uncovered retention/detention facilities shall be considered impervious surfaces for purposes of runoff modeling.
Impoundment	A natural or artificial containment for surface water.
Improvement	Streets (with or without curbs or gutters), sidewalks, crosswalks, parking lots, water mains, sanitary and storm sewers, drainage facilities, street trees, and other appropriate items.
Industrial Activities	Material handling, transportation, or storage; manufacturing; maintenance; treatment; or disposal. Areas with industrial activities include plant yards, access roads and rail lines used by carriers of raw materials, manufactured products, waste material, or by-products; material handling sites; refuse sites; sites used for the application or disposal of process wastewaters; sites used for the storage and maintenance of material handling equipment; sites used for residual treatment, storage, or disposal; shipping and receiving areas; manufacturing buildings; storage areas for raw materials, and intermediate and finished products; and areas where industrial activity has taken place in the past and significant materials remain and are exposed to stormwater.

Term	Definition
Ineffective Impervious Surfaces	Impervious surfaces are considered ineffective if: 1. The runoff is dispersed through at least 100 feet of native vegetation in accordance with Full Dispersion as described in Chapter 7, Section 7.4.2; 2. Residential roof runoff is infiltrated in accordance with Downspout Infiltration Systems Chapter 7, Section 7.4.10; or 3. Approved continuous runoff modeling methods indicate that the entire runoff file is infiltrated.
Infiltration	The downward movement of water from the land surface into and through the upper soil layers to the subsoil.
Infiltration Facility (or System)	A drainage facility designed to use the hydrologic process of surface and stormwater runoff soaking into the ground, commonly referred to as a percolation, to dispose of surface and stormwater runoff.
Infiltration Rate	The rate, usually expressed in inches/hour, at which water moves downward (percolates) through the soil profile. Short-term infiltration rates may be inferred from soil analysis or texture or derived from field measurements. Long-term infiltration rates are affected by variability in soils and subsurface conditions at the site, the effectiveness of pretreatment or influent control, and the degree of long-term maintenance of the infiltration facility.
Ingress/Egress	The points of access to and from a property.
Inlet	A form of connection between surface of the ground and a drain or MS4 for the admission of surface and stormwater runoff.
Insecticide	A substance, usually chemical, that is used to kill insects.
Interception (Hydraulics)	The process by which precipitation is caught and held by foliage, twigs, and branches of trees, shrubs, and other vegetation. Often used for “interception loss” or the amount of water evaporated from the precipitation intercepted.
Interflow	That portion of rainfall that infiltrates into the soil and moves laterally through the upper soil horizons until intercepted by a stream channel or until it returns to the surface, for example, in a roadside ditch, wetland, spring, or seep. Interflow is a function of the soil system depth, permeability, and water-holding capacity.
Intermittent Stream	A stream where portions flow continuously only at certain times of the year, for example, when it receives water from a spring, groundwater source, or surface source, such as melting snow (i.e., seasonal). At low flow there may be dry segments alternating with flowing segments.
International Building Code (IBC)	The most recent version of the International Building Code adopted by the City of Lacey.
Invasive Species	Opportunistic plant species (either native or nonnative) that colonize disturbed ecosystems and come to dominate the plant community in ways that are commonly viewed as reducing the values provided by the previous plant community. Most often, opportunistic plants are considered invasive if they reduce the value of an area as habitat for valuable species.
Invert	The lowest point on the inside of a pipe or other conduit.
Invert Elevation	The vertical elevation of a pipe or orifice in a pond that defines the water level.
Isopluvial Map	A map with lines representing constant depth of total precipitation for a given return frequency and duration.

Term	Definition
Junction	Point where two or more drainage pipes or channels converge (e.g., manhole).
Lake	An area permanently inundated by water in excess of 2 meters deep and greater than 20 acres in size as measured at the ordinary high water marks.
Land-Disturbing Activity	Any activity that results in a change in the existing soil cover (both vegetative and nonvegetative) and/or the existing soil topography. Land-disturbing activities include, but are not limited to, clearing, grading, filling, and excavation. Compaction that is associated with stabilization of structures and road construction shall also be considered a land-disturbing activity. Vegetation maintenance practices, including landscape maintenance and gardening, are not considered land-disturbing activity. Stormwater facility maintenance is not considered land-disturbing activity if conducted according to established standards and procedures.
Landscaping	The improvement or installation on a parcel or portion thereof of objects or vegetation for decorative or ornamental effect. Examples include trees, bushes, shrubs, flowers, grass, weeds, ornamental rocks or figures, low-lying ground cover, sprinkler systems, sidewalks, and lighting fixtures.
Landslide	Episodic downslope movement of a mass of soil or rock that includes but is not limited to rockfalls, slumps, mudflows, and earthflows. For the purpose of this manual, snow avalanches are considered to be a special case of landsliding.
Landslide Hazard Areas	Those areas subject to a severe risk of landslide.
Leachable Materials	Those substances that, when exposed to rainfall, measurably alter the physical or chemical characteristics of the rainfall runoff. Examples include erodible soils, uncovered process wastes, manure, fertilizers, oil substances, ashes, kiln dust, and garbage dumpster leakage.
Leaching	Water or other liquid that has been contaminated by dissolved or suspended materials due to contact with solid waste or gases.
Legume	A member of the legume or pulse family, *Leguminosae*, one of the most important and widely distributed plant families. Practically all legumes are nitrogen-fixing plants.
Level Pool Routing	The basic technique of storage routing used for sizing and analyzing detention storage and determining water levels for ponding water bodies. The level pool routing technique is based on the continuity equation: Inflow - Outflow = Change in storage.
Level Spreader	A device used to spread out stormwater runoff uniformly over the ground surface as sheet flow (i.e., not through channels). The purpose of level spreaders is to prevent concentrated, erosive flows from occurring, and to enhance infiltration.
Live Storage	The amount of storage in a stormwater facility that is intended to completely drain after a storm event.
Local Government	Any county, city, town, or special purpose district having its own incorporated government for local affairs, such as the City of Lacey.
Lot	A designated parcel, tract, or area of land established by plat, subdivision, or as otherwise permitted by law, to be used, developed, or built upon as a unit.

Term	Definition
Low Impact Development (LID)	A stormwater and land use management strategy that strives to mimic predisturbance hydrologic processes of infiltration, filtration, storage, evaporation and transpiration by emphasizing conservation, use of on-site natural features, and site planning to minimize impervious surfaces, native vegetation loss, and stormwater runoff. Distributed stormwater management practices are integrated into LID project design.
Low Impact Development Best Management Practices (LID BMPs)	Distributed stormwater management practices, integrated into a project design, that emphasize predisturbance 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, minimal excavation foundations, vegetated roofs, and water re-use.
Maintenance	Activities conducted on currently serviceable structures, facilities, and equipment that involves no expansion or use beyond that previously existing and resulting in no significant adverse hydrologic impact. Maintenance includes those usual activities taken to prevent a decline, lapse, or cessation in the use of structures and systems. Those usual activities may include replacement of dysfunctional facilities, including cases where environmental permits require replacing an existing structure with a different type structure, as long as the functioning characteristics of the original structure are not changed. One example is the replacement of a collapsed, fish blocking, round culvert with a new box culvert under the same span, or width, of roadway. In regard to stormwater facilities, maintenance includes assessment to ensure ongoing proper operation, removal of built-up pollutants (i.e., sediments), replacement of failed or failing treatment media, and other actions taken to correct defects as identified in the maintenance checklists of Appendix 3B.
Manning's Equation	An equation used to predict the velocity of water flow in an open channel or pipelines: $V = \frac{1.486R^{2/3}S^{1/2}}{N}$ where: V is the mean velocity of flow in feet per second R is the hydraulic radius in feet S is the slope of the energy gradient or, for assumed uniform flow, the slope of the channel in feet per foot; and N is Manning's roughness coefficient or retardance factor of the channel lining.
Manual, The	The City of Lacey Stormwater Design Manual including all amendments, corrections, and changes made through subsequent city ordinance.
Material	Any solid or semi-solid substance that displaces volume.
Maximum Extent Practicable	Refers to a paragraph of the federal Clean Water Act, which reads (in part): "Permits for discharges from municipal storm sewers shall require controls to reduce the discharge of pollutants to the maximum extent practicable, including management practices, control techniques, and system, design and engineering methods … for the control of such pollutants."

Term	Definition
Metals	Elements, such as mercury, lead, nickel, zinc and cadmium, which are of environmental concern because they can be toxic to life in high enough concentrations and do not degrade over time. Although many are necessary nutrients, they are sometimes magnified in the food chain. Some are also referred to as heavy metals.
Microbes	The lower trophic levels of the soil food web. They are normally considered to include bacteria, fungi, flagellates, amoebae, ciliates, and nematodes. These in turn support the higher trophic levels, such as mites and earthworms. Together they are the basic life forms that are necessary for plant growth. Soil microbes also function to bioremediate pollutants such as petroleum, nutrients, and pathogens.
Mitigation	Means, in the following order of preference: a. Avoiding the impact altogether by not taking a certain action or part of an action; b. Minimizing impacts by limiting the degree or magnitude of the action and its implementation, by using appropriate technology, or by taking affirmative steps to avoid or reduce impacts; c. Rectifying the impact by repairing, rehabilitating or restoring the affected environment; d. Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and e. Compensating for the impact by replacing, enhancing, or providing substitute resources or environments.
Modification, Modified (Wetland)	A wetland whose physical, hydrological, or water quality characteristics have been purposefully altered for a management purpose, such as by dredging, filling, forebay construction, and inlet or outlet control.
Monitor	To systematically and repeatedly measure something in order to track changes.
Monitoring	The collection of data by various methods for the purposes of understanding natural systems and features, evaluating the impacts of development proposals on such systems, and assessing the performance of mitigation measures imposed as conditions of development.
MS4	Municipal separate storm sewer system. A system of conveyances (including streets, curbs, gutters, catch basins, pipes and ditches) owned or operated by a city or other public entity, that is used for collecting or conveying stormwater (excluding combined sewers).
Mulch	A layer of organic material or aggregate applied to the surface of soil. Its purpose is any or all of the following: • To conserve soil moisture or temperature • To improve the fertility and health of the soil • To reduce weed growth • To hold fertilizer, seed, and soil in place • To enhance the visual appeal of the area. Types of mulches used in this manual include: Chipped site vegetation, compost, hydromulch, wood-based or wood straw, wood strand, straw, and aggregate.

Term	Definition
National Pollutant Discharge Elimination System (NPDES)	The part of the Clean Water Act that requires point source dischargers to obtain permits. These permits are referred to as NPDES permits and, in Washington, are administered by Ecology.
Native Growth Protection Easement	An easement granted for the protection of native vegetation within a sensitive area or its associated buffer. The native growth protection easement shall be recorded on the appropriate documents of title and filed with the Thurston County Records Division.
Native Vegetation	Vegetation comprising plant species, other than noxious weeds, that are indigenous to the coastal region of the Pacific Northwest and that reasonably could have been expected to naturally occur on the site. Examples include trees such as Douglas-fir, western hemlock, western red cedar, alder, big-leaf maple, and vine maple; shrubs such as willow, elderberry, salmonberry and salal; and herbaceous plants such as sword fern, foam flower, and fireweed.
Natural Channel	Stream, creek, river, lake, wetland, estuary, gully, swale, ravine, or any open conduit where water will concentrate and flow intermittently or continuously. Only includes artificial channels designed to mimic natural systems.
Natural Hydrologic Function	Refers to the processing of precipitation over and through the landscape in a forest or prairie condition. Includes evapotranspiration by on-site vegetation, storage of rainfall in the soil structure or on the soil surface within depressions in the topography, and the release of stormwater through either infiltration, interflow, or surface flow off the site.
Natural Location	The location of those channels, swales, and other non-artificial conveyance systems as defined by the first documented topographic contours existing for the subject property, from either maps or photographs, or such other means as appropriate. In the case of outwash soils with relatively flat terrain, no natural location of surface discharge may exist.
Natural Resources Conservation Service (NRCS)	Formerly the Soil Conservation Service (SCS), NRCS is an agency of the United States Department of Agriculture (USDA) that provides technical and financial assistance to farmers and other private landowners and managers.
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 Hard Surface	Hard surface created on or added to a site or structural development including construction, installation, or expansion of a building or other structure. Includes the addition of a hard or compacted surface like roofs, pavement, gravel, or dirt; or resurfacing by upgrading from dirt to gravel, asphalt, or concrete; upgrading from gravel to asphalt, or concrete; or upgrading from a bituminous surface treatment (“chip seal”) to asphalt or concrete. New hard surface may also include existing hard surface that is removed and replaced. To be considered new, the removal and replacement activity must result in significant changes in hard 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 thereof by or for the benefit of the applicant.

Term	Definition
Nitrate	A form of nitrogen that is an essential nutrient to plants. It can cause algal blooms in water if all other nutrients are present in sufficient quantities. It is a product of bacterial oxidation of other forms of nitrogen, from the atmosphere during electrical storms and from fertilizer manufacturing.
Nitrogen, Available	Usually ammonium, nitrite, and nitrate ions, and certain simple amines available for plant growth. A small fraction of organic or total nitrogen in the soil is available at any time.
Nonpoint Source Pollution	Pollution that enters a water body from diffuse origins on the watershed and does not result from discernible, confined, or discrete conveyances.
Normal Depth	The depth of uniform flow. This is a unique depth of flow for any combination of channel characteristics and flow conditions. Normal depth is calculated using Manning's Equation.
Notice of Intent	The application for coverage under a general stormwater permit in Washington State.
NPDES	The National Pollutant Discharge Elimination System as established by the Clean Water Act.
NRCS Method	A single-event hydrologic analysis technique for estimating runoff based on the Curve Number method. The Curve Numbers are published by NRCS in Technical Release No. 55: Urban Hydrology for Small Watersheds, 1986. May be referred to as the NRCS Method.
Nutrients	Essential chemicals needed by plants or animals for growth. Excessive amounts of nutrients can lead to degradation of water quality and algal blooms. Some nutrients can be toxic at high concentrations.
NWTPH-Dx and NWTPH-Gx	Northwest Total Petroleum Hydrocarbon Analytical Methods used for compliance with the MTCA. NWTPH-Dx is a qualitative and quantitative method (extended) for semi-volatile (Diesel-range organics and heavy oils) petroleum products in water. NWTPH-Gx is a qualitative and quantitative method (extended) for volatile (gasoline-range organics) in water. See Ecology publication number ECY 97-602.
Off-Line Facilities	Water quality treatment facilities to which stormwater runoff is restricted to some maximum flow rate or volume by a flow-splitter.
Off Site (adverb)	Any area lying upstream of the (project) site that drains onto the site and any area lying downstream of the site to which the site drains. (Note: when used as an adjective, off site is hyphenated. For example: off-site storage.)
Oil/Water Separator	A vault, usually underground, designed to provide a quiescent environment to separate oil from water.
On-Line Facilities	Water quality treatment facilities that receive all of the stormwater runoff from a drainage area. Flows above the water quality design flow rate or volume are passed through at a lower percent removal efficiency.
On Site (adverb)	The entire property that includes the proposed development. (Note: when used as an adjective, on site is hyphenated. For example: on-site vegetation.)
On-Site Stormwater Management BMPs	As used in this manual, a synonym for LID BMPs.

Term	Definition
Operational BMPs	Operational BMPs are a type of Source Control BMP. They are schedules of activities, prohibition of practices, and other managerial practices to prevent or reduce pollutants from entering stormwater. Operational BMPs include formation of a pollution prevention team, good housekeeping, preventive maintenance procedures, spill prevention and cleanup, employee training, inspections of pollutant sources and BMPs, and record keeping. They can also include process changes, raw material/product changes, and recycling wastes.
Ordinary High Water Mark	The line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank; shelving; changes in the character of soil destruction on terrestrial vegetation, or the presence of litter and debris; or other appropriate means that consider the characteristics of the surrounding area. The mark on all lakes, streams, and tidal water that will be found by examining the bed and banks and ascertaining where the presence and action of waters are so common and usual, and so long continued in all ordinary years, as to mark upon the soil a character distinct from that of the abutting upland, in respect to vegetation. In any area where the ordinary high water mark cannot be found, the ordinary high water mark adjoining fresh water shall be the line of mean high water.
Organic Matter	Organic matter is decomposed animal or vegetable matter. It is measured by ASTM D2974. Organic matter is an important reservoir of carbon and a dynamic component of soil and the carbon cycle. It improves soil and plant efficiency by improving soil physical properties including drainage, aeration, and other structural characteristics. It contains the nutrients, microbes, and higher-form soil food web organisms necessary for plant growth. The maturity of organic matter is a measure of its beneficial properties. Raw organic matter can release water-soluble nutrients (similar to chemical fertilizer). Beneficial organic matter has undergone a humification process either naturally in the environment or through a composting process.
Orifice	An opening with closed perimeter, usually sharp-edged, and of regular form in a plate, wall, or partition through which water may flow, generally used for the purpose of measurement or control of water.
Outlet	Point of water disposal from a stream, river, lake, tidewater, or artificial drain.
Outlet Channel	A waterway constructed or altered primarily to carry water from artificial structures, such as terraces, tile lines, and diversions.
Outwash Soils	Soils formed from highly permeable sands and gravels deposited by glacial meltwater.
Overflow	A pipeline or conduit device, together with an outlet pipe, that provides for the discharge of portions of combined sewer flows into receiving waters or other points of disposal, after a regular device has allowed the portion of the flow that can be handled by interceptor sewer lines and pumping and treatment facilities to be carried by and to such water pollution control structures.
Overtopping	Flowing over the limits of a containment or conveyance element.
Parcel	Any portion, piece, or division of land. Fractional part or subdivision of block, according to plat or survey; portion of platted territory measured and set apart for individual and private use and occupancy.
Particle Size	The effective diameter of a particle as measured by sedimentation, sieving, or micrometric methods.

Term	Definition
Paved Road	A road that has been treated or covered with asphalt to create an oil mat surface; a road that has a bituminous surface treatment, asphalt, or cement concrete surface.
Peak Discharge	The maximum instantaneous rate of flow during a storm, usually in reference to a specific design storm event.
Percolation	The movement of water through soil.
Percolation Rate	The rate, often expressed in inches/hour, at which clear water, maintained at a relatively constant depth, will seep out of a standardized test hole that has been previously saturated. The term percolation rate is often used synonymously with infiltration rate (short-term infiltration rate).
Permanent Stabilization	Permanent site stabilization is the covering of exposed surfaces through paving, gravels, landscaping materials, sodding, seeding, etc., but shall not mean the temporary use of erosion/sediment control materials unless used in conjunction with the above measures to aid in seed or landscaping vegetation establishment.
Permanent Stormwater Control Plan	A plan that includes permanent BMPs for the control of pollution from stormwater runoff after construction and/or land-disturbing activity has been completed.
Permeable Pavement	Pervious concrete, porous asphalt, permeable pavers or other forms of pervious or porous paving material intended to allow passage of water through the pavement section. It often includes an aggregate base that provides structural support and acts as a stormwater reservoir.
Permeable Soils	Soil materials with a sufficiently rapid infiltration rate to greatly reduce or eliminate surface and stormwater runoff. These soils are generally classified as NRCS hydrologic soil types A and B.
Person	Any individual, partnership, corporation, association, organization, cooperative, public or municipal corporation, agency of the state, or local government unit, however designated.
Pervious Surface	A surface material that allows stormwater to infiltrate into the ground. Examples include lawn, landscape, pasture, native vegetation areas, and permeable pavements.
Pesticide	A general term used to describe any substance—usually chemical—used to destroy or control organisms; includes herbicides, insecticides, rodenticides, algicides, fungicides, and others. Many of these substances are manufactured and are not naturally found in the environment. Others, such as pyrethrum, are natural toxins that are extracted from plants and animals.
pH	A measure of the alkalinity or acidity of a substance that is based on measuring the concentration of hydrogen ions in the substance. A pH of 7.0 indicates neutral water. A 6.5 reading is slightly acid.
Planned Unit Development (PUD)	A special classification authorized in some zoning ordinances, in which a unit of land under control of a single developer may be used for a variety of uses and densities, subject to review and approval by the local governing body. The locations of the zones are usually decided on a case-by-case basis.
Plat	A map or representation of a subdivision, short subdivision, large lot or binding site plan, showing thereon the division of a tract or parcel of land into lots, blocks, streets and alleys, or other divisions and dedications.

Term	Definition
Point Discharge	The release of collected and/or concentrated surface and stormwater runoff from a pipe, culvert, or channel.
Point of Compliance	The location at which compliance with a discharge performance standard or a receiving water quality standard is measured.
Polishing	Additional treatment of a waste stream that has already received one or more stages of treatment by other means. This is also called advance treatment. The conditions present across a landscape after a specific stormwater management project (e.g., raising the outlet, building, and outlet control structure) are placed in the wetland or a land use change that occurs in the landscape unit that will potentially affect the wetland.
Pollution	Contamination or other alteration of the physical, chemical, or biological properties, of 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, or 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 that receive direct rainfall or run-on or blow-in of rainfall and are subject to: vehicular use; industrial activities (as further defined in this glossary); or storage of erodible or leachable materials, wastes, or chemicals. In addition, 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 are considered PGIS. 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, restricted access fire lanes, and infrequently used maintenance access roads.
Pollution-Generating Pervious Surface (PGPS)	Any non-impervious surface that receives direct rainfall or run-on or blow-in of rainfall and is subject to: vehicular use; industrial activities (as further defined in this glossary); storage of erodible or leachable materials, wastes, or chemicals; 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).
Postproject	For use with Appendix I-D of the 2014 Ecology Manual. The conditions present across a landscape after a specific stormwater management project (e.g., raising the outlet, building an outlet control structure) is completed that will potentially affect wetlands.

Term	Definition
Postdevelopment Condition	The condition of site after the project has been constructed.
Pothole	A closed basin. See also Closed Depression.
Preproject	For use with Appendix I-D of the 2014 Ecology Manual. The conditions present across a landscape before a specific project is constructed.
Predeveloped Condition	The native vegetation and soils that existed at a site prior to the influence of Euro-American settlement. The predeveloped condition shall be assumed to be forested land cover unless reasonable, historical information is provided that indicates the site was prairie prior to settlement.
Preliminary Plat	A neat and approximate drawing of a proposed subdivision showing the general layout of streets, alleys, lots, blocks, and restrictive covenants to be applicable to the subdivision, which shall furnish a basis for the approval or disapproval of the general layout of a subdivision.
Pretreatment	The removal of material such as solids, grit, grease, and scum from flows prior to physical, biological, or physical treatment processes to improve treatability. Pretreatment may include screening, grit removal, settling, oil/water separation, or application of a basic treatment BMP prior to infiltration.
Private Road	A roadway facility in private ownership providing private access and used for travel of vehicles by the owner(s) or those having express or implied permission from the owner(s), but not by other persons.
Professional Engineer (PE)	A person currently licensed and registered in Washington State as a professional engineer in civil engineering.
Project	Any proposed action to alter or develop a site. The proposed action of a permit application or an approval.
Project Engineer	Professional Engineer.
Project Site	That portion of a property, properties, or right-of-way subject to land-disturbing activities, new hard surfaces, or replaced hard surfaces.
Rain Garden	A non-engineered shallow, landscaped depression, with compost-amended native soils and adapted plants. The depression is designed to pond and temporarily store stormwater runoff from adjacent areas, and to allow stormwater to pass through the amended soil profile.
Rational Method	A means of computing storm drainage flow rates (Q) by use of the formula Q = CIA, where C is a coefficient describing the physical drainage area, I is the rainfall intensity and A is the area. This method is only allowed for sizing conveyances in certain small basins.
Reach	A length of channel with uniform characteristics.
Receiving Waters (or Receiving Water Body)	Bodies of water or surface water systems to which surface runoff is discharged via a point source of stormwater or via sheet flow. Ground water to which surface runoff is directed by infiltration.
Recharge	The addition of water to the zone of saturation (i.e., an aquifer).

Term	Definition
Recommended BMPs	As used in reference to Source Control (Chapter 9 of this manual, and Volume IV of the 2014 Ecology Manual, recommended BMPs are those BMPs that are not expected to be mandatory by local governments at new development and redevelopment sites. However, they may improve pollutant control efficiency, and may provide a more comprehensive and environmentally effective stormwater management program.
Redevelopment	On a site that is already substantially developed (i.e., has 35 percent or more of existing hard 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 a routine maintenance activity; and land-disturbing activities.
Regional	An action or facility (for stormwater management purposes) that involves more than one discrete property.
Regional Detention (or Retention) Facility	A stormwater quantity control structure designed to correct existing surface water runoff problems of a basin or subbasin. The area downstream has been previously identified as having existing or predicted significant and regional flooding and/or erosion problems. This term is also used when a detention or retention facility is sited to detain or infiltrate stormwater runoff from a number of new developments or areas within a catchment.
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 impervious surfaces down to the foundation. For other impervious surfaces, the removal down to bare soil or base course and replacement.
Restoration	Actions performed to re-establish wetland functional characteristics and processes that have been lost by alterations, activities, or catastrophic events in an area that no longer meets the definition of a wetland.
Retention	The process of collecting and holding surface and stormwater runoff with no surface outflow.
Retention Pond	A retention facility that is an open pond.
Retention/Detention Facility	A type of drainage facility 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 surface and stormwater runoff for a short period of time and then release it to the surface and stormwater management system.
Retrofitting	The renovation of an existing structure or facility to meet changed conditions or to improve performance.
Return Frequency	A statistical term for the average time of expected interval that an event of some kind will equal or exceed given conditions (e.g., a stormwater flow that occurs every 2 years).
Rill	A small intermittent watercourse with steep sides, usually only a few inches deep. Often rills are caused by an increase in surface water flow when soil is cleared of vegetation.
Riparian	Pertaining to the banks of streams, wetlands, lakes, or tidewater.

Term	Definition
Riparian Areas	Transition zones between water bodies and upland areas that exhibit vegetation or soil characteristics reflective of permanent surface or subsurface water influence. Lands along, adjacent to, or contiguous with perennially and intermittently flowing rivers and streams, glacial potholes, and the shores of lakes and reservoirs with stable water levels are typical riparian areas.
Riprap	A facing layer or protective mound of rocks placed to prevent erosion or sloughing of a structure or embankment due to flow of surface and stormwater runoff.
Riser	A vertical pipe extending from the bottom of a pond BMP that is used to control the discharge rate from a BMP for a specified design storm.
Roadway Width	The sum of the traveled way width and the shoulder width measured at its narrowest location.
Runoff	Water originating from rainfall and other precipitation that is found in drainage facilities, rivers, streams, springs, seeps, ponds, lakes, and wetlands, as well as shallow groundwater. As applied in this manual, it also means the portion of rainfall or other precipitation that becomes surface flow and interflow.
Salmonid	A member of the fish family *Salmonidae*. Chinook, coho, chum, pink, and sockeye salmon; cutthroat, brook, brown, rainbow, and steelhead trout; Dolly Varden, kokanee, and char are examples of salmonid species.
Sand Filter	An artificial depression or basin with a layer of sand that treats stormwater as it percolates through the sand.
Scour	Erosion of channel banks due to excessive velocity of the flow of surface and stormwater runoff.
SCS	Soil Conservation Service (now the Natural Resources Conservation Service), United States Department of Agriculture.
SCS Method	See NRCS Method.
SDM Administrator	City of Lacey Stormwater Design Manual Administrator. See Director.
Seasonal High Groundwater Level	The upper level at which the groundwater table normally is located during the season of the year when such levels are at their highest (typically December 1 through April 30).
Section 401; Section 404	Section 401 and Section 404 of the Clean Water Act. Under Section 401, an activity involving a discharge into waters of the U.S. authorized by a federal permit must receive water quality certification from the appropriate certifying agency (Ecology), indicating the activity will comply with applicable water quality standards. Under Section 404, the USACE regulates the discharge of dredged or fill material into waters of the U.S., including wetlands.
Sediment	Fragmented material that originates from weathering and erosion of rocks or unconsolidated deposits, and is transported by, suspended in, or deposited by water.
Sedimentation	The depositing or formation of sediment.
Sensitive Area	Those areas designated by resolution or ordinance of the City of Lacey Council pursuant to WAC 197-11-908 and LMC 16.54 or the most recent amendments thereto. See Environmentally Sensitive Area.
Settleable Solids	Those suspended solids in stormwater that separate by settling when the stormwater is held in a quiescent condition for a specified time.

Term	Definition
Shared Access Facility	A privately-owned drivable surface that serves up to and including four lots in the rural area or two lots in the urban area for access to single-family and two-family dwelling units.
Sheet Flow	Runoff that flows over the ground surface as a thin, even layer, not concentrated in a channel.
Short-Circuiting	The passage of runoff through a BMP in less than the design treatment time.
Siltation	The process by which a river, lake, or other water body becomes clogged with sediment. Silt can clog gravel beds and prevent successful salmon spawning.
Site	The area defined by the legal boundaries of a parcel or parcels of land that is (are) subject to new development or redevelopment. For road projects, the length of the project site and the right-of-way boundaries define the site.
Slope	Degree of deviation of a surface from the horizontal measured as a numerical ratio, percent, or in degrees. Expressed as a ratio, the first number is the horizontal distance (run) and the second is the vertical distance (rise), as 2:1. A 2:1 slope is a 50 percent slope. Expressed in degrees, the slope is the angle from the horizontal plane, with a 90-degree slope being vertical (maximum) and 45-degree being a 1:1 or 100 percent slope.
Sloughing	The sliding of overlying material. It is the same effect as caving, but it usually occurs when the bank or an underlying stratum is saturated or scoured.
Soil	The unconsolidated mineral and organic material on the immediate surface of the Earth that serves as a natural medium for the growth of land plants. See also Topsoil and Engineered Soil.
Soil Group, Hydrologic	A classification of soils by the NRCS into four runoff potential groups. The groups range from A soils, which are very permeable and produce little or no runoff, to D soils, which are not very permeable and produce much more runoff.
Soil Horizon	A layer of soil, approximately parallel to the surface, which has distinct characteristics produced by soil-forming factors.
Soil Permeability	The ease with which gases, liquids, or plant roots penetrate or pass through a layer of soil.
Soil Profile	A vertical section of the soil from the surface through all horizons, including C horizons.
Soil Stabilization	The use of measures such as rock lining, vegetation or other engineering structures to prevent the movement of soil when loads are applied to the soil.
Soil Structure	The relation of particles or groups of particles that impart to the whole soil a characteristic manner of breaking; types include crumb structure, block structure, platy structure, and columnar structure.
Soil Texture Class	The relative proportion, by weight, of particle sizes, based on the USDA soil textural class system, of individual soil grains less than 2 mm equivalent diameter in a mass of soil. The basic texture classes in the approximate order of increasing proportions of fine particles include sand, loamy sand, sandy loam, loam, silt loam, silt, clay loam, sandy clay, silty clay, and clay.
Soils Professional	A person certified by the Soil Science Society of America (or an equivalent national program); a locally licensed on-site sewage designer; or a suitably trained person working under the supervision of a professional engineer, geologist, hydrogeologist, or engineering geologist registered in Washington State.

Term	Definition
Sorption	The physical or chemical binding of pollutants to sediment or organic particles.
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. This 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 Chapter 9 for details.
Spill Control Device	A T-section or turned-down elbow designed to retain a limited volume of pollutant that floats on water, such as oil or antifreeze. Spill control devices are passive and must be cleaned-out for the spilled pollutant to be removed.
Spillway	A passage such as a paved apron or channel for surplus water over or around a dam or similar obstruction. An open or closed channel, or both, used to convey excess water from a reservoir. It may contain gates, either manually or automatically controlled, to regulate the discharge of excess water.
State Environmental Policy Act (SEPA)	The Washington law (RCW 43.21c) intended to minimize environmental damage. SEPA requires that state agencies and local governments consider environmental factors when making decisions on activities, such as development proposals over a certain size, and comprehensive plans. As part of this process, environmental documents are prepared and opportunities for public comment are provided.
Storage Routing	A method to account for the attenuation of peak flows passing through a detention facility or other storage feature.
Storm Drains	The enclosed conduits that transport surface and stormwater runoff toward points of discharge (sometimes called storm sewers).
Storm Sewer	A sewer that carries stormwater and surface water, street wash, and other washwaters or drainage, but excludes sewage and industrial wastes. Also called a storm drain. Local storm sewers may flow to stormwater treatment ponds, but they do not flow to sewage treatment plants (as sanitary sewers do).
Stormwater	Surface runoff due to precipitation or snowmelt. That portion of precipitation that does not naturally percolate into the ground or evaporate, but flows via overland flow, interflow, pipes and other features of the stormwater drainage system to a surface water body or constructed stormwater facility.
Stormwater Drainage System	Constructed and natural features that function together as a system to collect, convey, channel, hold, inhibit, retain, detain, infiltrate, divert, treat, or filter stormwater.
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, bioretention, permeable pavement, and biofiltration swales.
Stormwater Management Manual for Western Washington	The stormwater manual issued by Ecology to provide guidance on measures necessary in western Washington to control the quantity and quality of stormwater runoff from new development and redevelopment. The current manual is the *2012 Stormwater Management Manual for Western Washington, as Amended in December 2014*, also referred to as the 2014 Ecology Manual.

Term	Definition
Stormwater Program	Either the basic stormwater program or the comprehensive stormwater program (as appropriate to the context of the reference) called for under the Puget Sound Water Quality Management Plan.
Stormwater Site Plan	The comprehensive report containing all of the technical information and analysis 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. It includes a Construction Stormwater Pollution Prevention Plan (Construction SWPPP) and a Permanent Stormwater Control Plan. Guidance on preparing a Stormwater Site Plan is contained in Chapter 3 of Lacey's Stormwater Design Manual.
Stream Banks	The usual boundaries, not the flood boundaries, of a stream channel. Right and left banks are named facing downstream.
Streams	Those areas where surface waters flow sufficiently to produce a defined channel or bed. A defined channel or bed is an area that demonstrates clear evidence of the passage of water and includes, but is not limited to, indicated by hydraulically sorted sediments or the removal of vegetative litter or loosely rooted vegetation by the action of moving water. The channel or bed need not contain water year-round. This definition is not meant to include irrigation ditches, canals, stormwater runoff devices, or other entirely artificial watercourses, unless they are used to convey streams naturally occurring prior to construction. Those topographic features that resemble streams but have no defined channels (i.e., swales) shall be considered streams when hydrologic and hydraulic analyses done pursuant to a development proposal predict formation of a defined channel after development.
Structural Source Control BMPs	Physical, structural, or mechanical devices or facilities that are intended to prevent pollutants from entering stormwater. Structural source control BMPs typically include: • Enclosing and/or covering the pollutant source (building or other enclosure, a roof over storage and working areas, temporary tarp, etc.). • Segregating the pollutant source to prevent run-on of stormwater, and to direct only contaminated stormwater to appropriate treatment BMPs.
Structure	A catch basin or manhole in reference to a storm drainage system.
Stub-Out	A short length of pipe provided for future connection to a stormwater drainage system.
Subbasin	A drainage area that drains to a point contained within a larger basin.
Subgrade	A layer of stone or soil used as the underlying base for a BMP or road.
Subsoil	The B horizons of soils with distinct profiles. In soils with weak profile development, the subsoil can be defined as the soil below the plowed soil (or its equivalent of surface soil), in which roots normally grow. Although a common term, it cannot be defined accurately. It has been carried over from early days when "soil" was conceived only as the plowed soil and that under it as the "subsoil."
Substrate	The natural soil base underlying a BMP.
Surface and Stormwater	Water originating from rainfall and other precipitation that is found in drainage facilities, rivers, streams, springs, seeps, ponds, lakes, and wetlands, as well as shallow ground water.

Term	Definition
Suspended Solids	Organic or inorganic particles that are suspended in and carried by the water. The term includes sand, mud, and clay particles (and associated pollutants), as well as solids, in stormwater.
Swale	A shallow drainage conveyance with relatively gentle side slopes, generally with flow depths less than 1 foot.
Terrace	An embankment or combination of an embankment and channel across a slope to control erosion by diverting or storing surface runoff instead of permitting it to flow uninterrupted down the slope.
Threatened or Endangered Species	Plant or animal species that are nearing endangered status, or whose existence is in immediate jeopardy and is usually restricted to highly specific habitats. Threatened and endangered species are officially listed by federal and state authorities.
Threshold Discharge Area	An on-site area draining to a single natural discharge location or multiple natural discharge locations that combine within 0.25 mile downstream (as determined by the shortest flowpath). The examples in Chapter 4, Figure 4.1 illustrate this definition. The purpose of this definition is to clarify how the thresholds of this manual are applied to project sites with multiple discharge points.
Tightline	A continuous length of pipe that conveys water from one point to another (typically down a steep slope) with no inlets or collection points in between.
Tile, Drain	Pipe made of burned clay, concrete, or similar material, in short lengths, usually laid with open joints to collect and carry excess water from the soil.
Till	See Glacial Till.
Time of Concentration	The time necessary for surface runoff to reach the outlet of a subbasin from the hydraulically most remote point in the tributary drainage area.
Topography	General term to include characteristics of the ground surface such as plains, hills, mountains, degree of relief, steepness of slopes, and other physiographic features.
Topsoil	The upper portion of a soil, usually dark colored and rich in organic material. It is more or less equivalent to the upper portion of an A horizon in an ABC soil.
Total Maximum Daily Load (TMDL) – Water Cleanup Plan	A calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources. A TMDL (also known as a water cleanup plan or water quality improvement program) is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The calculation must include a margin of safety to ensure that the water body can be used for the purposes the state has designated. The calculation must also account for seasonable variation in water quality. Water quality standards are set by states, territories, and tribes. They identify the uses for each water body, for example, drinking water supply, contact recreation (swimming), and aquatic life support (fishing), and the scientific criteria to support that use. The Clean Water Act, Section 303, establishes the water quality standards and TMDL programs.
Total Suspended Solids	That portion of the solids carried by stormwater that can be captured on a standard glass filter.
Toxic	Poisonous, carcinogenic, or otherwise directly harmful to life.

Term	Definition
Total Phosphorus	A water quality parameter.
TPH	Total petroleum hydrocarbons. A water quality parameter.
TR-55	Technical Release No. 55 of the USDA Natural Resources Conservation Service, Conservation Engineering Division, June 1986, titled *Urban Hydrology for Small Watersheds*, which describes procedures for estimating runoff and peak discharges. See NRCS Method.
Tract	A legally created parcel of property designated for special nonresidential and noncommercial uses.
Trash Rack	A structural device used to prevent debris from entering a spillway or other hydraulic structure.
Travel Time	The estimated time for surface water to flow between two points of interest.
Traveled Way	That portion of the roadway used for the movement of vehicles exclusive of the portion of the roadway width that is used, or available for parking of vehicles. The traveled way does not include curbs and gutters.
Treatment BMP or Facility	A BMP that is intended to remove pollutants from stormwater. A few examples of treatment BMPs are bioretention areas, wet ponds, wet vaults, detention ponds, oil/water separators, biofiltration swales, and constructed wetlands.
Treatment Liner	A layer of soil that is designed to slow the rate of infiltration and provide sufficient pollutant removal to protect groundwater quality.
Treatment Train	A combination of two or more treatment facilities connected in series.
Turbidity	Dispersion or scattering of light in a liquid, caused by suspended solids and other factors; commonly used as a measure of suspended solids in a liquid.
U.S. EPA	The United States Environmental Protection Agency.
UIC	Underground injection control. Used in reference to an Ecology program regulating injection wells and specific types of infiltration systems.
UIC Well	Underground injection control well. An artificial, subsurface, fluid distribution system designed to discharge fluids into the ground, and 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 (WAC 173-218-030). Subsurface infiltration systems include drywells, French drains, drain fields, and other similar devices that are used to discharge stormwater directly into the ground. Drywells are UIC wells completed above the water table so that the bottom and sides are typically dry except when receiving fluids. Drywells may be stand-alone or as part of a larger drainage system, such as the overflow for a swale or other stormwater treatment BMP. Infiltration trenches with perforated pipe are considered to be UIC wells.
Underdrain	Plastic pipes with holes or slots drilled through the top, installed within the bottom of an infiltration BMP to collect and remove excess runoff.
Unpaved Road	A road that consists of gravel, crushed surfacing top course, or other dirt surface that has not received a surfacing coat of asphalt. A road treated with only a dust preventative or dust treatment shall be considered an unpaved road.
Unstable Slopes	Those sloping areas of land that have in the past exhibited, are currently exhibiting, or will likely in the future exhibit, mass movement of earth.

Term	Definition
Values (Wetland)	Wetland processes or attributes that are valuable or beneficial to society (also see Functions). Wetland values include support of commercial and sport fish and wildlife species, protection of life and property from flooding, recreation, education, and aesthetic enhancement of human communities.
Variance	Relief from the application of a core requirement to a project.
Vegetation	Any organic plant life growing on the surface of the earth.
Vehicular Use	Regular use of an impervious or pervious surface by motor vehicles. The following are subject to regular vehicular use: roads, unvegetated road shoulders, bike lanes within the traveled lane of a roadway, driveways, parking lots, unrestricted access fire lanes, vehicular equipment storage yards, and airport runways. The following are not considered subject to regular vehicular use: paved bicycle pathways separated from and not subject to drainage from roads for motor vehicles, restricted access fire lanes, and infrequently used maintenance access roads.
Water Body	Surface waters including rivers, streams, lakes, marine waters, estuaries, and wetlands.
Water Cleanup Plan	See Total Maximum Daily Load.
Water Quality	The chemical, physical, and biological characteristics of water, usually in respect to its suitability for a particular purpose.
Water Quality BMP	A BMP specifically designed to control the quality of runoff.
Water Quality Design Storm	The 24-hour rainfall amount with a 6-month return frequency. Commonly referred to as the 6-month, 24-hour storm.
Water Quality Standards	Minimum requirements of purity of water for various uses; for example, water for agricultural use in irrigation systems should not exceed specific levels of sodium bicarbonate, pH, total dissolved salts, etc. In Washington State, Ecology sets water quality standards.
Water Table	The upper surface or top of the saturated portion of the soil or bedrock layer indicates the uppermost extent of groundwater.
Watercourse	A river, stream, creek, or other course of flowing water that flows intermittently or perennially and discharges into another watercourse or body of water.
Waters of the State	Those waters as defined in 40 CFR Subpart 122.2 and Chapter 90.48 RCW.
Watershed	A geographic region within which water drains into a particular river, stream, or body of water. Watersheds can be as large as those identified and numbered by the State of Washington Water Resource Inventory Areas (WRIAs) as defined in Chapter 173-500 WAC.
Weir	Device for measuring or regulating the flow of water, by having the water flow over a specifically-designed spillway.
Wet Ponds and Wet Vaults	Drainage facilities for water quality treatment that contain permanent pools of water that are filled during the initial runoff from a storm event. They are designed to optimize water quality by providing retention time in order to settle out particles of fine sediment to which pollutants such as heavy metals absorb, and to allow biologic activity to occur that metabolizes nutrients and organic pollutants.

Term	Definition
Wet Pool	A pond or constructed wetland that stores runoff temporarily and whose normal discharge location is elevated so as to maintain a permanent pool (i.e., a wet pool) of water between storm events.
Wetlands	Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Wetlands do not include those artificial wetlands intentionally created from nonwetland sites, including, but not limited to, irrigation and drainage ditches, grass-lined swales, canals, detention facilities, wastewater treatment facilities, farm ponds, and landscape amenities, or those wetlands created after July 1, 1990, that were unintentionally created as a result of the construction of a road, street, or highway. Wetlands may include those artificial wetlands intentionally created from nonwetland areas to mitigate the conversion of wetlands. (Water bodies not included in the definition of wetlands as well as those mentioned in the definition are still waters of the state.)

Abbreviations

Abbreviation	Definition
AADT	average annual daily traffic
AASHTO	American Association of State Highway and Transportation Officials
ADA	Americans with Disabilities Act
AKART	all known, available, and reasonable methods of treatment, prevention, and control
API	American Petroleum Institute
APWA	American Public Works Association (Washington State Chapter)
ASTM	American Society for Testing and Materials
BMP	best management practice
CARA	critical aquifer recharge area
CAVFS	compost-amended vegetated filter strip
CEC	cation exchange capacity
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (commonly known as Superfund)
CESCL	Certified Erosion and Sediment Control Lead
cfs	cubic feet per second
CPEP	corrugated polyethylene pipe
CPESC	Certified Professional in Erosion and Sediment Control
CSWGP	Construction General Stormwater Permit
C-TAPE	Chemical Technology Assessment Protocol – Ecology
CULD	Conditional Use Level Designation
DBH	diameter at breast height
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FS	factor of safety
ft/sec	feet per second
GULD	General Use Level Designation
HDPE	high-density polyethylene
HPA	hydraulic project approval
HSPF	Hydrological Simulation Program—Fortran
HSG	hydrologic soil group
IBC	International Building Codes

Abbreviation	Definition
in/hr	inches per hour
ISGP	Industrial Stormwater General Permit
JARPA	Joint Aquatic Resources Permit Application
LF (or lf)	linear feet
LID	low impact development
LMC	Lacey Municipal Code
MFD	media filter drain
mg/L	milligrams per liter
MS4	municipal separate storm sewer system
MSDS	material safety data sheets
MTCA	Model Toxics Control Act
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NWTPH	Northwest Total Petroleum Hydrocarbons
O.C.	on center
O&M	operation and maintenance
OSHA	Occupational Safety and Health Administration
PAM	polyacrylamide
PDF	Portable Document Format
PE	professional engineer
PGHS	pollution-generating hard surface
PGIS	pollution-generating impervious surface
PGPS	pollution-generating pervious surface
PIT	pilot infiltration test
PUD	planned unit development
PVC	polyvinyl chloride
RCW	Revised Code of Washington
SA	surface area
SBUH	Santa Barbara Urban Hydrograph
SCS	Soil Conservation Service (now Natural Resources Conservation Service)
SDM	Stormwater Design Manual (City of Lacey)
SEPA	State Environmental Policy Act

Abbreviation	Definition
SF (or sf)	square feet
SWPPP	Stormwater Pollution Prevention Plan
TAPE	Technology Assessment Protocol – Ecology
TMDL	total maximum daily load
TPH	total petroleum hydrocarbons
TR-55	Technical Release No. 55 of the USDA Natural Resources Conservation Service
TSS	total suspended solids
UGA	urban growth area
UIC	underground injection control
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
U.S. EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington State Department of Natural Resources
WQ	water quality
WRIA	Water Resource Inventory Area
WSDOT	Washington State Department of Transportation
WWHM	Western Washington Hydrology Model, 2012 or newest version

Chapter 2 – Requirements for New Development and Redevelopment

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Chapter 2 – Requirements for New Development and Redevelopment

2.1 Introduction

2.1.1 Purpose, Content, and Organization

Purpose

Chapter 2 of this manual summarizes the nine core requirements for stormwater management applicable to new development and redevelopment. The remaining chapters of this manual cover submittal requirements and BMPs for specific aspects of stormwater management.

Core requirements cover a range of issues, such as submittal requirements, pollution prevention during the construction phase of a project, control of potential pollutant sources, treatment of runoff, control of stormwater flow volumes, protection of wetlands, and long-term operation and maintenance. The core requirements applicable to a project vary depending on the type and size of the proposed project.

Content

This chapter identifies the nine core requirements for stormwater management applicable to new development and redevelopment sites. The core requirements are:

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

Depending on the type and size of the proposed project, different combinations of these core requirements apply. In general, small sites are required to control erosion and sedimentation from construction activities and to apply simpler approaches for treatment and flow control of stormwater runoff from the developed site. Controlling flows from

small sites is important because the cumulative effect of uncontrolled flows from many small sites can be as damaging as those from a single large site.

Larger sites must provide erosion and sedimentation control during construction, permanent control of stormwater runoff from the developed site through selection of appropriate BMPs and facilities, and other measures to reduce and control the impacts of the project. Sites being redeveloped must generally meet the same core requirements as new development for the new hard surfaces and pervious surfaces converted to lawn or landscaped areas. Redevelopment sites must also provide erosion control, source control, and on-site stormwater management for the portion of the site being redeveloped. In addition, if the redevelopment meets certain cost or space (as applied to roads) thresholds, updated stormwater management for the redeveloped pervious and hard surfaces must be provided. There may also be situations in which additional controls are required for sites, regardless of type or size, as a result of basin plans or special water quality concerns.

Sections 2.2 and 2.3 provide additional information on applicability of the core requirements to different types of sites. Development sites are to demonstrate compliance with these requirements through the preparation of Stormwater Site Plans. The plans are described in detail in Chapter 3.

Finally, it is important to note that other city requirements beyond those outlined in this chapter, but still related to stormwater management, may apply to a given project. Project proponents are responsible for identifying and addressing all requirements applicable to their proposed project.

Organization

Following this introduction, Chapter 2 contains four additional sections:

- *Section 2.2 – Core Requirements* identifies the core requirements for stormwater management at all new development and redevelopment projects.
- *Section 2.3 – Additional Requirements* describes additional requirements, including financial guarantees and other applicable regulations.
- *Section 2.4 – Adjustments* describes allowable adjustments to the core requirements.
- *Section 2.5 – Exceptions and Variances* describes allowable exceptions and variances to the core requirements.

2.1.2 Applicability of the Core Requirements

Not all of the core requirements apply to every development or redevelopment project. The applicability varies depending on the project type and size. This section identifies thresholds that determine the applicability of the core requirements to different projects.

Use the flow charts in Figures 2.1 (new development) and 2.2 (redevelopment) to determine which core requirements apply. The core requirements themselves are presented in Section 2.2. Development sites are to demonstrate compliance with the core requirements through the preparation and submittal of drainage plans and reports. Submittal requirements are described in Chapter 3.

Note: For definitions related to the core requirements (redevelopment, converted pervious surface, pollutant generating surface, etc.) refer to the Glossary.

New Development

All new development shall be required to comply with Core Requirement #2.

The following new development shall comply with Core Requirements #1 through #5 for the new and replaced hard surfaces and the land disturbed:

- Results in 2,000 square feet, or greater, of new, replaced, or new plus replaced hard surface area, or
- Has land disturbing activity of 7,000 square feet, or greater.

The following new development shall comply with Core Requirements #1 through #9 for the new and replaced hard surfaces and the converted vegetation areas:

- Results in 5,000 square feet, or more, of new plus replaced hard surface area, or
- Converts 0.75 acre, or greater, of vegetation to lawn or landscaped areas, or
- Converts 2.5 acres, or greater, of native vegetation to pasture.

Supplemental Guidelines

For purposes of applying the above thresholds to a proposed single-family residential subdivision (i.e., a plat or short plat project) the hard surface coverage, as well as the converted vegetation areas, must be specified for each lot and recorded with the city on the face of the final plat (or an alternative acceptable to the city). Where city regulations restrict maximum hard (or impervious) surfaces to smaller amounts, those maxima may be used.

Basin planning is encouraged and may be used to tailor Core Requirements #5: On-Site Stormwater Management, #6: Runoff Treatment, #7: Flow Control, and/or #8: Wetlands Protection. Basin planning may be used to support alternative treatment, flow control, and/or wetland protection through construction of regional stormwater facilities. Such facilities must be operational prior to and must have capacity for new development. Additional examples of how basin planning can alter the core requirements are given in Appendix I-A of the 2014 Ecology Manual.

Basin planning provides a mechanism by which the core requirements and implementing BMPs can be evaluated and refined based on an analysis of a basin or watershed. Basin plans may be used to develop control strategies to address impacts from future development and to correct specific problems whose sources are known or suspected. Basin plans can be effective at addressing both long-term cumulative impacts of pollutant loads and short-term acute impacts of pollutant concentrations, as well as hydrologic impacts to streams, wetlands, and groundwater resources. Basin planning will require the use of continuous runoff computer models and field work to verify and support the models.

In order for a basin plan to serve as a means of modifying the core requirements the following conditions must be met:

- The plan must be formally adopted by all jurisdictions with responsibilities under the plan; and
- All ordinances or regulations called for by the plan must be in effect; and
- The basin plan must be reviewed and approved by Ecology.

Compensatory Flow Control or Treatment

Where new development projects require improvements (e.g., frontage improvements) that are not within the same threshold discharge area, the city may allow the core requirements to be met for an equivalent (flow and pollution characteristics) area that drains to the same receiving water.

Redevelopment

All redevelopment shall be required to comply with Core Requirement #2.

The following redevelopment shall comply with Core Requirements #1 through #5 for the new and replaced hard surfaces and the land disturbed:

- Results in 2,000 square feet, or greater, of new plus replaced hard surface area, or
- Has land disturbing activity of 7,000 square feet, or greater.

The following redevelopment shall comply with Core Requirement #1 through #9 for the new hard surfaces and converted pervious areas:

- Adds 5,000 square feet or greater of new hard surfaces, or
- Converts 0.75 acre, or greater, of vegetation to lawn or landscaped areas, or
- Converts 2.5 acres, or greater, of native vegetation to pasture.

In addition, projects that exceed the above thresholds and: **1) are within the 1-year time of travel zone for a wellhead protection area, and 2) contain existing hard surfaces that do not drain to an approved stormwater management facility** are required to apply the applicable core requirements to the entire project site (i.e., not just to the new and replaced hard surfaces). See area maps in Appendix 8B as well as on the city's web site at <http://www.ci.lacey.wa.us/stormwater-design-manual>.

The city may allow the core requirements to be met for an equivalent (flow and pollution characteristics) area within the same site. For roadway projects, the equivalent area does not have to be within the project limits, but must drain to the same receiving water.

Additional Requirements for the Project Site

For road-related projects, runoff from the replaced and new hard surfaces (including pavement, shoulders, curbs, and sidewalks) and the converted vegetated areas shall meet all the core requirements if the new hard surfaces total 5,000 square feet or greater and total 50 percent or more of the existing hard surfaces within the project limits. The project limits shall be defined by the length of the project and the width of the right-of-way.

Other types of redevelopment projects shall comply with Core Requirements #1 through #9 for the new and replaced hard surfaces and the converted vegetated areas if the total of new plus replaced hard surfaces is 5,000 square feet or greater, and the valuation of proposed improvements—including interior improvements—exceeds 50 percent of the assessed value of the existing site improvements as determined by the city Building Official.

Finally, if the city determines that the project site contributes to an existing water quality, flooding, or erosion problem, the city may require that the project site comply with additional stormwater management requirements. The city shall base the determination on the results of basin planning for the basin in which the project is located; historical water quality data; or historical information on flooding, erosion, or habitat degradation in receiving waters.

Objective

Redevelopment projects have the same requirements as new development projects in order to minimize the impacts from new surfaces. To not discourage redevelopment projects, replaced surfaces are not required to be brought up to new stormwater standards unless the noted cost or space thresholds are exceeded. As long as the replaced surfaces have similar pollution-generating potential, the amount of pollutants discharged shouldn't be significantly different. However, if the redevelopment project scope is sufficiently large that the cost or space criteria noted above are exceeded, it is reasonable to require the replaced surfaces to be brought up to current stormwater standards. This is consistent with other utility standards.

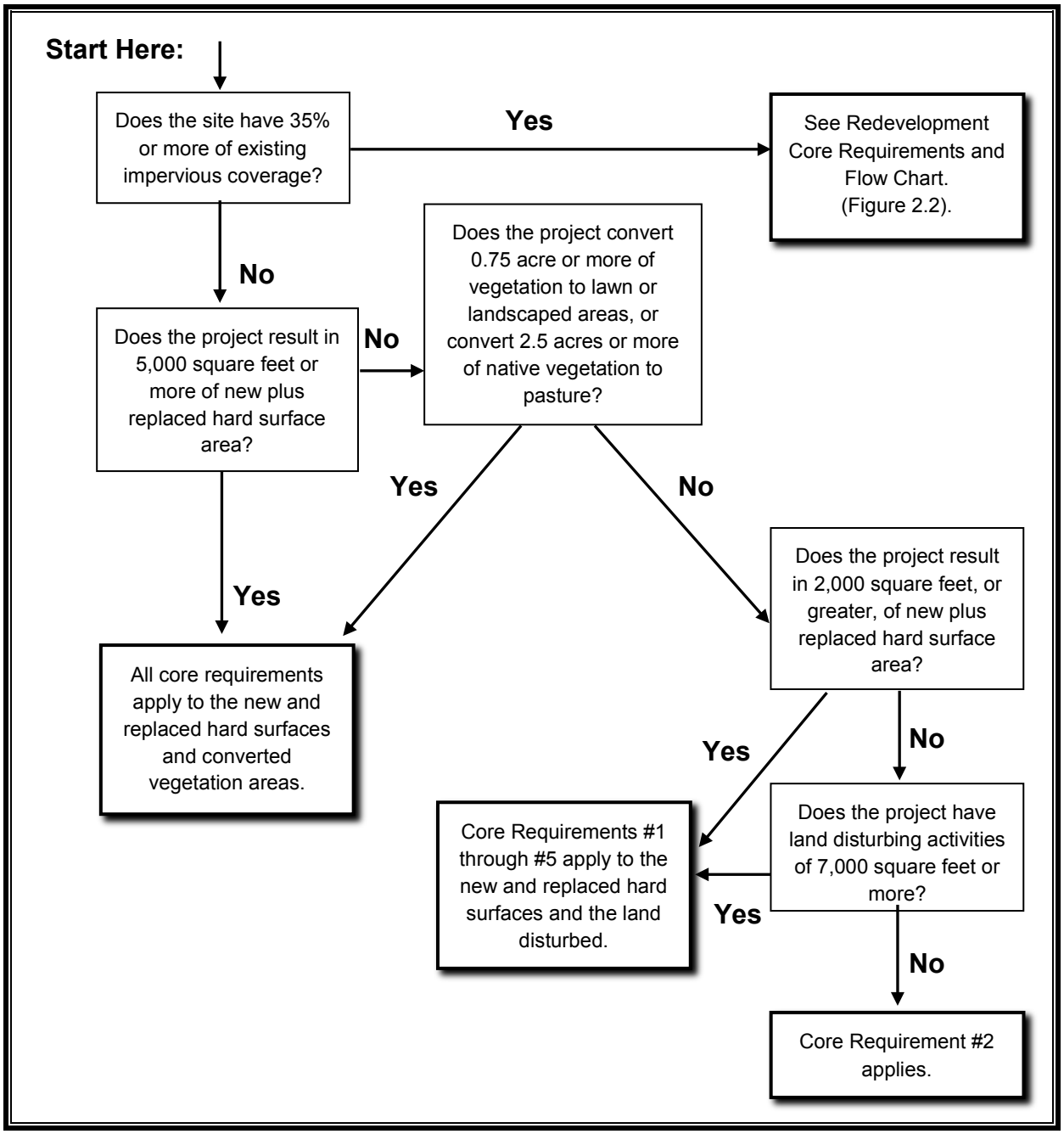

Figure 2.1. Flow Chart for Determining Requirements for New Development.

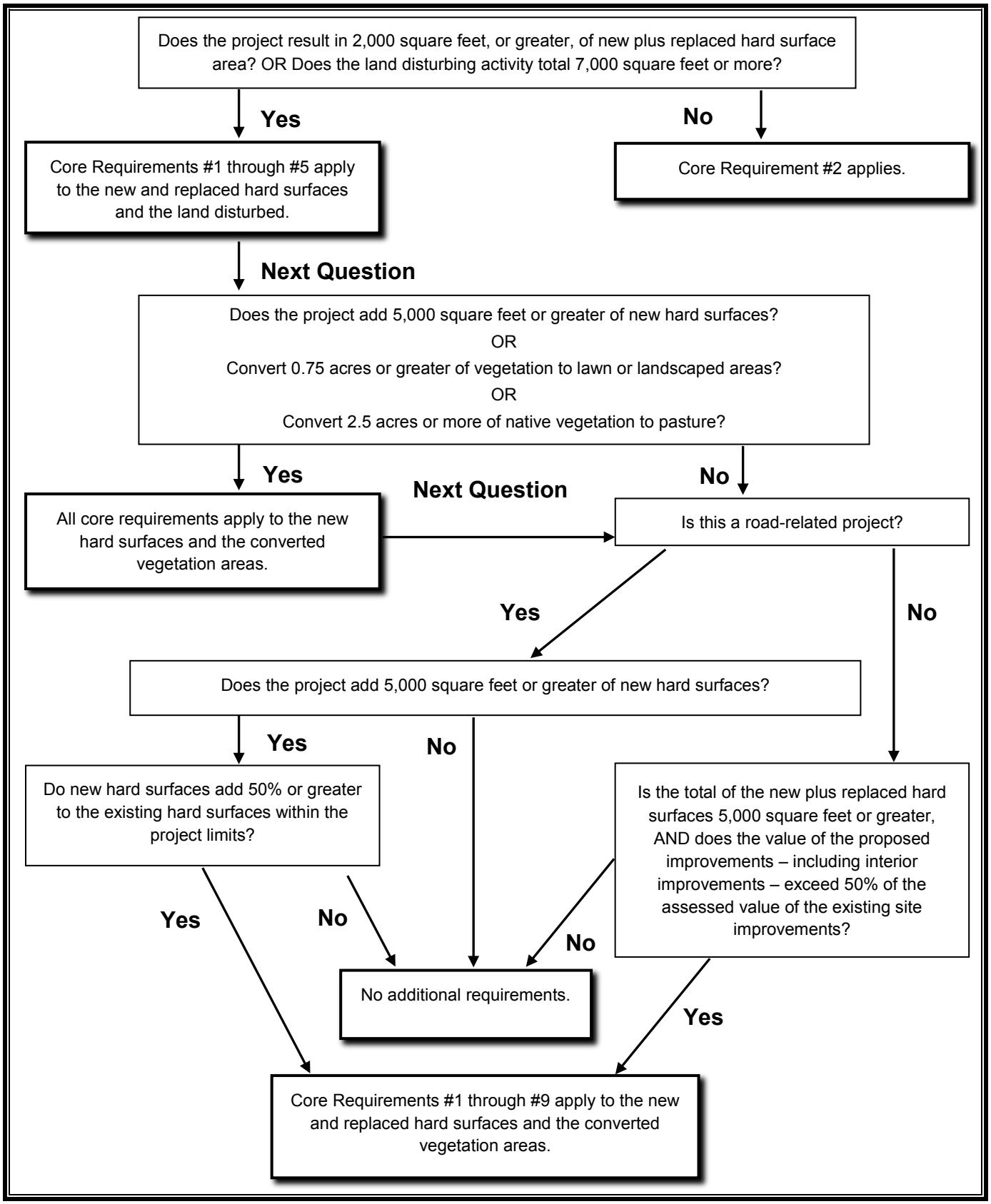

Figure 2.2. Flow Chart for Determining Requirements for Redevelopment.

2.1.3 Exemptions

Unless otherwise indicated in this section, the practices described in this section are exempt from the core requirements, even if such practices meet the definition of new development or redevelopment.

Forest Practices

Forest practices regulated under Title 222 WAC, except for Class IV General forest practices that are conversions from timberland to other uses, are exempt.

Commercial Agriculture

Commercial agriculture practices involving working the land for production are generally exempt. However, the conversion from timberland to agriculture, and the construction of impervious surfaces are not exempt.

Pavement Maintenance

The following pavement maintenance practices are exempt from the core requirements, but should use appropriate BMPs to minimize erosion and sediment transport: pothole and square cut patching, grinding/inlays, overlaying existing asphalt or concrete pavement with asphalt or concrete without expanding the area of coverage, shoulder grading, reshaping/regrading drainage systems, crack sealing, resurfacing with in-kind material without expanding the road prism, and vegetation maintenance.

The following pavement maintenance practices are not categorically exempt. The extent to which the manual applies is explained for each circumstance.

- Removing and replacing a paved surface to base course or lower, or repairing the pavement base: If impervious surfaces are not expanded, Core Requirements #1 through #5 apply.

- Extending the pavement edge without increasing the size of the road prism, or paving graveled shoulders: These are considered new impervious surfaces and are subject to the core requirements that are triggered when the thresholds identified for new or redevelopment projects are met.

- Resurfacing by upgrading from dirt to gravel, asphalt, or concrete; upgrading from gravel to asphalt, or concrete; or upgrading from a bituminous surface treatment (“chip seal”) to asphalt or concrete: These are considered new impervious surfaces and are subject to the core requirements that are triggered when the thresholds identified for new or redevelopment projects are met.

Underground Utility Projects

Underground utility projects that replace the ground surface with in-kind material or materials with similar runoff characteristics are only subject to Core Requirement #2: Construction Stormwater Pollution Prevention.

2.2 Core Requirements

This section describes the core requirements for stormwater management at development and redevelopment sites. Section 2.1 must be consulted to determine which requirements apply to any given project. Figures 2.1 and 2.2 should be consulted to determine whether the core requirements apply to new surfaces, replaced surfaces, or new and replaced surfaces. Chapters 5, 7, and 8 of this manual present BMPs for use in meeting the core requirements.

2.2.1 Core Requirement #1: Preparation of Stormwater Site Plans

All projects meeting the thresholds in Section 2.1 shall prepare a Stormwater Site Plan for city review. Stormwater Site Plans shall be prepared in accordance with Chapter 3 of this manual.

A Stormwater Site Plan is a comprehensive report containing all of the technical information, analysis, calculations, maps and graphics necessary for the City of Lacey to evaluate a proposed project for compliance with stormwater requirements. The information required in the Stormwater Site Plan depends on the nature of the project and its location. Stormwater Site Plans shall use site-appropriate development principles to retain native vegetation and minimize impervious surfaces to the extent feasible.

Each of the plan submittals listed below are described in detail in Chapter 3. See Chapter 3 and Table 3.1 for the specific information on required plans and plan content.

- Stormwater Pollution Prevention Plan (SWPPP) Short Form
- Abbreviated Plan
- Drainage Control Plan

Completing the applicable plan in accordance with the requirements in Chapter 3 will meet Core Requirement #1.

Objective

The 2,000-square-foot threshold for hard surfaces and 7,000-square-foot threshold for land disturbance are specified by the Department of Ecology to capture most single-family home construction and their equivalent. The city-specific thresholds and requirements identified in Chapter 3, Table 3.1, were developed to meet more specific city needs and interests, without negating Ecology's requirements.

Supplemental Guidelines

Projects proposed by city departments and agencies must comply with this requirement. The city shall determine the process for ensuring proper project review, inspection, and compliance by its own departments and agencies. See also Chapter 3, Section 3.2.1.

2.2.2 Core Requirement #2: Construction Stormwater Pollution Prevention

All projects shall address erosion and sediment control during site construction activities.

Thresholds

All new development and redevelopment projects are responsible for preventing erosion and discharge of sediment and other pollutants into receiving waters, and shall comply with Construction SWPPP Elements #1 through #13 as detailed in Chapter 5. The 13 elements are summarized below, but project applicants must refer to Chapter 5 for the full description of applicable requirements.

Projects which result in 2,000 square feet or more of new plus replaced hard surface area, or which disturb 7,000 square feet or more of land must prepare a Construction SWPPP as part of the Stormwater Site Plan submittal (see Chapter 3, Section 3.3). Each of the 13 elements must be considered and included in the Construction SWPPP unless site conditions render the element unnecessary and the exemption from that element is clearly justified in the narrative of the Construction SWPPP. The SWPPP shall be implemented beginning with initial soil disturbance and shall be maintained until final stabilization of the entire project site.

Projects that result in less than 2,000 square feet of new plus replaced hard surface area, or disturb less than 7,000 square feet of land are not required to prepare a Construction SWPPP, but must consider all of the 13 elements of Construction Stormwater Pollution Prevention and develop controls for all elements that pertain to the project site. In addition, these projects shall submit a complete SWPPP Short Form (see Appendix 3A) to record basic project information, and to document that the 13 elements are being considered and addressed as applicable. See also Chapter 3.

These elements cover the general water quality protection strategies of limiting site impacts, preventing erosion and sedimentation, and managing activities and sources during the construction phase of a project. The 13 elements are:

1. Preserve vegetation/mark clearing limits
2. Establish construction access
3. Control flow rates
4. Install sediment controls
5. Stabilize soils
6. Protect slopes
7. Protect drain inlets

8. Stabilize channels and outlets
9. Control pollutants
10. Control dewatering
11. Maintain BMPs
12. Manage the project
13. Protect Low Impact Development BMPs

A complete description of each element and the associated BMPs are given in Chapter 5.

Additional Requirements

If a Construction SWPPP is found to be inadequate (with respect to erosion and sediment control requirements), the city may require that other BMPs be implemented as needed.

Note that clearing and grading activities for developments may be permitted only if conducted pursuant to an approved site development plan (e.g., subdivision approval) that establishes permitted areas of clearing, grading, cutting, and filling. These permitted clearing and grading areas and any other areas required to preserve critical or sensitive areas, buffers, native growth protection easements, or tree retention areas shall be delineated on the site plans and at the development site. See Chapter 3 for additional details on project submittal requirements.

2.2.3 Core Requirement #3: Source Control of Pollution

All known, available, and reasonable source control BMPs shall be applied to all projects to prevent stormwater from coming in contact with pollutants on the developed site.

"Source control" is *postdevelopment* pollution prevention. Source control BMPs shall be selected, designed, and maintained according to Volume IV of the 2014 Ecology Manual, as described and referenced in Chapter 9. Source control BMPs shall be identified in the Stormwater Site Plans submitted for city review and must be shown on all applicable plans submitted for city review and approval.

Objective

The intent of source control BMPs is to prevent stormwater from coming in contact with pollutants. They are a cost-effective means of reducing pollutants in stormwater, and therefore should be a first consideration in all projects.

Supplemental Guidelines

An adopted and implemented basin plan or a TMDL (also known as a water cleanup plan or water quality improvement program) may be used to develop more stringent source control requirements that are tailored to a specific basin.

Source control BMPs include operational BMPs and structural source control BMPs. See Chapter 9 for design details of these BMPs. For construction sites, see Chapter 5.

2.2.4 Core Requirement #4: Preservation of Natural Drainage Systems and Outfalls

Natural drainage patterns shall be maintained, and discharges from the project site shall occur at the natural location, to the maximum extent practicable.

The manner by which runoff is discharged from the project site must not cause a significant adverse impact to downstream receiving waters or down gradient properties. The discharge must have an identified overflow route that is safe and certain, and leads to the ultimate outfall location (such as a receiving water or municipal drainage system). All outfalls require energy dissipation. To demonstrate compliance with this core requirement, all projects shall submit a *qualitative analysis* downstream from the site to the receiving water. A *quantitative analysis* may be required for any project deemed to need additional downstream information or where the project proponent or the City of Lacey SDM Administrator determines that a quantitative analysis is necessary to evaluate the off-site impacts or the capacity of the conveyance system. See Chapter 3 for additional details.

Off-site drainage is drainage from adjacent property that enters the proposed project site in other than a defined natural channel. Existing off-site flows must be accommodated without causing erosion or flooding impacts. Off-site flows shall not be routed through the project's conveyance, treatment, or retention/detention systems, unless those systems are sized to control those flows. Off-site contribution areas shall be mapped.

Off-site flows that are collected and routed through or around the site in a separate conveyance shall be dispersed at the downgradient property line, if feasible, or discharged at a project outfall (or outfalls) in a manner that does not violate the criteria below or cause the capacity of a conveyance system to be exceeded.

Where no conveyance system exists at the adjacent downgradient property line and the discharge was previously unconcentrated flow or significantly lower concentrated flow, measures must be taken to prevent downgradient impacts. Drainage easements from downstream property owners may be needed and should be obtained prior to approval of engineering plans.

Where no conveyance system exists at the abutting downstream property line and the natural (existing) discharge is unconcentrated, any runoff concentrated by the proposed project, including off-site drainage, must be discharged as follows:

1. If the 100-year peak discharge is less than or equal to 0.2 cfs (0.3 cfs using 15-minute time steps) under existing conditions and will remain less than or equal to 0.2 cfs under developed conditions, then the concentrated runoff may be discharged onto a rock pad or to any other system that serves to disperse flows.

2. If the 100-year peak discharge is between 0.2 and 0.5 cfs (or 0.75 cfs using 15-minute time steps) under existing conditions and will remain in that range under developed conditions, then the concentrated runoff may be discharged through a dispersal trench or other dispersal system, provided the applicant can demonstrate that there will be no significant adverse impact to downhill properties or drainage systems.

3. If the 100-year peak discharge is greater than 0.5 cfs for either existing or developed conditions, or if a significant adverse impact to downgradient properties or drainage systems is likely, then a conveyance system shall be provided to convey the concentrated runoff across the downstream properties to an acceptable discharge point (i.e., an enclosed drainage system or open drainage feature where concentrated runoff can be discharged without significant adverse impact).

Stormwater retention, detention, or treatment facilities, as required by this manual, shall not be located within the expected 25-year water level elevations for salmonid-bearing waters. Such areas may provide off-channel habitat for juvenile salmonids and salmonid fry. Designs for outfall systems to protect against adverse impacts from concentrated runoff are included in Chapter 6.

Objective

To preserve and utilize natural drainage systems to the fullest extent because of the multiple stormwater benefits these systems provide; and to prevent erosion at and downstream of the discharge location.

2.2.5 Core Requirement #5: On-Site Stormwater Management

Projects shall employ on-site stormwater management BMPs in accordance with the following project thresholds, standards, and lists to infiltrate, disperse, and retain stormwater runoff on site to the maximum extent feasible without causing flooding or erosion impacts. A flow chart (Figure 2.3) is provided at the end of this section to help summarize the core components of this core requirement.

Projects qualifying as flow control exempt per Section 2.2.7 of this chapter do not have to achieve the LID Performance Standard, nor consider bioretention, rain gardens, permeable pavement, or full dispersion BMPs if using List #1 or List #2. However, those projects must implement the following BMPs:

1. Postconstruction soil quality and depth (see Chapter 7, Section 7.4.1);

2. Downspout infiltration or downspout dispersion (see Chapter 7, Section 7.4.10); and

3. Concentrated flow dispersion or sheet flow dispersion (see Chapter 7, Section 7.4.2), if feasible.

Project Thresholds

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

1. Use on-site stormwater management BMPs from List #1 for all surfaces within each type of surface in List #1; or

2. Demonstrate compliance with the LID Performance Standard. Projects selecting this option cannot use rain gardens. They may choose to use bioretention areas as described in Chapter 7, Section 7.4.4, to achieve the LID Performance Standard. Projects selecting this option must implement the postconstruction soil quality and depth BMP described in Chapter 7, Section 7.4.1, if feasible.

Projects triggering Core Requirements #1 through #9 must use the LID Performance Standard and postconstruction soil quality and depth BMP (see Chapter 7, Section 7.4.1), or apply List #2 (applicant option).

Low Impact Development Performance Standard

Stormwater discharges shall match developed discharge durations to predeveloped durations for the range of predeveloped discharge rates from 8 percent of the 2-year peak flow to 50 percent of the 2-year peak flow. Refer to the Standard Flow Control Requirement section in Core Requirement #7 for information about the assignment of the predeveloped condition. Project sites that must also meet Core Requirement #7: Flow Control must match flow durations between 8 percent of the 2-year flow through the full 50-year flow.

List #1: On-Site Stormwater Management BMPs for Projects Triggering Core Requirements #1 through #5

For each surface, consider the BMPs in the order listed for that type of surface. Use the first BMP that is considered feasible. No other on-site stormwater management BMP is necessary for that surface. Feasibility shall be determined by evaluation against:

1. Design criteria, limitations, and infeasibility criteria identified for each BMP in this manual; and

2. Competing Needs Criteria listed below.

(See also Chapter 7, Appendix 7B for a summary of infeasibility criteria for all BMPs.)

Lawn and Landscaped Areas

1. Postconstruction soil quality and depth in Chapter 7, Section 7.4.1

Roofs

1. Full dispersion in Chapter 7, Section 7.4.2, or downspout infiltration in Chapter 7, Section 7.4.10.

2. Rain gardens in Chapter 7, Section 7.4.5, or bioretention in Chapter 7, Section 7.4.4. The rain garden or bioretention area must have a minimum horizontal projected surface area below the overflow which is at least 5 percent of the area draining to it.

3. Downspout dispersion systems in Chapter 7, Section 7.4.10.

4. Perforated stub-out connections in Chapter 7, Section 7.4.10.

Other Hard Surfaces

1. Full dispersion in Chapter 7, Section 7.4.2.

2. Permeable pavement[1] in Chapter 7, Section 7.4.6, or rain gardens in Chapter 7, Section 7.4.5, or bioretention in Chapter 7, Section 7.4.4. The rain garden or bioretention area must have a minimum horizontal projected surface area below the overflow which is at least 5 percent of the area draining to it.

3. Sheet flow dispersion or concentrated flow dispersion in Chapter 7, Section 7.4.2.

List #2: On-Site Stormwater Management BMPs for Projects Triggering Core Requirements #1 through #9

For each surface, consider the BMPs in the order listed for that type of surface. Use the first BMP that is considered feasible. No other on-site stormwater management BMP is necessary for that surface. Feasibility shall be determined by evaluation against:

1. Design criteria, limitations, and infeasibility criteria identified for each BMP in this manual; and

2. Competing Needs Criteria listed below.

3. (See also Chapter 7, Appendix 7B for a summary of infeasibility criteria for all BMPs.)

Lawn and Landscaped Areas

1. Postconstruction soil quality and depth in Chapter 7, Section 7.4.1.

[1] This is not a requirement to pave these surfaces. Where pavement is proposed, it must be permeable to the extent feasible unless full dispersion is employed.

Roofs

1. Full dispersion in Chapter 7, Section 7.4.2, or downspout infiltration in Chapter 7, Section 7.4.10.

2. Bioretention in Chapter 7, Section 7.4.4, that has a minimum horizontally projected surface area below the overflow, which is at least 5 percent of the total surface area draining to it.

3. Downspout dispersion in Chapter 7, Section 7.4.10.

4. Perforated stub-out connections in Chapter 7, Section 7.4.10.

Other Hard Surfaces

1. Full dispersion in Chapter 7, Section 7.4.2.

2. Permeable pavement[2] in Chapter 7, Section 7.4.6.

3. Bioretention in Chapter 7, Section 7.4.4, that has a minimum horizontally projected surface area below the overflow, which is at least 5 percent of the total surface area draining to it.

4. Sheet flow dispersion or concentrated flow dispersion BMPs in Chapter 7, Section 7.4.2.

Objective

To use practices as feasible, distributed across a development, which reduce the amount of disruption of the natural hydrologic characteristics of the site.

Competing Needs

The on-site stormwater management BMPs can be superseded or restricted where they are in conflict with:

- Requirements of the following federal or state laws, rules, and standards: historic preservation laws and archaeology laws listed at <www.dahp.wa.gov/learn-and-research/preservation-laws>, Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA; commonly known as Superfund) or Washington State Model Toxics Control Act (MTCA), Federal Aviation Administration requirements for airports, Americans with Disabilities Act (ADA).

- Special zoning design criteria and community plans found in LMC Title 16 the existing local codes may supersede or reduce the LID requirement.

[2] This is not a requirement to pave these surfaces. Where pavement is proposed, it must be permeable to the extent feasible unless full dispersion is employed.

- Critical Area Ordinance (LMC 16.54), as well as LMC 14.32 that provides specific protection of tree species.
- Public health and safety standards.
- Transportation regulations to maintain the option for future expansion or multi-modal use of public rights-of-way.
- A local code or rule adopted as part of a wellhead protection program established under the Safe Drinking Water Act; or adopted to protect a critical aquifer recharge area established under the state Growth Management Act.

Supplemental Guidelines

"Flooding or erosion impacts" include flooding of septic systems, crawl spaces, living areas, outbuildings, etc.; increased ice or algal growth on sidewalks/roadways; earth movement/settlement; erosion and other potential damage.

Note that rain gardens cannot be used to meet the requirements of the Low Impact Development Performance Standard outlined above. This is because the LID Performance Standard requires the submittal of an engineered design and analysis. For projects proposing to meet the LID Performance Standard, a bioretention area must be used in lieu of a rain garden, even though they may look and perform similarly in practice.

An adopted and implemented basin plan, or a TMDL may be used to develop on-site stormwater management requirements that are tailored to a specific basin and may also be used to ensure that stormwater design provides a sampling location for sampling the water quality of any stormwater leaving the site. However, on-site stormwater management requirements shall not be less than that required by List #1, List #2, or the LID Performance Standard.

Recent research indicates that traditional development techniques in residential, commercial, and industrial land development cause gross disruption of the natural hydrologic cycle with severe impacts to water and water-related natural resources. Based upon gross-level applications of continuous runoff modeling and assumptions concerning minimum flows needed to maintain beneficial uses, watersheds must retain the majority of their natural vegetation cover and soils, and developments must minimize their disruption of the natural hydrologic cycle in order to avoid significant natural resource degradation in lowland streams.

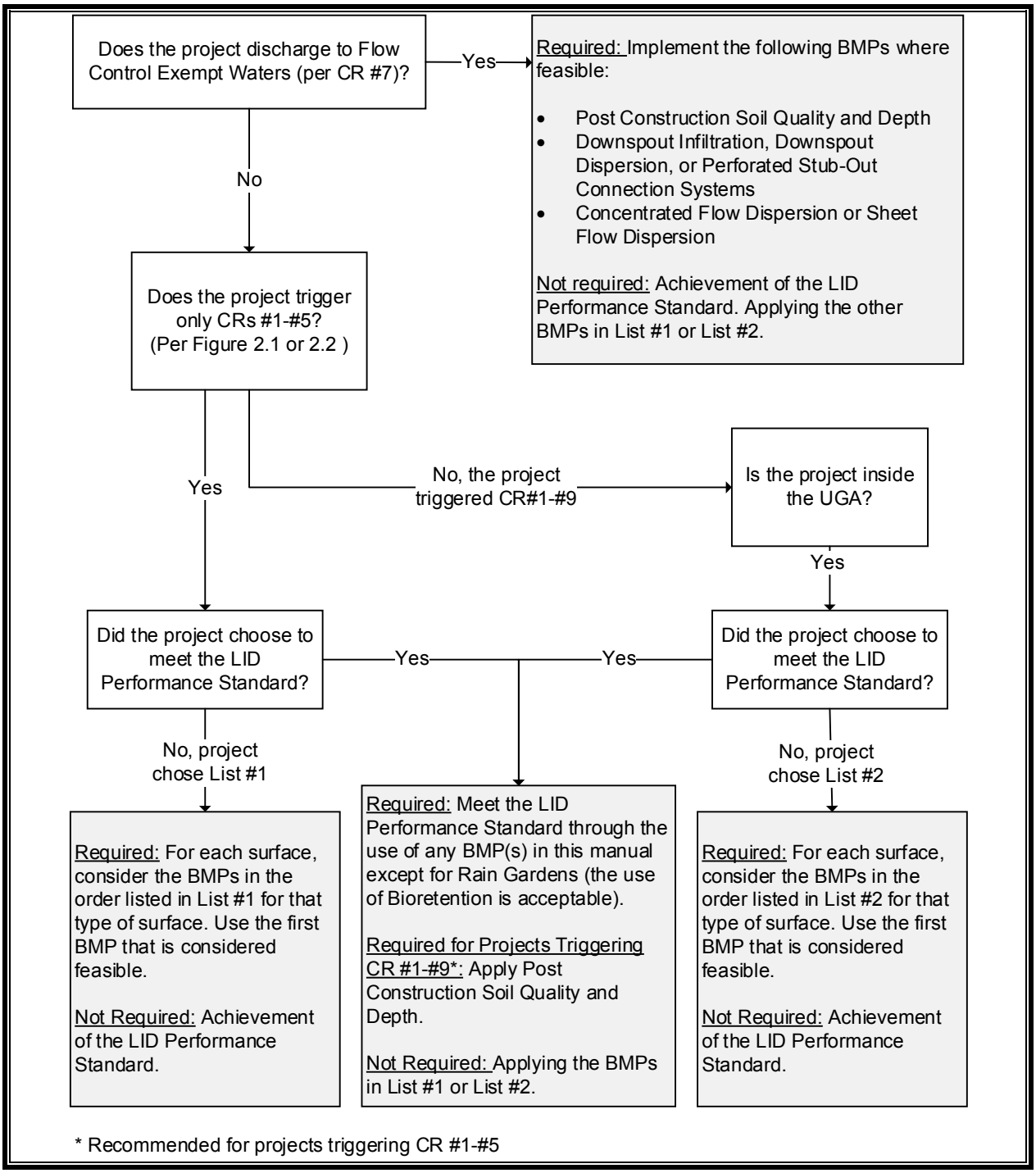

Figure 2.3. Flow Chart for Determining Core Requirement #5 Requirements.

2.2.6 Core Requirement #6: Runoff Treatment

Runoff treatment shall be provided at development project sites to reduce the water quality impacts of stormwater runoff from pollution-generating surfaces.

This shall include treatment for oil products, phosphorus control, and basic or enhanced treatment for dissolved metals and suspended solids for projects that meet specified thresholds.

Treatment Facility Selection, Design, and Maintenance

Stormwater treatment facilities shall be:

- Selected in accordance with the process identified in Chapter 4 and detailed in Chapter 8
- Designed in accordance with the design criteria in Chapter 8
- Maintained in accordance with the maintenance checklists in Chapter 3, Appendix 3B

Thresholds

When assessing a project against the following thresholds, only consider those hard and pervious surfaces that are subject to this core requirement as determined in Section 2.1.2 of this chapter.

The following require construction of stormwater treatment facilities:

- Projects in which the total of effective, pollution-generating hard surface (PGHS) is 5,000 square feet or more in a threshold discharge area of the project, or
- Projects in which the total area of pollution-generating pervious surfaces (PGPS)—not including permeable pavements—is 0.75 acre or more in a threshold discharge area, and from which there will be a surface discharge in a natural or artificial conveyance system from the site.

Treatment Facility Sizing

Size stormwater treatment facilities for the entire area that drains to them, even if some of those areas are not pollution-generating, or were not included in the project site threshold decisions (Section 2.1.2 of this chapter) or the treatment threshold decisions of this core requirement.

Water Quality Design Storm Volume:

- Using an approved continuous runoff model (e.g., the Western Washington Hydrology Model [WWHM] or MGSFlood), the water quality design storm

volume shall be equal to the simulated daily volume that represents the upper limit of the range of daily volumes that accounts for 91 percent of the entire runoff volume over a multi-decade period of record.

Water Quality Design Flow Rate:

- *Preceding Detention Facilities or when Detention Facilities are not required*: The flow rate at or below which 91 percent of the runoff volume, as estimated by an approved continuous runoff model, will 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 percent total suspended solids (TSS) removal). At a minimum, 91 percent of the total runoff volume, as estimated by an approved continuous runoff model, must pass through the treatment facility(ies) at or below the approved hydraulic loading rate for the facility(ies).

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

Additional Requirements

Direct discharge of untreated stormwater from pollution-generating impervious surfaces to groundwater is prohibited. Chapter 8, Section 8.3, provides additional detail on stormwater treatment requirements that may apply to projects that incorporate infiltration facilities, while Section 8.6.3 details the soil requirements to achieve water quality treatment through infiltration.

Additional/specific requirements apply to development projects located within basins with known water quality problems. A water quality problem, for the purposes of impact mitigation in this manual, is defined as a stream reach, lake, or other waterbody of the state that is either: currently designated in the state's Water Quality Assessment 303(d)/305(b) Integrated Report as a Category 5, 4, or 2 water due to exceedance or concern for exceedance of the state's numeric action standard for any pollutants of concern (fecal coliform, dissolved oxygen, or temperature, as noted below), or 2) is currently designated by the City of Lacey or Thurston County as a problem based on credible data indicating exceedance or concern for exceedance of the state's numeric action standard.

Based on the current 303(d) listings in the city, there are currently three types of downstream water quality problems for which additional attention needs to be given to preventing or minimizing increases in the pollutant or pollutants of concern discharging from the site (fecal coliform, dissolved oxygen, or temperature issues). The additional requirements associated with these known problem conditions are outlined in Chapter 8, Sections 8.2.1 and 8.3.5.

Objective

The purpose of runoff treatment is to reduce pollutant loads and concentrations in stormwater runoff using physical, biological, and chemical removal mechanisms so that

beneficial uses of receiving waters are maintained and, where applicable, restored. When site conditions are appropriate, infiltration can potentially be the most effective BMP for runoff treatment.

Supplemental Guidelines

See Chapter 8 for more detailed guidance on selection, design, and maintenance of treatment facilities. Chapter 8 includes performance goals for basic, enhanced, phosphorus, and oil control treatment, and a menu of facility options for each treatment type. Treatment facilities that are selected from the appropriate menu and designed in accordance with their design criteria are presumed to meet the applicable performance goals.

An adopted and implemented basin plan, or a TMDL may be used to develop runoff treatment requirements that are tailored to a specific basin. However, treatment requirements shall not be less than that achieved by facilities in the applicable treatment menu for the site (see Chapter 8, Section 8.3).

Treatment facilities applied consistent with this manual are presumed to meet the requirement of state law to provide all known available and reasonable methods of treatment (RCW 90.52.040, RCW 90.48.010). This technology-based treatment requirement does not excuse any discharge from the obligation to apply whatever technology is necessary to comply with state water quality standards, Chapter 173-201A WAC; state groundwater quality standards, Chapter 173-200 WAC; state sediment management standards, Chapter 173-204 WAC; and the underground injection control program, Chapter 173-218 WAC. Additional treatment to meet those standards may be required by federal, state, or local governments.

Infiltration through use of on-site stormwater management BMPs can provide both treatment of stormwater, through the ability of certain soils to remove pollutants, and volume control of stormwater, by decreasing the amount of water that runs off to surface water. Infiltration through engineered treatment facilities that utilize the natural soil profile can also be very effective at treating stormwater runoff. However, note that pretreatment is required for most infiltration facilities, and soil conditions must also be appropriate to achieve effective treatment while not impacting groundwater resources. See Chapter 8, Section 8.6.3 for further details.

2.2.7 Core Requirement #7: Flow Control

Projects that discharge stormwater directly or indirectly into a fresh water must provide flow control of stormwater discharges and infiltration, to reduce the impacts of stormwater runoff from impervious surfaces and land-cover conversions. Discharges to closed depressions also must provide flow control to minimize potential flooding in the closed depression area.

Projects must provide flow control to reduce the impacts of stormwater runoff from hard surfaces and land cover conversions. The requirements below apply to projects that discharge stormwater directly, or indirectly through a conveyance system, into a fresh

waterbody—except for projects that discharge to Puget Sound (including its inlets). Discharges to these exempt waterbodies (i.e., Puget Sound) are only allowed in accordance with the following restrictions:

- The project site must be drained by a conveyance system that is composed entirely of artificial conveyance elements (e.g., pipes, ditches, outfall protection) and extends to the ordinary high water mark of the exempt receiving water.

- The conveyance system between the project site and the exempt receiving water shall have sufficient hydraulic capacity to convey discharges from future build-out conditions (under current zoning) of the site, and the existing condition from non-project areas from which runoff is or will be collected.

- Any erodible elements of the artificial conveyance system must be adequately stabilized to prevent erosion under the conditions noted above.

- Surface water from the area must not be diverted from or increased to an existing wetland, stream, or near-shore habitat sufficient to cause a significant adverse impact.

If the discharge is to a stream that leads to a wetland, or to a wetland that has an outflow to a stream, both this requirement and Core Requirement #8 apply.

Refer to Appendix I-E (Flow Control Exempt Surface Waters) of the 2014 Ecology Manual for a complete list of Flow Control Exempt Surface Waters. An exemption from flow control requirements for a waterbody that is not listed in Ecology's Appendix I-E (Flow Control Exempt Surface Waters) is subject to Ecology approval on the basis of a hydrologic study demonstrating the absence of significant downstream impacts.

Thresholds

When assessing a project against the following thresholds, consider only those impervious, hard, and pervious surfaces that are subject to this core requirement as determined in Section 2.1.2 of this chapter.

The following circumstances require achievement of the standard flow control requirement for western Washington:

- Projects in which the total of effective impervious surfaces is 10,000 square feet or more in a threshold discharge area.

- Projects that convert 0.75 acre or more of vegetation to lawn or landscape, or convert 2.5 acres or more of native vegetation to pasture in a threshold discharge area, and from which there is a surface discharge in a natural or artificial conveyance system from the site.

- Projects that through a combination of effective hard surfaces and converted vegetation areas cause a 0.10 cubic feet per second (cfs) increase in the 100-year recurrence interval flow frequency from a threshold discharge area as estimated using the WWHM, MGSFlood, or other approved model and 1-hour time steps (or a 0.15 cfs increase using 15-minute time steps). See the supplemental guidelines below for example scenarios that could trigger this requirement.

Development projects that discharge stormwater off site shall submit an off-site analysis report that assesses the potential off-site water quality, erosion, slope stability, and drainage impacts associated with the project and that proposes appropriate mitigation of those impacts.

Discharge Requirements

The allowable release rates from a project are dependent upon the ultimate destination for the stormwater. All projects not directly attributable to Category B below, and not exempted per the flow-control exempt receiving waters outlined above, shall use Category A for determining the allowable discharge rates.

Category A: Discharge to a fresh waterbody.

Any waterbody not defined as a flow control-exempt receiving waters (described above), or closed depression.

Requirements

Stormwater discharges shall match developed discharge durations to predeveloped durations for the range of predeveloped discharge rates from 50 percent of the 2-year recurrence interval peak flow up to the full 50-year peak flow. The predeveloped condition to be matched shall be a forested land cover unless reasonable, historical information is provided that indicates the site was prairie prior to settlement (modeled as “pasture” in the WWHM).

In addition, flow control BMPs shall be selected, designed, and maintained according to this manual.

Alternative Requirement

An alternative requirement may be established through application of watershed-scale hydrological modeling and supporting field observations. Possible reasons for an alternative flow control requirement include:

- Establishment of a stream-specific threshold of significant bedload movement other than the assumed 50 percent of the 2-year recurrence interval peak flow

- Zoning and Land Clearing Ordinance restrictions that, in combination with an alternative flow control standard, maintain or reduce the naturally occurring erosive forces on the stream channel

- A duration control standard is not necessary for protection, maintenance, or restoration of designated and existing beneficial uses or Clean Water Act compliance

Objective

To prevent increases in the stream channel erosion rates that are characteristic of natural conditions (i.e., prior to disturbance by European settlement). The standard intends to maintain the total amount of time that a receiving stream exceeds an erosion-causing threshold based upon historical rainfall and natural land cover conditions. That threshold is assumed to be 50 percent of the 2-year recurrence interval peak flow. Maintaining the naturally occurring erosion rates within streams is vital, though by itself insufficient, to protect fish habitat and production.

Category B: Discharge to a closed depression.

Discharges to any low-lying area which has no outlet, or such a limited surface outlet that in most storm events the area acts as a retention basin holding water for infiltration or evaporation, shall be considered discharges to a closed depression. Appropriate water quality treatment BMPs shall be applied to all discharges.

Requirements

Due to the significant adverse impacts that can result from increasing the rate, volume, and duration of stormwater runoff to closed depressions, the contributing area to the closed depression must be analyzed using a continuous runoff model for the 100-year recurrence interval flow. When a proposed development contributes to a closed depression area, flow from the entire drainage basin tributary to the closed depression shall be routed into the closed depression, using only infiltration as outflow. (Infiltration rates shall be determined as specified in Chapter 7, Section 7.2.3, and Appendix 7A.) Discharge to the area may be allowed when modeling of the postdevelopment (i.e., postproject) high water level indicates no more than a 0.1-foot increase relative to the predevelopment (i.e., existing) high water level for the 100-year recurrence interval, unless the development has acquired ownership or discharge rights to the closed depression. Absent ownership or discharge rights, projects must excavate additional storage volume in the closed depression (subject to all applicable requirements, for example, providing a defined overflow system) needed to achieve the 0.1-foot maximum water level increase.

Note that where there is a flooding potential, concern about rising ground water levels, property rights/ownership/use issues, or sensitive area ordinances and rules, this analysis may not be sufficient. In such cases, the city may require additional analysis and impose more stringent requirements.

Appropriate water quality treatment BMPs must also be applied to all discharges. When selecting appropriate treatment BMPs, the engineer shall assume the soil is fully saturated all year within the closed depression unless the engineer provides supporting documentation for an alternative condition.

Supplemental Guidelines

Calculations to determine whether a project exceeds the 0.10 cubic feet per second (cfs) increase (using a 1-hour time step, or 0.15 cfs using a 15-minute time step) in the 100-year recurrence interval flow must be done individually for each project using an approved continuous simulation runoff model. The calculation will compare runoff in the post development site to the predevelopment land cover. Predevelopment, for this activity, is the lower runoff of the pre project condition or the site in 1997[3]. The unique site, soil, precipitation, and other project-specific factors will ultimately determine whether this threshold is exceeded. Nonetheless, the following general guidelines (based on hypothetical site designs) may be used to help identify the likelihood of this threshold being exceeded. The following land uses changes are likely to exceed this threshold under certain conditions:

- Converting approximately 5,000 square feet of forest to impervious surface
- Converting approximately 5,000 square feet of pasture to impervious surface
- Converting approximately 0.25 acre of forest to landscape surface
- Converting approximately 1.25 acres of forest to pasture surfaces (in till soil conditions)

Reduction of flows through infiltration decreases surface water runoff and helps to maintain base flow throughout the summer months. However, infiltration shall follow the requirements in this manual (particularly Chapters 7 and 8) to reduce the chance that groundwater quality is threatened by such discharges.

Chapter 7 includes a description of the WWHM and other approved continuous simulation runoff models. Some of these models provide tools and/or credits for use of certain on-site stormwater management BMPs and LID techniques described in Chapter 7. Using those BMPs and LID techniques reduces the predicted runoff rates and volumes and thus also reduces the size of the required flow control facilities.

Application of sufficient types of on-site stormwater management BMPs can result in reducing the effective impervious area and the converted vegetation areas, thereby reducing or eliminating the need for a flow control facility. Impervious surfaces that are fully dispersed in accordance with full dispersion in Chapter 7, Section 7.4.2, are not considered effective impervious surfaces. Impervious surfaces that are dispersed in accordance with downspout dispersion in Chapter 7, Section 7.4.10; concentrated flow dispersion in Chapter 7, Section 7.4.2; and sheet flow dispersion in Chapter 7, Section 7.4.2, are still considered effective surfaces though they may be modeled as pervious surfaces if flow path lengths meet the specified minimums. Permeable pavers and modular grid pavements are assigned lower surface runoff calibrations and may also

[3] November 3, 1997, effective date of first ordinance to meet Clean Water Act and NPDES permit requirements for flow control.

reduce stormwater flow control facility sizes. See Chapter 7 for more complete descriptions of hydrologic credits for LID and on-site stormwater management BMPs.

Diversions of flow from perennial streams and from wetlands can be considered if significant existing (i.e., preproject) flooding, stream stability, water quality, or aquatic habitat problems would be solved or significantly mitigated by bypassing stormwater runoff rather than providing stormwater detention and discharge to natural drainage features. Bypassing shall not be considered as an alternative to applicable flow control or treatment if the flooding, stream stability, water quality, or habitat problem to be solved would be caused by the project. In addition, the proposal shall not exacerbate other water quality/quantity problems such as inadequate low flows or inadequate wetland water elevations. The existing problems and their solution or mitigation as a result of the direct discharge shall be documented by a stormwater engineer or scientist after review of any available drainage reports, basin plans, or other relevant literature. The restrictions in this core requirement on conveyance systems that transfer water to an exempt receiving water are applicable in these situations. Approvals by all regulatory authorities with relevant permits applicable to the project are necessary.

2.2.8 Core Requirement #8: Wetlands Protection

Discharges to wetlands shall maintain the hydrologic conditions, hydrophytic vegetation, and substrate characteristics necessary to support existing and designated wetland uses and functions.

Applicability

The requirements below apply only to projects whose stormwater discharges into a wetland, either directly or indirectly through a conveyance system.

Thresholds

The thresholds identified in Core Requirement #6: Runoff Treatment and Core Requirement #7: Flow Control shall also be applied to determine the applicability of this requirement to discharges to wetlands.

Standard Requirement

Projects shall comply with Lacey Municipal Code, Title 14, Chapter 14.28 Wetlands Protection, and Guide Sheet #1 through #3 of the 2014 Ecology Manual, Volume I, Appendix I-D. The hydrologic analysis shall use the existing land cover condition to determine the existing hydrologic conditions unless directed otherwise by a regulatory agency with jurisdiction.

Additional Requirements

Stormwater treatment and flow control facilities shall not be built within a natural vegetated buffer, except for:

- Necessary conveyance systems as approved by the City of Lacey

- As allowed in wetlands approved for hydrologic modification and/or treatment as approved by the City of Lacey and any additional regulatory agency with jurisdiction

An adopted and implemented basin plan or TMDL may be used to develop requirements for wetlands that are tailored to a specific basin.

Objective

To ensure that wetlands receive the same level of protection as any other waters of the state. Wetlands are extremely important natural resources which provide multiple stormwater benefits, including groundwater recharge, flood control, and stream channel erosion protection. They are easily impacted by development unless careful planning and management are conducted. Wetlands can be severely degraded by stormwater discharges from urban development due to pollutants in the runoff and also due to disruption of natural hydrologic functioning of the wetland system. Changes in water levels and the frequency and duration of inundations are of particular concern.

Supplemental Guidelines

Appendix I-D of the 2014 Ecology Manual, "Guidelines for Wetlands when Managing Stormwater," shall be used for discharges to natural wetlands and wetlands constructed as mitigation. While it is always necessary to pretreat stormwater prior to discharge to a wetland, there are limited circumstances where wetlands may be used for additional treatment and detention of stormwater. These situations must comply with the City of Lacey Critical Area Ordinance (LMC 16.54) as well as the requirements and Guide Sheet 2 of Appendix I-D.

Note that if selective runoff bypass is an alternative being considered to maintain the hydroperiod, the hydrologic analysis must consider the impacts of the bypassed flow. For instance, if the bypassed flow is eventually directed to a stream, the flow duration standard, Core Requirement #7, applies to the bypass.

2.2.9 Core Requirement #9: Operation and Maintenance

Maintenance access, a project-specific operation and maintenance agreement, and Maintenance and Source Control Manual shall be provided for all proposed stormwater facilities and BMPs.

The Maintenance and Source Control Manual shall be consistent with the provisions in Chapter 3 and Chapter 9 of this manual. A Maintenance and Source Control Manual shall be provided for all proposed stormwater facilities and BMPs, and the party (or parties) responsible for maintenance and operation shall be identified. For most facilities, the owner shall sign the maintenance agreement and record it at the Thurston County Auditor's Office. At private facilities, a copy of the manual shall be retained on site or within reasonable access to the site, and shall be transferred with the property to the new owner. Copies of the agreement and manual shall be retained on site or within reasonable access to the site. For city-owned facilities, maintenance agreements are not required, but

a copy of the maintenance manual shall be retained in the appropriate department. A log of maintenance activity that indicates what actions were taken and when (as part of the required ongoing maintenance inspections) shall be kept and be available for inspection by the city at any time. See also the stormwater maintenance requirements within the City of Lacey Stormwater Code, LMC 14.25.

Objective

To ensure that stormwater control facilities are adequately maintained and operated properly.

Supplemental Guidelines

Inadequate maintenance is a common cause of failure for stormwater control facilities. The Maintenance and Source Control Manual should be viewed as the owner's manual, written for the person who was not the designer, builder, or inspector but who, in the future, is charged with the responsibility to maintain the facilities built for them. While the Maintenance and Source Control Manual may be submitted during permitting at the same time as the complete set of construction plans, the two are often separated after final construction. The manual should be written with sufficient information to describe the number, location, and type of facilities as well as specific details and inspection intervals to ensure proper maintenance long into the future. The description of each BMP in Chapters 5, 7, and 8 includes a section on maintenance to assist in writing the Maintenance and Source Control Manual. Chapter 3, Appendix 3B, includes maintenance checklists for many drainage facilities.

2.3 Additional Requirements

2.3.1 Financial Guarantees

Maintenance and/or operational bonding or other appropriate financial guarantees are required for all projects to ensure construction and functionality of drainage facilities in compliance with applicable standards. These guarantees are to be consistent with the most recent edition of the City of Lacey *Development Guidelines and Public Works Standards*.

2.3.2 Other Additional Requirements

Requirements of this manual may be superseded or augmented by the adoption of ordinances and rules to implement the recommendations of watershed plans or basin plans, or through the adoption of actions and requirements identified in a TMDL (or water quality improvement program) that is approved by Ecology and the U.S. EPA. These additional requirements are reflected in (Core Requirement #6 and Chapter 8).

The City of Lacey may request additional information or impose controls that differ from (and may exceed the core requirements of) those specified in this manual, at the discretion of the city. In doing so, the city shall act reasonably, exercising best

professional judgment based on available information. Typical reasons for requiring additional information or controls may include, but are not limited to, the following:

- Water quality degradation potential
- Stream bank erosion potential caused by increased flows, leading to habitat damage
- Flooding potential that may present risk to life, safety, vital services, or property
- TMDLs or other regulatory mandates imposed by state or federal agencies

2.4 Adjustments

Adjustments to the core requirements may be granted prior to permit approval and construction. The SDM Administrator may grant an adjustment, subject to a written finding of fact that documents the following:

- The adjustment provides substantially equivalent environmental protection.
- The objectives of safety, function, environmental protection and facility maintenance are met, based upon sound engineering practices.

2.5 Exceptions and Variances

Exceptions/variances to the core requirements may only be granted prior to permit approval and construction, subject to the requirements specified below and pursuant to provisions of the Lacey Municipal Code (LMC). Title 2, Chapter 2.30 Land Use Hearings Examiner, Title 16, Chapter 16.90 Variances, and other sections of the LMC may be applicable.

Exceptions and variances to the core requirements may be granted following legal public notice of an application for an exception or variance, legal public notice of the city's decision on the application, and written findings of fact that document the city's determination to grant an exception. The city shall keep records, including the written findings of fact, of all local exceptions to the core requirements.

The city may grant an exception to the core requirements if such application imposes a severe and unexpected economic hardship. To determine whether the application imposes a severe and unexpected economic hardship on the project applicant, the applicant must consider and document with written findings of fact the following:

- The current (preproject) use of the site
- How the application of the core requirements restricts the proposed use of the site compared to the restrictions that existed prior to the adoption of the core requirements

- The possible remaining uses of the site if the exception were not granted
- The uses of the site that would have been allowed prior to the adoption of the core requirements
- A comparison of the estimated amount and percentage of value loss as a result of the core requirements versus the estimated amount and percentage of value loss as a result of requirements that existed prior to adoption of the core requirements
- The feasibility for the applicant to alter the project to apply the core requirements

In addition, any exception must meet the following criteria:

- The exception will not increase risk to the public health and welfare, nor be injurious to other properties in the vicinity and/or downstream, and to the quality of waters of the state; and
- The exception is the least possible exception that could be granted to comply with the intent of the core requirements.

Chapter 3 – Stormwater Submittals

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Chapter 3 – Stormwater Submittals

3.1 Purpose, Content, and Organization

This chapter outlines the various requirements for submittals of stormwater plans, reports, and other documents for review by the City of Lacey. The submittals described in this chapter are required for compliance with Core Requirement #1: Preparation of Stormwater Site Plans and Reports, as well as for preparation of a Construction SWPPP, in accordance with Core Requirement #2.

The amount of document preparation and review required for stormwater plan submittals are tiered to match the impact potential of a particular project to the appropriate amount of regulatory oversight and control. All projects are subject to the core requirements outlined in Chapter 2, and the plans described in this chapter meet the requirements of the Stormwater Site Plan required by Core Requirement #1. Based on the project size and proposed conditions, an applicant will have to prepare one of three submittal types: a SWPPP Short Form, an Abbreviated Plan, or a Drainage Control Plan (outlined further below).

The remainder of this chapter is divided into three major sections:

- Section 3.2 describes which submittals are required, depending on project thresholds
- Section 3.3 describes each type of drainage review submittal, including SWPPP Short Forms, Abbreviated Plans, and Drainage Control Plans
- Section 3.4 describes submittal requirements for changes that may occur after Stormwater Site Plan approval.

3.2 Drainage Review Types and Submittals

Project thresholds and associated submittal requirements are summarized in Table 3.1. Project applicants should identify their type of project in the Table 3.1 rows, and then identify the appropriate submittal requirements by each column, as well as any applicable table notes. Note that Table 3.1 only summarizes submittal requirements and cannot be used to identify applicable minimum requirements, exemptions, etc. Project proponents must refer to Chapter 2 for detailed information and requirements. Information on other project permit requirements and materials—including applications, fees, right-of-way use requirements, and other code requirements—are outlined in the City of Lacey *Development Guidelines and Public Works Standards*, or can be obtained from the City of Lacey Public Works Department or Community Development Department.

In addition, any activity that alters the approved plans for a given project (e.g., stormwater facility maintenance or repair, drainage facility resizing, other project design changes to impervious surfaces or land cover) will require re-approval by the city,

regardless of whether the thresholds listed in Table 3.1 have been exceeded. This may include updates to the original SWPPP Short Form, Abbreviated Plan, or Drainage Control Plan, and associated Construction SWPPP. See Sections 3.4 and 3.5 for additional details.

3.2.1 City Projects

Projects conceived, designed, or constructed by or through an agent of the city shall meet the requirements of this manual. This includes development of all required Stormwater Site Plan documentation, and maintenance of records adequate to reflect compliance with these requirements.

3.2.2 Project Submittal Process

Presubmission Meeting

Most projects will require a presubmission meeting, as outlined in DG&PWS 1B.020. The presubmission meeting is to help the city understand the project, to help the applicant understand the requirements, and to make a preliminary determination of the type of submittal required based on project thresholds.

Stormwater Scoping Meeting

In addition to the presubmission meeting described above, most projects will require a stormwater scoping meeting prior to any stormwater plan submittals. The purpose of the stormwater scoping meeting is to discuss what stormwater requirements apply to a given project, and what steps the project proponent must take toward developing a complete project submittal.

Draft Stormwater Site Plans

Projects requiring an Abbreviated Plan or Drainage Control Plan (per Section 3.3 below) shall submit a complete draft of the plan for review and inclusion in the permit or land use application package, provided to the city in both electronic (PDF) and hard copy formats. The draft plan shall target an approximately 90 percent (or greater) level of completion, with the majority of the content outlined in Section 3.3 being complete or nearly complete at the time of submittal.

Plan drawings shall show a well-developed concept with sufficient detail to enable review and evaluation of the feasibility and acceptability of the proposed Stormwater Site Plan. All pertinent Drainage Report documentation requirements (per Section 3.3) shall also be sufficient to enable review and evaluation of the proposed plan. Minor changes and revisions may be made following the draft plan submittal and review, though substantive changes are only expected if the draft plan does not meet the intent or requirements of this manual.

Final Stormwater Submittal

After the draft Abbreviated Plan or draft Drainage Control Plan has been reviewed and accepted (e.g., Site Plan Review approval or Preliminary Plat approval), the applicant shall submit a final plan for the project, incorporating any comments and necessary revisions from the draft plan review. The final Stormwater Site Plans shall incorporate any minor revisions and modifications identified in the draft, and shall be provided to the city in both electronic (PDF) and hard copy formats.

The final Abbreviated Plan or Drainage Control Plan is intended to be complete and final, however it is understood that occasionally further changes may be needed after project approval. See Section 3.4 for procedures related to submitting changes to final plans after approval.

3.2.3 Design Plan Certification

Drainage Control Plan preliminary and final Site Development Drawings and Drainage Reports must be stamped and signed by a civil engineer licensed in the State of Washington. In many situations, it also will be necessary for a licensed professional to prepare components of the Abbreviated Plan. See Sections 3.3.1 through 3.3.3 for plan-specific requirements.

All land boundary surveys and legal descriptions used for preliminary and engineering plans must be stamped and signed by a land surveyor licensed in the State of Washington. Topographic survey data and mapping prepared for a proposed project may be performed by the civil engineer who stamps the engineering plans.

Table 3.1. Thresholds for SWPPP Short Forms, Abbreviated Plans, and Drainage Control Plans.

Category[1,2,3]	<2,000 sq. ft. New or Replaced Impervious/ Hard Surface	If Core Requirements #1 through #5 Apply	If Core Requirements #1 through #9 Apply
Subdivisions, Short Plats, Binding Site Plans	SWPPP Short Form	Abbreviated Plan	Drainage Control Plan
Creation of New or Replaced Impervious/Hard Surface[7]	SWPPP Short Form	Abbreviated Plan[4]	Drainage Control Plan[4]
Construction of Roads, Shared Accesses, and Alleyways	SWPPP Short Form	Abbreviated Plan	Drainage Control Plan
Building Permit	SWPPP Short Form	Abbreviated Plan[4]	Drainage Control Plan[4]
Clearing or Grading	SWPPP Short Form	Abbreviated Plan	Drainage Control Plan
Maintenance and Repair of Roads, Shared Accesses, and Alleyways		Abbreviated Plan	Drainage Control Plan
Utility Line Work (construction or maintenance—inside R/W)[5]		Abbreviated Plan	Drainage Control Plan
Utility Line Work (construction or maintenance—outside R/W)[6,7]		Abbreviated Plan	Drainage Control Plan
Driveway culvert installation in Roadside Swales/Ditches[8]	SWPPP Short Form		

SWPPP Short Form = Construction Stormwater Pollution Prevention Plan Short Form (see Appendix 3A).

Note that all Abbreviated Plans and Drainage Control Plans also require a completed Construction Stormwater Pollution Prevention Plan (SWPPP).

Table 3.1 notes:

1. See Chapter 2 to identify applicable minimum requirements, exemptions, etc. Chapter 2, Section 2.1.3 in particular includes information on projects that are exempt from the requirements of this manual. Table 3.1 is only intended to summarize submittal requirements, not overall project requirements.

2. For sites that contain critical areas or critical area buffers, a submittal stamped by a licensed professional engineer is required, unless waived by the city.

3. All development must consider the thirteen elements of Core Requirement #2 (see Section 2.4.2). Depending on the scope of the project, components of the Construction SWPPP shall be required with the plan submittal.

4. As noted in Chapter 2, Section 2.1.2, projects that exceed the above thresholds and: 1) are within the 1-year time of travel zone for a wellhead protection area, and 2) contain existing hard surfaces that do not drain to an approved stormwater management facility are required to apply the applicable core requirements to the entire project site (i.e., not just to the new and replaced hard surfaces).

5. All work shall be performed in accordance with the City of Lacey *Development Guidelines and Public Works Standards*, shall include the implementation of the applicable Abbreviated Plan or Drainage Control Plan measures, and shall be in compliance with this manual for the life of the installation.

6. An individual site development permit is not required if utility line improvements are performed within a larger project (i.e., subdivision construction) that has a site development permit and the utility line improvements have been addressed under the larger project's site development permit.

7. Routine, repetitive maintenance or repair activities that do not meet the threshold for an Abbreviated Plan or Drainage Control Plan shall be performed in accordance with standard BMPs as published by the city.

8. Driveway culvert size and location to be per city inspector's direction. The city may require that the applicant retain an engineer to size and design the culvert in situations where there may be a drainage issue. Note that a driveway and/or right-of-way permit may also be required.

3.3 Drainage Submittals for Permit Application

3.3.1 SWPPP Short Form

In accordance with Core Requirement #2: Construction Stormwater Pollution Prevention, all projects must address construction-phase erosion and sediment control, starting prior to initial land disturbance and continuing throughout the site work. Projects that are identified in Table 3.1 as needing a SWPPP Short Form shall submit a complete SWPPP Short Form (see Appendix 3A) as well as a basic site illustration showing existing and

proposed site features including SWPPP BMPs. The intent of the SWPPP Short Form is to record basic project information, and to document that the 13 Construction Stormwater Pollution Prevention elements of Core Requirement #2 are being considered and addressed as applicable.

3.3.2 Abbreviated Plan

Projects that are identified in Table 3.1 as needing an Abbreviated Plan require a Site Development Permit submittal, document preparation, city review, and city inspection. Abbreviated Plans have to address Core Requirements #1 through #5. Detailed descriptions of Abbreviated Plan thresholds and requirements are outlined in the following subsections. A schematic showing the components of a typical Abbreviated Plan is presented in Figure 3.1.

The purpose of an Abbreviated Plan is:

1. To ensure that a project complies with the applicable core requirements.
2. To incorporate requirements that achieve the intent and purpose of the Critical Area Regulations. Flood, Landslide, Shoreline Erosion, Wetland, and other critical areas sometimes require measures that must be depicted on Abbreviated Plan drawings to achieve compliance with these regulations.
3. To prevent development-related stormwater runoff from impacting neighboring properties.

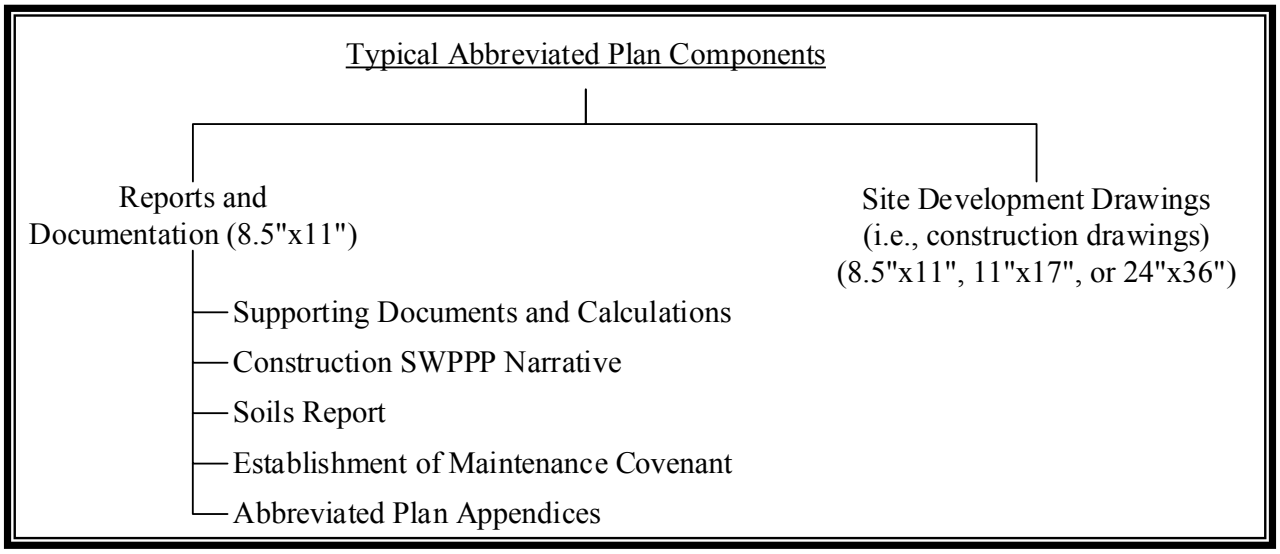


Figure 3.1. Typical Abbreviated Plan Components.

Abbreviated Plan Requirements

If new, replaced, or new plus replaced hard surfaces are greater than or equal to 2,000 square feet (but less than 5,000 square feet), or if land-disturbing activity is greater than or equal to 7,000 square feet, an Abbreviated Plan must be submitted.

Fundamentally, the Abbreviated Plan must demonstrate how Core Requirements #1 through #5 are being met. Note that Core Requirement #5 includes detailed requirements and decision points that can affect the project significantly, which must be reflected in the Abbreviated Plan documentation. Likewise, compliance with Core Requirement #2 will require preparation of a full Construction SWPPP.

The following sections provide detail on the requirements for Abbreviated Plans. Each section covers a required Abbreviated Plan section or attachment. In many situations, it will be necessary for a licensed professional to prepare components of the Abbreviated Plan. In some cases, the additional required information pertinent to the Abbreviated Plan may be available within the plat or other approved documents related to the project.

The following Abbreviated Plans topics are discussed:

- Abbreviated Plan Report contents
- Drawing requirements for Abbreviated Plans
- Construction SWPPP requirements
- Soils Report requirements
- Establishment of maintenance obligation
- Abbreviated Plan appendices

Abbreviated Plan Report

The Abbreviated Plan shall include narrative and quantitative data that facilitate plan review for compliance with all applicable elements of Core Requirements #1 through #5. Two copies of the Abbreviated Plan shall be submitted and bound in 8.5- by 11-inch size.

Abbreviated Plan Section 1 – Cover Sheet

The Abbreviated Plan must have a cover sheet with the project name; applicant's name, address, telephone number, and email address; project engineer's (if applicable) name, address telephone number, and email address; date of submittal; contact's name, address, telephone number, and email address; and the name, address, telephone number, and email address of the contractor, if known.

Abbreviated Plan Section 2 – Proposed Project Description

Describe type of permit for which the applicant is applying, address and legal description of property, parcel number, property zoning, etc. Describe any other permits required (hydraulic permits, U.S. Army Corps of Engineers (USACE) Section 404 Permit, wetlands, etc.) and present status.

Provide a brief description of the following:

- The development project (type, size, location, proposed improvements, and for additions/remodels only—current assessed value and cost of improvements excluding land value)
- Stormwater features to be installed for flow control, treatment, and conveyance (types, sizes, and locations).
- Which of the core requirements apply to the project, and how they are being addressed. Also include justification for those core requirements that do not apply.

Summarize calculations for all facilities (detailed calculations shall be included in Section 5 below). Include a tabulation of the following:

- Current and proposed hard surfaces
- New and replaced pollution-generating pervious, impervious, and hard surfaces; and effective impervious surfaces
- Disturbed pervious (such as landscaped areas); converted vegetation areas; and undisturbed areas.
- In this table, indicate any additions of hard surfaces, and the value of any additions or remodels completed during the last 5 years.

Describe the stormwater BMPs incorporated into the design. For LID features and Core Requirement #5 specifically, describe the following:

- Project narrative showing how the project will fulfill the requirement for on-site management of stormwater to the extent feasible.
- Total area of vegetation retained.
- For projects using the list option for Core Requirement #5, an explanation and documentation, including citation of site conditions identified in a Soils Report, for any determination that an on-site stormwater management BMP was considered infeasible for the site. Information obtained and documented in the Existing Conditions Description (Section 3, see below) shall be used to substantiate any BMP infeasibility determinations. Detailed explanations and/or calculations can be included in Section 5 (see below) if needed. (See also Chapter 7, Appendix 7B, for a summary of infeasibility criteria for all BMPs.)
- Areas of disturbed soils to be amended. (Note: All lawn and landscaped areas are to meet requirements of postconstruction soil quality and depth [see Chapter 7, Section 7.4.1]. Use of compost is one way to meet the requirement).
- Retained trees and newly planted trees for which impervious reduction credits are claimed.

Abbreviated Plan Section 3 – Existing Conditions Description

Low impact development site design in particular is intended to complement the existing conditions on the site. However, not all sites are appropriate for all LID and on-site stormwater management BMPs, as site conditions often determine the feasibility of using these techniques. The existing conditions site analysis, consistent with the requirements of this section, shall determine the feasibility of using these BMPs.

Describe existing conditions and relevant hydrologic conditions including, but not limited to, the items listed below. Where subsequent report sections call for more details on these issues, a brief description and reference to the specific report section, attachment, or appendix is sufficient.

- Existing ground cover, including pervious (trees, shrubs, lawn, etc.), hard surface, and pollution generating areas.
- Off-site drainage to the property.
- Creeks, lakes, ponds, wetlands, ravines, gullies, steep slopes, springs, erosion hazards, fresh water designations, ESA species habitat, and other environmentally critical or sensitive areas on or downgradient of the property.
- Whether the project is located in a critical aquifer recharge area or wellhead protection area as defined by the city (see area maps in Appendix 8B as well as on the city's web site at <http://www.ci.lacey.wa.us/stormwater-design-manual>).
- Any specific requirements included in a basin plan or TMDL (such as the Henderson Inlet TMDL) for the area.
- Drains, channels, and swales, within the project site and immediately adjacent.
- Points of exit for existing drainage from the property.
- Any known historical drainage problems such as flooding, erosion, etc. including drainage complaints history from city and road drainage problems (per City of Lacey and Thurston County).
- Proximity to structures, property lines, on-site structures, utilities (lines, pedestals, vaults, etc.), sewers, septic tanks, septic fields and reserve areas, basements, bulkheads, closed or active landfills, and underground storage tanks.
- Summary of existing soil types, groundwater levels, and soil hydraulic conductivity (details to be covered in Soils Report – Attachment 3).
- Projects that involve work in or near critical areas must demonstrate compliance with LMC 16.54. The Abbreviated Plan must indicate any specific site design and

construction requirements that implement the applicable critical area standards and requirements.

Abbreviated Plan Section 4 – Vicinity Analysis

In accordance with Core Requirement #4, all projects shall submit a qualitative analysis downstream from the site to the receiving water. A quantitative analysis may be required for any project where the City of Lacey SDM Administrator determines that a quantitative analysis is necessary to evaluate the off-site impacts or the capacity of the conveyance system. A quantitative analysis may include calculations and/or modeling analyses of on-site and off-site water quality, erosion, slope stability, and other drainage-related impacts that may be caused or aggravated by a proposed project.

The qualitative and/or quantitative analysis must be sufficient for the city to evaluate whether the project has adequately identified potential impacts and whether proposed mitigation measures are supported by the analysis. The analysis shall identify where and how stormwater runoff will leave the proposed development site, and describe conditions downstream of the site including any existing or potential future problem areas (e.g., spot flooding, property damage, erosion issues, capacity-limited drainage systems, etc.). Some "rough" quantitative analysis, which can be based on non-surveyed field data, may be necessary as part of the qualitative analysis. Note that any related site visits should be conducted during winter months and after significant precipitation events to identify undocumented surface seeps or other indicators of near surface groundwater.

Abbreviated Plan Section 5 – Supporting Analyses and Calculations

Abbreviated Plans must include all calculations and/or analyses necessary to demonstrate compliance with applicable core requirements. This may include calculations related to sizing stormwater BMPs or conveyance systems, analyses of site or downstream conditions, documentation of infeasibility issues, etc. All relevant work/calculations shall be submitted for city review, either in this section of the report or in appendices if needed.

For Core Requirement #5 in particular, if using List #1, provide detailed written justification, including citation of site conditions identified in the Soils Report, for any on-site stormwater management BMPs that are determined to be "infeasible" for the project site. If the applicant elects or must use the LID performance standard option of Core Requirement #5, they shall provide design details of all BMPs that are used to help achieve the standard, and a complete computer model report (include as an appendix to the Abbreviated plan) including input files and output files. Projects taking an impervious surface reduction credit for newly planted or retained trees must provide those calculations and documentation on site plans for the locations of the trees. Projects using full dispersion or full downspout infiltration BMPs must provide information to confirm conformance with design requirements that allow removal of the associated drainage areas from computer model input.

Licensed Engineer Required For Roads

Abbreviated Plans that propose work on public roads, private roads, and unopened city right-of-way must be prepared by a professional engineer licensed in Washington State.

Site Development Drawings (Abbreviated Plan Attachment No. 1)

The Abbreviated Plan Site Development Drawings generally contain all the pertinent information necessary for construction of a project. This may include applicable drainage, grading, sediment control, and topographic survey information, as well as any applicable notes or details. These drawings shall be included in the Abbreviated Plan as Attachment 1 to the report.

Refer to the City of Lacey *Development Guidelines and Public Works Standards* for requirements related to site drawing size, content, organization, etc. The following notes identify and emphasize important stormwater-related components that must be reflected in the site drawings.

At a minimum, Abbreviated Plan drawings must contain:

- The location and type of any existing or proposed on-site stormwater management BMPs (e.g., soil amendment, infiltration trenches, dispersion, rain gardens, permeable pavement, etc.)
- The location and type of construction stormwater pollution prevention BMPs used for erosion and sediment control
- The location and type of other construction stormwater pollution prevention BMPs (such as refueling areas and concrete washout areas)
- Location of stormwater conveyance systems for runoff from structures
- Notes, specifications, and details related to selected BMPs
- Natural drainage channels, wetlands, canyons, gullies, water bodies, etc.
- Areas to be graded, filled, excavated, or otherwise disturbed
- Location of known wells, and underground storage tanks
- Survey information prepared by a registered land surveyor or other qualified professional including but not limited to:
    - Minor hydrologic features, including seeps, springs, closed depression areas, and drainage
    - Major hydrologic features including streams, wetlands, and water bodies, as well as wetland and buffer boundaries and classifications

- Flood hazard areas on or adjacent to the site
- Geologic hazard areas and associated buffer requirements on or adjacent to the site
- Aquifer and wellhead protection areas on or adjacent to the site
- Topographic features that may act as natural stormwater storage, infiltration, or conveyance
- Locations of soil surveys, soil test pits, and soil borings conducted as part of the required Soils Report.

It is useful when these drawings also include:

- A driveway approach detail
- Building setbacks from property lines.

In addition, if a geotechnical assessment is required, any recommendations contained in the report must be incorporated into the Site Development Drawings.

Construction SWPPP Requirements (Abbreviated Plan Attachment No. 2)

Abbreviated Plans must include a complete Construction SWPPP. See Chapter 5, Section 5.2.2 of this manual for information on the items that shall be included as part of the Construction SWPPP narrative (i.e., report) and drawings. The Construction SWPPP shall be implemented beginning with initial land disturbance and until final stabilization. Note that the Construction SWPPP drawings should be included in the drawing packet required as Abbreviated Plan Attachment No. 1.

Soils Report Requirements (Abbreviated Plan Attachment No. 3)

In support of the requirements of Core Requirement #5, Abbreviated Plans must include a Soils Report prepared by: a professional soil scientist certified by the Soil Science Society of America (or an equivalent national program); a locally licensed on-site sewage designer; or by other suitably trained persons working under the supervision of a professional engineer, geologist, hydrogeologist, or engineering geologist registered in the State of Washington. The report shall include the following information:

- Soil surveys, soil test pits, soil borings, or soil grain analyses sufficient to identify underlying soils on the site.
- The results of saturated hydraulic conductivity (Ksat) testing to assess infiltration capability and feasibility (i.e., per Core Requirement #5 infeasibility requirements). Use one of the infiltration testing methods outlined in Chapter 7, Appendix 7A.

- The results of testing for a hydraulic restriction layer (groundwater, soil layer with less than 0.3 in/hr Ksat, bedrock, etc.) under possible sites for infiltration BMPs. This analysis should be performed in the winter season (December 1 through April 30). The optimum time to test for depth to groundwater is usually late winter and shortly after an extended wet period. Site historical information and evidence of high groundwater in the soils can also be used.

- The results of site-specific soil tests on sites proposed for downspout infiltration systems. The report shall at a minimum identify the limits of any outwash type soils (i.e., those meeting USDA soil texture classes ranging from coarse sand and cobbles to medium sand) versus other soil types and include an inventory of topsoil depth. Refer to Chapter 7, Section 7.4.10, for additional soils investigation and report requirements for downspout infiltration systems.

- Any additional BMP-specific soils and infiltration testing information that is required for the project. Specific infiltration testing requirements are outlined in Chapter 7, Section 7.4.4 (for bioretention), Section 7.5.4 (for rain gardens), Section 7.4.6 (for permeable pavements), and Section 7.4.10 (for roof downspout infiltration). Of particular note is that if the site is located near a groundwater protection area or water supply well, the Soils Report must demonstrate and document that the criteria for infiltrating near a water supply well (refer to Chapter 7 and Chapter 8) are met. Additional soils information related to water quality treatment may be required as outlined in Chapter 8 (e.g., Section 8.6).

- If on-site infiltration may result in shallow lateral flow (interflow), the conveyance and possible locations where that interflow may re-emerge shall be assessed by a professional engineer, geologist, hydrogeologist, or engineering geologist registered in the State of Washington.

Establishment of Maintenance Covenant (Abbreviated Plan Attachment No. 4)

To ensure future maintenance of on-site stormwater management BMPs used to meet the requirements of Core Requirement #5, a maintenance covenant must be recorded for each parcel that contains on-site stormwater management BMPs. The proposed covenant must be reviewed and approved by the city prior to recording. All required covenants must be recorded prior to final construction approval for the proposed project.

The recorded maintenance covenant must be created using the provided City of Lacey *Stormwater Maintenance Covenant Form* (obtainable from the city's website at <http://www.ci.lacey.wa.us/stormwater-design-manual>). The covenant shall include an 8.5- by 11-inch plan view showing the location of on-site stormwater management BMPs relative to structures and property lines, and maintenance instructions for each on-site stormwater management BMP. A map showing the location of newly planted and retained trees claimed as flow reduction credits shall also be attached. All documents and attachments shall meet the recording requirements of the Thurston County Auditor's

Office. After approval by the city and county, the declaration of covenant must be signed and recorded at the Thurston County Auditor's Office.

Abbreviated Plan Appendices

The previous sections outline the required documentation for Abbreviated Plan submittals. Where the project warrants additional technical documentation, or where the SDM Administrator determines that additional information is necessary, that information may be included as appendices to the Abbreviated Plan. The following potential Abbreviated Plan appendices may be necessary or useful.

Abbreviated Plan Appendix 1 – Design Calculations

Provide complete calculations for the conveyance, flow control, and water quality facilities not included in Abbreviated Plan Section 5, including printouts of the continuous modeling computation files and any other computer printouts or manual calculations used in the stormwater design. Present the calculations in a clear and orderly manner, labeled and annotated as needed, to facilitate an efficient review and approval process. For example, the appendix should include continuous modeling inputs (e.g., screenshot) and an annotated printout of results to highlight and clarify key results and conclusions. The project applicant must also include digital copies of the model with files sufficient to re-run the model and include input parameters, as well as model output files to the city.

Abbreviated Plan Appendix 2 – Soil Management Plan

If Postconstruction Soil Quality and Depth BMP is used on site (refer to Chapter 7, Section 7.4.1), a Soil Management Plan must be included in the project submittal. The Soil Management Plan must include the following:

- A site map showing areas to be fenced and left undisturbed during construction, and areas that will be amended at the turf or planting bed rates
- Determination of soil conditions
- Identified soil quality implementation option
- Calculations of the amounts of compost, compost amended topsoil, and mulch to be used on the site.

General guidance on these procedures can be found in the Building Soil manual (Stenn et al. 2012), available at <www.buildingsoil.org>.

Abbreviated Plan Appendix 3 – Supplemental Reports and Information

Depending on site and vicinity characteristics, various special reports and studies may be required to provide supplemental information. The various types of supplemental reports and information may include:

- Wetland Delineation and Description
- Floodplain delineation
- Flood protection facility conformance
- Critical areas analysis and delineation
- Geotechnical/geology
- Groundwater quality and/or hydrogeology
- Structural engineering

3.3.3 Drainage Control Plan

The Drainage Control Plan is the full submittal package meeting all core requirements per Chapter 2, Figures 2.1 and 2.2. The Drainage Control Plan submittal package includes the following components: Drainage Report, Site Development Drawings, Construction SWPPP, Maintenance and Source Control Manual, Maintenance Covenant, and any plan appendices. A schematic showing the components of a typical Drainage Control Plan is presented in Figure 3.2. The Construction SWPPP consists of two parts: a narrative report and drawings, which should be included in the plan set with the other Site Development Drawings. Additional details on each component of the Drainage Control Plan are provided in the following sections.

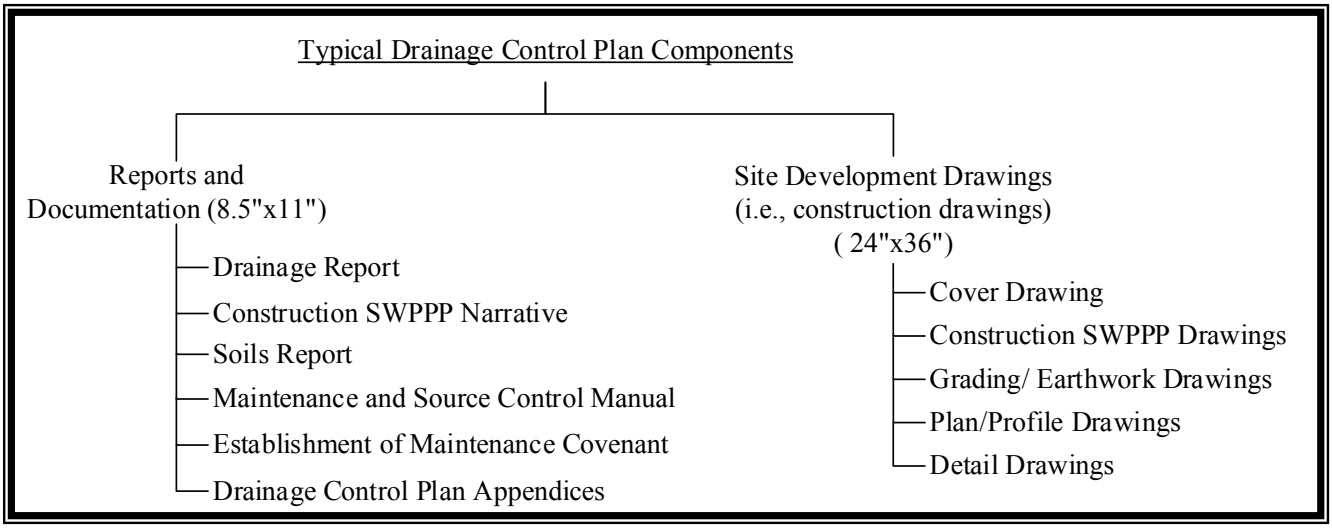


Figure 3.2. Typical Drainage Control Plan Components.

Phased Project Submittals

Phased projects shall be completed in accordance with approved Drainage Control Plans and in accordance with phased development requirements placed upon the development by the city. Phasing of projects shall not result in a reduction of drainage control

requirements. Drawings showing the overall project, clearly delineating phase boundaries, and estimating dates of construction (if known), shall be part of any initial submittal.

Drainage Report

The Drainage Report is a major component of the Drainage Control Plan. The Drainage Report shall include detailed information and data related to stormwater planning and design that facilitate plan review. Specific components of the Drainage Report are described in detail below. Two copies of the Drainage Report shall be submitted and bound in 8.5- by 11-inch size.

Cover Sheet: The Drainage Report must have a cover sheet with the project name; applicant's name, address, telephone number, and email address; project engineer's name, company name, address, telephone number, and email address; date of submittal; contact's name, address, telephone number, and email address; and the name, address, telephone number, and email address of the contractor, if known. The cover sheet must also include a list of all appendices included within the Drainage Report, as well as a list of all attachments included with the report.

Project Engineer's Certification: The project engineer responsible for completion of a Drainage Control Plan submittal as described herein shall be a professional engineer with a current State of Washington license. All plans and specifications, calculations, certifications, as-built drawings, and all other submittals which will become part of the permanent record of the project must be dated and bear the project engineer's official seal and signature.

The Drainage Report shall contain a page with the project engineer's seal and the following statement:

> *"I hereby state that this Drainage Control Plan for _____ (name of project) has been prepared by me or under my supervision and meets the standard of care and expertise which is usual and customary in this community for professional engineers. I understand that the City of Lacey does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities prepared by me."*

Table of Contents: Show the page number for each section of the report. Show page numbers of appendices. Identify all attachments included with the report. All pages of the Drainage Report shall be numbered.

Maps: The Drainage Report shall include the following maps, sized so that all pertinent details are clearly visible:

- **Basin Map**. Show project boundaries, subbasin boundaries, and off-site area tributary to the project. Show major drainage features (such as channels and detention facilities and floodways), and flow path to receiving waters. Use an appropriate scale for the project site.

- **Work Map (or maps)**. On a topographic map at an appropriate scale for the project site, show:
    - Unit areas greater than 1 acre as contributing to a reach of swale or to a catch basin including off-site area. Identify areas contributing to retention/detention facilities. Identify threshold discharge areas (TDAs) where applicable. Show the following on the work map (or on a schedule) for unit areas: total project area; total hard surfaces, pollution generating hard/impervious surface, pollution generating pervious surface, and total disturbed area; average slope; and estimated ultimate infiltration rate and Soil Conservation Service (SCS) Soil Group.
    - Conveyance data, conveyance system capacities, identifier (for reference to model output), length, slope, inverts up and down.
    - Overland flow paths and distances.
    - Soil types.
    - Locations of soil pits and infiltration tests.
    - Spot water surface elevations, discharges and velocities for the design event.
- **Schedule of Structures.** The Drainage Report shall include a table or "schedule" for the storm drainage structures used on the project, including the following information:
    - Catch basin/manhole number
    - Stationing
    - Washington State Plane Coordinate System (i.e., Northings and Eastings) if used
    - Street name and side located on, if applicable
    - Catch basin/manhole diameter or size
    - Invert elevation in/out
    - Pipe diameter in/out
    - Type of each structure and pipe, i.e., Type II, concrete.

All Drainage Reports shall have each of the following section titles (if some sections do not apply, list and mark N.A.):

Drainage Report Section 1 – Proposed Project Description

Describe type of permit for which the applicant is applying, address and legal description of property, parcel number, property zoning, etc. Describe other permits required (hydraulic permits, USACE Section 404 Permit, wetlands, etc.) and present status.

Provide a brief description of the development project (type, size, location, proposed improvements, phasing (if applicable), and for additions/remodels only, current assessed value and cost of improvements excluding land value) and the stormwater features to be installed for storage, treatment, conveyance, and disposal/discharge (types, sizes, and locations).

Identify which of the core requirements apply to the project, and how they are being addressed. Also include justification for those core requirements that do not apply. For Core Requirement #5, indicate whether the project used the mandatory list option, or the LID performance standard option, and complete documentation demonstrating compliance with either approach (additional guidance provided below).

Summarize calculations for all facilities. Include a tabulation of the current and proposed hard surfaces; new and replaced pollution generating pervious, impervious, and hard surfaces; effective impervious surfaces; disturbed pervious (such as landscaped areas); converted vegetation areas; and undisturbed areas. In this table, indicate any additions of hard surfaces, and the value of any additions or remodels completed, during the last 5 years. Complete engineering calculations, including hydrologic modeling analyses and documentation, must be included with the report. It is recommended that these be placed in appendices and be referenced where appropriate.

Describe the stormwater BMPs and conveyance systems incorporated into the design. Describe the detention system, outlet works, and spillways. Discuss vegetation establishment and management plan for conveyance and detention systems. For LID features and Core Requirement #5 specifically, describe the following:

- Project narrative showing how the project will fulfill the requirement for on-site management of stormwater to the extent feasible.

- Total area of vegetation retained.

- For projects using the list option for Core Requirement #5, an explanation and documentation, including citation of site conditions identified in a Soils Report, for any determination that an on-site stormwater management BMP was considered infeasible for the site. Information obtained and documented in the Existing Conditions Description (Section 2, see below) shall be used to substantiate any BMP infeasibility determinations. (See also Chapter 7, Appendix 7B, for a summary of infeasibility criteria for all BMPs.)

- Areas of disturbed soils to be amended. (Note: All lawn and landscaped areas are to meet requirements of postconstruction soil quality and depth [see Chapter 7, Section 7.4.1]. Use of compost is one way to meet the requirement).

- Retained trees and newly planted trees for which impervious reduction credits are claimed (see Chapter 7, Section 7.4.3 for information on impervious surface credits associated with trees).

Drainage Report Section 2 – Existing Conditions Description

Existing conditions analysis results shall be submitted as part of the Drainage Control Plan submittal. Information in this section should also be used to help prepare the Construction Stormwater Pollution Prevention Plan.

Low impact development site design in particular is intended to complement the existing conditions on the site. However, not all sites are appropriate for all LID and on-site stormwater management BMPs, as site conditions often determine the feasibility of using these techniques. The existing conditions site analysis, consistent with the requirements of this section, shall determine the feasibility of using these BMPs.

Describe existing conditions and relevant hydrologic conditions including, but not limited to, the items listed below. Where subsequent report sections call for more details on these issues (e.g., soils, wells, septic systems), a brief description and reference to the specific Drainage Report section or appendix is sufficient.

- Existing ground cover, including pervious (trees, shrubs, lawn, etc.), hard surface, and pollution-generating areas.

- Off-site drainage to the property.

- Creeks, lakes, ponds, wetlands, ravines, gullies, steep slopes, springs, erosion hazards, fresh water designations, ESA species habitat, and other environmentally critical or sensitive areas on or downgradient of the property.

- Whether the project is located in a critical aquifer recharge area or wellhead protection area as defined by the city (see area maps in Appendix 8B as well as on the city's web site at <http://www.ci.lacey.wa.us/stormwater-design-manual>).

- Any specific requirements included in a basin plan or water quality improvement program (such as the Henderson Inlet Watershed TMDL) for the area.

- Drains, channels, and swales, within the project site and immediately adjacent.

- Points of exit for existing drainage from the property.

- Any known historical drainage problems such as flooding, erosion, etc. including drainage complaints history from city and road drainage problems (per City of Lacey and Thurston County).

- Proximity to structures, property lines, on-site structures, utilities (lines, pedestals, vaults, etc.), sewers, septic tanks, septic fields and reserve areas, basements, bulkheads, closed or active landfills, and underground storage tanks.

- Summary of existing soil type, groundwater levels, and soil hydraulic conductivity (details to be covered in Attachment 3).

- Include references to relevant reports such as basin plans, flood studies, groundwater studies, wetland designations, sensitive area designations, environmental impact statements, environmental checklists, lake restoration plans, water quality reports, soils reports, etc. Where such reports impose additional conditions on the applicant, state these conditions and describe any proposed mitigation measures.

Drainage Report Section 3 – Vicinity Analysis and Subbasin Description

In accordance with Core Requirement #4, all projects shall submit a qualitative analysis downstream from the site to the receiving water. A quantitative analysis may be required for any project deemed to need additional downstream information or where the project engineer or the SDM Administrator determines that a quantitative analysis is necessary to evaluate the off-site impacts or the capacity of the conveyance system.

A **qualitative analysis** must be sufficient for the city to evaluate whether the project has adequately identified potential impacts and whether proposed mitigation measures are supported by the analysis. Some "rough" quantitative analysis, which can be based on non-surveyed field data, may be necessary at this stage. A downstream analysis of the project for a minimum of one-half of a mile is required. The analysis must also extend upstream to a point beyond any backwater effects caused by the project. The analysis must include field-inspection of all existing stormwater drainage systems downstream from the project and determination of whether the capacity of the drainage system(s) is adequate to handle the existing flows, flows generated by the proposed project, and any overflow. Adequacy will be evaluated based on conveyance capacity, flooding problems, erosion damage or potential, amount of freeboard in channel and pipes, and storage potential within the system. Note that site visits should be conducted during winter months and after significant precipitation events to identify undocumented surface seeps or other indicators of near surface groundwater.

A **quantitative analysis** shall include the qualitative analysis describe above, as well as quantitative calculations and/or modeling analyses of on-site and off-site water quality, erosion, slope stability, and other drainage-related impacts that may be caused or aggravated by a proposed project. Measures for preventing impacts and for not aggravating existing impacts shall also be identified. ("Aggravating existing impacts" means increasing the frequency of occurrence and/or severity of an impact.) The analysis

shall document how temporary and permanent flow control and water quality control measures identified in the Drainage Control Plan will mitigate the potential to create new problems or aggravate existing conditions. In many cases, design of flow control and water quality systems according to the procedures contained in this manual will be adequate demonstration of mitigation. However, upon review of this analysis and the severity of an existing problem, the City of Lacey may require more detailed analysis and/or additional mitigation measures.

Both the qualitative analysis and the quantitative analysis (when required) shall include descriptions and/or analyses of the following items. The descriptions shall identify existing or potential problem areas, and whether adequate mitigation can be identified (or whether more detailed quantitative analysis is necessary). References to other Drainage Report sections (e.g., facility sizing, conveyance, attachments and appendices, etc.) are encouraged to eliminate report redundancy, as long as all of the required Drainage Report issues are clearly presented:

- All areas pertinent to the analyses such as site boundaries, study area boundaries, streets and prominent features, downstream flowpath, potential/existing problems, etc. shall be keyed to features shown on the work map (described previously).

- Describe drainage system between the site and the receiving surface waters (or pothole, regional detention facility, etc.). Provide information on pipe sizes, channel characteristics, and drainage structures. Describe emergency services located along the flow path (e.g., fire/police stations, hospitals). Describe environmentally sensitive areas, such as wetlands, etc.

- Describe off-site drainage tributary to the project. Describe any bypass drainage from the project which will not be controlled.

- The bulk of the analysis shall focus on highlights of important considerations from the existing conditions section related to the drainage system and potential problems or concerns. Existing and potential impacts to be evaluated and mitigated shall include, but not be limited to:

    - Conveyance system capacity issues

    - Flooding or bank overtopping

    - Upland erosion impacts, including slope stability and landslide hazards

    - Stream channel erosion (at the outfall location and to the downstream limit of analysis)

    - Violations of surface water quality standards as identified in a basin plan or a TMDL; or violations of groundwater standards in a wellhead protection area.

  - For each existing or potential problem, document existing and/or future: magnitude of damage caused by the problem, general frequency and duration, current mitigation of the problem (if any), likely or possible cause of the problem, and whether the project is likely to aggravate the problem or create a new one.

- Identify the existence of critical aquifer recharge areas, wellhead protection areas, drinking water wells, and septic systems both of record and others on the site and on adjacent property within the setback distance for stormwater retention/detention facilities identified in Chapter 7. See also area maps in Appendix 8B as well as on the city's web site at <http://www.ci.lacey.wa.us/stormwater-design-manual>. The project engineer shall inquire with the Thurston County Environmental Health Department and neighboring property owners as necessary to obtain location of wells and septic systems that are not of record. Wells and septic systems thus found, both active and abandoned, shall also be shown on the plans or as-builts (if found during construction). If no wells or septic systems were found, indicate so.

- Identify the existence of fuel tanks, in-use or abandoned. Fuel tanks shall be shown on the plans or as-builts (if found during construction). If fuel tanks will be abandoned, contact the Thurston County Environmental Health Department for specific instructions. If no fuel tanks are found, indicate so.

- Determine whether the project is within the potential flood hazard area as defined in LMC Title 14.34, show the 100-year flood hazard area on the plans. If project is determined to be in the flood hazard area additional requirements may apply per LMC Title 14.34.

Drainage Report Section 4 – Flow Control and Water Quality Facility Sizing

The project engineer shall provide calculations for the project's flow control and water quality treatment system components. All relevant work/calculations shall be submitted for city review, either in this section of the report or in included appendices if needed. Documentation outlining whether and how each of the core requirements have been addressed in the Drainage Control Plan shall be submitted for city review. All calculations shall be keyed to features shown on the work map as described above. In addition, project submittals must include a table that identifies the design facility stage expected for the 2-, 5-, 10-, 25-, 50-, and 100-year recurrence interval flows.

If hydrologic modeling (see Chapters 2, 6, 7, and 8) is required, the project engineer shall use an approved continuous simulation runoff model and document modeling methods, assumptions, parameters, data sources, and all other relevant information to the analysis. If model parameters are used that are outside the standards of practice, or if parameters are different than those standards, justify the parameters. The applicant shall include hard copies of the model outputs, with annotations (clear, hand-written notes are acceptable) specifically highlighting key model inputs and results. Hard copies of pertinent model output shall be provided in Appendix 1 of the Drainage Control Plan [Design

Calculations], and summarized in this section.) The applicant must also include digital copies of the model with files sufficient to re-run the model and include input parameters, as well as model output files to the city. (Projects taking an impervious surface reduction credit for newly planted or retained trees (see tree planting and tree retention in Chapter 7, Section 7.4.3) must provide those calculations and documentation on site plans for the locations of the trees. Projects using full dispersion or full downspout infiltration BMPs must provide information to confirm conformance with design requirements that allow removal of the associated drainage areas from computer model input.

For design of water quality treatment systems specifically, if bioretention and/or infiltration below pollution-generating hard surfaces through adequate soils (see Chapter 8, Section 8.6.3) will be used to help meet treatment requirements, the runoff model output files must include the volume of water that has been treated through those BMPs. The summation of those volumes and the volume treated through a centralized, conventional treatment system must meet or exceed 91 percent of the total stormwater runoff file. This sum of volumes must include:

- Stormwater that has infiltrated through a bioretention area, and stormwater that has infiltrated below pollution-generating hard surfaces (e.g., permeable pavement) through adequate soils.
- Stormwater that passes through a properly-sized treatment facility. Note that stormwater that is re-collected below a bioretention area and routed to a centralized treatment facility must not be counted twice.
- Subtraction of any stormwater that does not receive treatment due to bypass of, or overflow from a treatment facility or a bioretention area (if the overflow is not subsequently routed to a treatment facility).

For a subdivision project, document assumptions related to roof, driveway, and other hard surface lot coverages (as well as contributing pervious areas) that have been used in the design and sizing of facilities.

Drainage Report Section 5 – Aesthetic Considerations for Facilities

Describe the effort made to make the facilities aesthetically pleasing, how facilities will provide useable open space, and how the facilities will fit into the landscaping plan for the property and be in keeping with any approved community plan. Drainage facilities should be made attractive features of the urban environment. Engineers are encouraged to be creative in shaping and landscaping facilities. Note that facilities shall also meet the landscaping requirements of LMC 16.80.

Drainage Report Section 6 – Conveyance System Analysis and Design

This section must document the methods and results of analyses used to evaluate and design the conveyance system per the hydraulic computation guidance in Chapter 6. All calculations, equations, graphs, nomographs, and references used shall be provided in

Appendix 1 of the Drainage Control Plan (Design Calculations), and summarized in this section.

Provide a narrative description of the conveyance system, and identify all components of the system including pipes, inlets, manholes, open channels, natural channels, and culverts. Include summaries of all calculations for capacity of channels, culverts, drains, gutters, etc. Describe design flow rates for each component, as well as pipe/culvert/ditch dimensions, inverts, slopes and flow capacities. Summarize the applicable performance standard (e.g., 25-year return period peak runoff) used for the conveyance system. Describe required materials or specifications for the design (e.g., rock lining for channels when velocity is exceeded, high density polyethylene pipe needed for steep slope). If a backwater analysis is required, calculations should also include grate interception calculations (spread and bypass), hydraulic grade line at structures, and tabulated results.

If used, include nomographs and tables indicating how they were used. Show headwater and tailwater analysis for culverts when necessary. Provide details on references and sources of information used.

Drainage Report Section 7 – Covenants, Dedications, Easements

Information relevant to covenants, dedications, and easements need only be summarized in this section. Details shall be provided in the Maintenance and Source Control Manual (see Drainage Control Plan Attachment 4 below) and the Establishment of Maintenance Covenant (see Drainage Control Plan Attachment 5 below).

Describe legal instruments needed to guarantee preservation of drainage systems and access for maintenance purposes (attach copies if not included as part of other Drainage Control Plan submittals). Describe the organization or person which will be responsible for operation and maintenance of storm drainage facilities. For projects subject to Core Requirement #5, a declaration of covenant must be recorded for each parcel that contains on-site stormwater management BMPs, to ensure future maintenance of those BMPs. Also attach a copy of any property owners' articles of incorporation, if applicable and available.

Last, describe how utilities will be installed, any easements that affect stormwater facilities, and how the project will ensure no conflicts exist between proposed utility locations and proposed stormwater quantity and quality control measures.

Drainage Report Section 8 – Agreements and Guarantees

Maintenance and/or operational bonding or other appropriate financial guarantees are required for all projects to ensure construction and functionality of drainage facilities in compliance with applicable standards. These guarantees are to be consistent with the most recent edition of the City of Lacey *Development Guidelines and Public Works Standards*.

Drainage Report Section 9 – Other Permits or Conditions Placed on the Project

Construction of road and drainage facilities may require additional permits from other agencies. These additional permits may contain more restrictive drainage control requirements. This section should provide the title of any other necessary permits, the agencies requiring the other permits, and identify the permit requirements that affect the project.

Other agencies including, but not limited to, those listed below may require drainage review for a proposed project's impact on surface waters, stormwater, and conveyance systems. The applicant should take care to note that these other agency drainage requirements are separate from, and in addition to, City of Lacey's drainage requirements. The applicant will be responsible to coordinate joint agency drainage review, including resolution of any conflicting requirements between agencies. The additional agencies that may require permits for some projects are listed in Table 3.2. However, this is not a complete list of permits that may be required.

Table 3.2. Other Potential Permits.

Agency	Permit/Approval
Thurston County Environmental Health Department	On-site Sewage Disposal and Well Permits
Washington State Department of Transportation (WSDOT)	Developer/Local Agency Agreement
Washington State Department of Ecology	Short Term Water Quality Modification Approval
Washington State Department of Fish and Wildlife	Hydraulic Project Approval
Washington State Department of Ecology	Dam Safety Permit
United States Army Corps of Engineers	Section 10 Permit
United States Army Corps of Engineers	Section 401 Certification
United States Army Corps of Engineers	Section 404 Permit
City of Lacey	Shoreline Substantial Development Permits, Conditional Use Permits and Variance Permits
City of Lacey	Right-of-Way Access Permit
City of Lacey	Wetland Development Permit

* This is not a complete list of possible permits that may be required.

Site Development Drawings (Drainage Control Plan Attachment No. 1)

It is the responsibility of the project engineer to ensure that engineering drawings submitted for review are sufficiently clear to construct the project in proper sequence, using specified methods and materials, and with sufficient dimensions to fulfill the intent of drainage laws and ordinances and these design guidelines.

The most recently adopted editions of standard specifications and standard plans shall be the standards for all design and construction of drainage facilities not explicitly described herein. In the event of a conflict between the standard specifications, standard plans, and the manual, this manual shall prevail. When required by the city, standard specifications and general provisions for construction must be submitted with any road construction plans.

Projects that involve work in or near critical areas must demonstrate compliance with LMC 16.54. The Drainage Control Plan must indicate any site design and construction requirements that implement the applicable critical area standards and requirements.

General Site Development Drawing Requirements

Refer to the City of Lacey *Development Guidelines and Public Works Standards* for requirements related to site drawing size, content, organization, etc. The following notes identify and emphasize important stormwater-related components that must be reflected in the site drawings. Complete drawing requirements are provided in the City of Lacey *Development Guidelines and Public Works Standards*.

- The project's existing and proposed storm drainage along with easements, tracts, drainage facilities, all buffer and screening areas, off-site and on-site existing drainage courses, delineated wetlands, and associated buffers. Indicate direction of flow, size, and kind of each drainage channel, pipe, and structure. The status of existing drainage structures must be clarified as either "existing-abandon" or "existing-remove." For on-site stormwater management BMPs, provide a scale drawing of the lot or lots, and any public-right-of-way that displays the location of the BMPs and the areas served by them.

- Details of all on-site stormwater management BMPs that are used to help achieve compliance with Core Requirement #5. If distributed bioretention areas and/or storage below permeable pavement are used, provide details to confirm accurate facility representation in the runoff models (submitted as part of Drainage Report Section 4).

- Identify locations and species types for newly planted or retained trees for which impervious surface reduction credits are claimed. Supporting areas such as the flow paths for dispersion BMPs shall also be shown.

- If distributed bioretention areas and/or infiltration below pollution-generating hard surfaces are used to help meet treatment requirements, provide details to confirm accurate representation in the runoff model (submitted as part of Drainage Report Section 4).

- Existing paved surfaces, including roads.

- Areas of possible significant environmental concern (gullies, ravines, swales, wetlands, steep slopes, estuaries, springs, creeks, lakes, etc.). For natural drainage features show direction of flow.

- 100-year floodplain boundary (if applicable).

- Soil logs, soil log locations, and soils within the project site as verified by field testing (and documented in Drainage Control Plan Section 3).

- Wells and wellhead protection areas—existing and proposed, on site and on adjacent properties (both of record and not of record) within specified setbacks.

- Topographic features that may act as natural stormwater storage, infiltration, or conveyance.

- Drainage Control Plans must include a complete Construction SWPPP. See Chapter 5, Section 5.2.2, of this manual for information on the items that shall be included as part of the Construction SWPPP narrative (i.e., report) and drawings. Construction SWPPP drawings should be included as part of the Site Development Drawings package.

- Proposed grades.

- Topographic information including contour lines of the property in its existing condition. City or U.S. Geological Survey (USGS) topographic mapping must be field verified and supplemented with additional field topographic information when necessary to provide an accurate depiction of the property.

- Other typical features as listed in the City of Lacey *Development Guidelines and Public Works Standards* including but not limited to: utilities, lot dimensions and areas, grading/clearing setbacks from property lines, earthwork/geotechnical requirements, etc.

Detail Drawings

- All applicable standard notes.

- A minimum of two cross-sections of each retention/detention pond and bioretention area showing original property lines, slope catch points, and all other pertinent information to adequately construct the pond or bioretention area.

- Details of all on-site stormwater management BMPs that are used to help achieve compliance with Core Requirement #5. If distributed bioretention areas and/or storage below permeable pavement are used, provide details to confirm accurate facility representation in the runoff models (submitted as part of Drainage Report Section 4).

- Identify locations and approximate size of all permeable pavement surfaces and bioretention areas to be installed, including those that will be installed on individual lots.

- If distributed bioretention areas and/or infiltration below pollution-generating hard surfaces are used to help meet treatment requirements, provide details to confirm accurate representation in the runoff model (submitted as part of Drainage Report Section 4).

- Standard open conveyance system cross-sections if applicable.
- Right-of-way cross-sections as required by the city.
- Construction recommendations from a Soils Report, if applicable.

Construction SWPPP Report (Drainage Control Plan Attachment No. 2)

Chapter 5, Section 5.2.2, of this manual describes the items that shall be included in the Construction SWPPP report. At a minimum, all 13 Construction Stormwater Pollution Prevention elements in accordance with Core Requirement #2 (Section 2.4.2) must be addressed. The Construction SWPPP shall be implemented starting prior to any land disturbance and continue until final stabilization.

Note: The Construction SWPPP consists of two parts: a narrative report and drawings. **A complete Construction SWPPP (both report and drawings) is required as part of the Drainage Control Plan submittal.** Note that the Construction SWPPP drawings should be included in the drawing packet required as Drainage Control Plan Attachment No. 1.

Soils Report (Drainage Control Plan Attachment No. 3)

For all sites utilizing infiltration for stormwater management, a Soils Report must be prepared that is stamped by a professional engineer with geotechnical expertise, a licensed geologist, an engineering geologist, or a hydrogeologist, and that summarizes site characteristics and demonstrates that sufficient permeable soil for infiltration exists at the proposed facility location. The reporting requirements depend on the type of facility and analysis being performed. Also note that additional BMP-specific soils and infiltration testing and documentation requirements are outlined in Chapter 7, Section 7.2 (for infiltration basins and trenches), Section 7.4.4 (for bioretention), and Section 7.4.6 (for permeable pavements). Of particular note is that if the site is located near a groundwater protection area or water supply well, the Soils Report must demonstrate and document that the criteria for infiltrating near a water supply well (refer to Chapter 7 and Chapter 8) are met. Additional soils information related to water quality treatment may be required as outlined in Chapter 8 (e.g., Section 8.6).

At a minimum, the Soils Report for all sites must contain the following:

- Figure showing the following:
  - Topography within 500 feet of the proposed facility
  - Locations of any water supply wells within 500 feet of the proposed facility
  - Location of groundwater protection areas, critical aquifer recharge areas, and 1-, 5-, and 10-year times of travel zones for wellhead protection areas (see area maps in Appendix 8B as well as on the city's web site at <http://www.ci.lacey.wa.us/stormwater-design-manual>)

  - Locations of test pits or test holes.

- Soil surveys, soil test pits, soil borings, or soil grain analyses sufficient to identify underlying soils on the site.

- Results of soils tests including but not limited to: detailed soil logs, visual grain size analysis, grain-size distribution (required if using the grain size analysis method to estimate infiltration rates), percent clay content (include type of clay, if known), color/ mottling, variations and nature of stratification.

- Description of local site geology, including soil or rock units likely to be encountered at soil sampling depths and the seasonal high groundwater elevation.

- Detailed documentation of the design infiltration rate determination, as specified in Chapter 7 and Appendix 7A.

- State whether location is suitable for infiltration and recommend a design infiltration rate.

- The results of testing for a hydraulic restriction layer (groundwater, soil layer with less than 0.3 in/hr Ksat, bedrock, etc.) under possible sites for infiltration BMPs. This analysis should be performed in the winter season (December 1 through April 30). Site historical information and evidence of high groundwater in the soils can also be used.

- Any additional BMP-specific soils and infiltration testing information that is required for the project's flow control or water quality treatment designs (e.g., for infiltration basins and trenches, bioretention, and permeable pavements).

- If on-site infiltration may result in shallow lateral flow (interflow), the conveyance and possible locations where that interflow may re-emerge shall be assessed by a professional engineer, geologist, hydrogeologist, or engineering geologist registered in the State of Washington.

- If a retention and/or detention facility is near the top of a slope that is regulated through local ordinance, then a geotechnical assessment addressing effects of seepage and the potential for slope failure during any precipitation event though the design event is required as part of this section of the Drainage Report.

Maintenance and Source Control Manual (Drainage Control Plan Attachment No. 4)

In accordance with Core Requirement #9 and Table 3.1, a Maintenance and Source Control Manual must be developed for projects that require a Drainage Control Plan. At private facilities, a copy of the manual shall be retained on site or within reasonable access to the site, and shall be transferred with the property to the new owner. A log of maintenance activity that indicates what actions were taken shall also be kept and be

available for inspection by the city. For public facilities, a copy of the manual shall be retained in the appropriate department.

The manual must be prepared in an 8.5- by 11-inch format and must comply with the recording standards of the Thurston County Auditor's Office. The manual must be prepared by a professional engineer, but must be understandable to the typical property owner and/or person responsible for maintenance. (Note that the Maintenance and Source Control Manual may be presented in outline form for the draft Drainage Control Plan submittal since it is a document that will live with the project after completion and needs to reflect final [built] conditions.)

For both private and public facilities, it is important to work with maintenance personnel early and throughout the design process. During discussions with maintenance personnel, describe the maintenance procedures that will be performed on the site BMPs. This will help ensure that future maintenance work and potential access needs are clearly understood.

The Maintenance and Source Control Manual must include the following components:

Cover Page: The Maintenance and Source Control Manual must have a cover page that includes the project name; engineer's name, address, telephone number, and email address; date of preparation of the manual (and any updates); project parcel numbers; and applicable city permit numbers.

Map: A map of the project area must be included in the manual. The extent of the map shall be inclusive of all the drainage facilities that are a part of the Drainage Control Plan for the project. The intent of the map is to show the drainage facilities, boundaries (drainage easements) of the maintenance responsibilities, and access easements that the Maintenance and Source Control Manual addresses. Include a key referencing the applicable maintenance checklists required to be used in performing routine inspection and maintenance for the facility. The map is not intended to provide a high level of detail nor is it intended to call out every drainage structure (e.g., catch basins). The map shall provide road names of the existing roads that the project connects to as well as any proposed roads. The map can be one or multiple pages.

Drawings: Engineering drawings of the stormwater facilities including details and specifications shall be included. Drawings may be 11″ by 17″ fold-outs, or full-size 22″ by 34″ sheets folded in a map pocket.

Section 1 – Project Description

Provide a brief description of the development project, including project type (plat, short plat, commercial center, industrial, etc.) and size (acres, number of lots, linear feet of road, square feet of building, etc.). Describe the stormwater BMPs and conveyance systems, and how these systems are designed to manage the volume, rate, and quality of stormwater runoff from the project. Describe where stormwater flows come from, how water moves through the site and facilities, and how and where the stormwater leaves the site.

Section 2 – Maintenance Importance and Intent

Include the following statement in this section:

"The importance of maintenance for the proper functioning of stormwater control facilities cannot be over-emphasized. A substantial portion of failures (clogging of filters, resuspension of sediments, loss of storage capacity, etc.) are due to inadequate maintenance. Stormwater BMP maintenance is essential to ensure that BMPs function as intended throughout their full life cycle.

The fundamental goals of maintenance activities are to ensure the entire flow regime and treatment train designed for this site continue to fully function. For this site these include (Note to engineer: include in your text all of the following bullets that apply to your site. Non-applicable content can be omitted):

- Maintain designed stormwater infiltration capacity
- Maintain designed stormwater detention/retention volume
- Maintain ability of storm facility to attenuate flow rates
- Maintain ability to safely convey design stormwater flows
- Maintain ability to treat stormwater runoff quality
- Preserve soil and plant health, as well as stormwater flow contact with plant and soil systems
- Clearly identify systems so they can be protected
- Keep maintenance costs low
- Prevent large-scale or expensive stormwater system failures
- Prevent water quality violations or damage to downstream properties.

The intent of this section and manual is to pass on to the responsible party(s) all the information critical to understand the design of the system, risks and considerations for proper use, suggestions for maintenance frequencies, and cost so that realistic budgets can be established."

Section 3 – Responsible Parties

Stormwater facilities range in size and complexity. Entities responsible for maintenance should be appropriately matched to the tasks required to ensure long-term performance. For example, an individual homeowner may be able to reasonably maintain a rain garden, permeable driveway, infiltration trench, or other small facility. However, larger facilities

are often maintained through private parties, shared maintenance covenants with the city, or by city ownership.

This section of the Maintenance and Source Control Manual must identify the party (or parties) responsible for maintenance and operation of all stormwater structures and BMPs requiring maintenance. Also include a statement of who will keep the Maintenance and Source Control Manual, the address where it will be kept, and language noting that it must be made available for inspection by the city upon request. For a subdivision, the Maintenance and Source Control Manual shall be held by the Home Owners Association president, and shall be included by reference in the articles of incorporation of the Home Owners Association.

Section 4 – Facilities Requiring Maintenance

Provide a detailed inventory of all stormwater structures and BMPs requiring maintenance. For situations where there are split maintenance responsibilities (e.g., private/public), provide a breakdown of the entity responsible for each structure and BMP. Describe (or include reference to other plan sections) how each collection, conveyance, treatment, and flow control component works. Explain the principles of facility operation, overview of maintenance requirements, and any other information that might be helpful for future maintenance of the facilities. This could include pipe and swale data, the design capacities of the conveyance systems, sizing and dimensions of facilities, rip rap specifications, and calculated flow rates.

Section 5 – Maintenance Instructions

This section shall begin with the following statement, unless otherwise approved by the city:

> *"The parties responsible for maintenance must review and apply the maintenance requirements contained herein. These maintenance instructions outline conditions for determining if maintenance actions are required, as identified through inspection. However, they are not intended to be measures of the facility's required condition at all times between inspections. Exceedance of these conditions at any time between inspections or maintenance activity does not automatically constitute a violation of these standards. However, based upon inspection observations, the inspection and maintenance presented in the checklists shall be adjusted to minimize the length of time that a facility is in a condition that requires a maintenance action. For facilities not owned and maintained by the city, a log of maintenance activity that indicates what actions were taken must be kept on site and be available for inspection by the city."*

In addition, include a narrative description of the purpose, function, and maintenance requirements for all stormwater structures and BMPs requiring maintenance. Following the narrative description(s), include detailed maintenance checklists for all stormwater structures and BMPs requiring maintenance. Appendix 3B includes maintenance checklists for all stormwater facilities and BMPs included in this Stormwater Design Manual. The Maintenance and Source Control Manual shall include only those checklist

items that are pertinent to the structures and BMPs proposed for your project. Do not include all of the checklists provided in Appendix 3B. Note that the maintenance checklists (and narrative descriptions) can be included as an attachment to the Maintenance and Source Control Manual, so long as they are clearly referenced in this section. The checklists (or city-approved equivalent) shall be used as the required log sheet for recording inspection observations and maintenance activities in accordance with the stormwater maintenance requirements within the City of Lacey Stormwater Code, LMC 14.25. Note also the ongoing stormwater facility inspection and reporting requirements, also outlined in the Stormwater Code.

Section 6 – Vegetation Maintenance

The effectiveness of many stormwater facilities will depend on the plants included in the facility design, and their proper maintenance. A listing and location of plant species and their requirements for maintenance shall be included in this section. This includes newly planted and retained trees claimed as flow reduction credits, as well as vegetation retention and restoration areas. Maintenance requirements must address issues including but not limited to pest and disease management practices, pruning requirements, irrigation requirements, fertilization requirements, etc.

Section 7 – Pollution Source Control Measures

Pollution source control is the application of pollution prevention practices on a developed site to reduce contamination of stormwater runoff at its source. BMPs and resource management systems are designed to reduce the amount of contaminants used and potentially discharged to the environment. This section of the Maintenance and Source Control Manual shall contain language regarding pollution source controls that are specifically applicable to the site. Include pertinent text from the 15 pollution prevention principles outlined in Chapter 9, Section 9.3, plus any additional site-specific pollution source control issues. Additional information on required and suggested source control measures is provided in Chapter 9.

The completed Stormwater Pollution Source Control Checklist and Worksheet provided in Appendix 9A shall be attached to the Maintenance and Source Control Manual. Any required BMPs shall be listed on the Stormwater Pollution Source Control Worksheet and identified on Stormwater Site Plans.

Section 8 – Annual Cost of Maintenance

Provide an estimate of the expected annual cost of maintenance projected for 20 years. The estimate shall include the annualized cost of both routine tasks (e.g., vegetation maintenance and debris removal, refurbishing media filter cartridges, etc.) and non-routine major tasks (e.g., wet pond sediment removal, infiltration enhancement, etc.). Refer to Section 4 and summarize the number of catch basins, control structures, linear feet of pipe, etc. that require maintenance and the cost implications. See Appendix 3C – O&M Cost Estimate Calculations for specific requirements and examples, or contact the city for additional guidance if needed.

Establishment of Maintenance Covenant (Drainage Control Plan Attachment No. 5)

A maintenance covenant is required for each site/lot that contains stormwater management BMPs that will be maintained by a private entity such as an individual, corporation, or homeowner's association. The recorded maintenance covenant must be created using the provided City of Lacey *Stormwater Maintenance Covenant Form* (obtainable from the city's web site at <http://www.ci.lacey.wa.us/stormwater-design-manual>), and any attachments shall meet the recording requirements of the Thurston County Auditor's Office. The covenant shall be recorded at the Thurston County Auditor's Office at the expense of the applicant, and shall be tied to the parcel numbers that the project is built on. All covenants must be recorded prior to final construction approval for the proposed project.

The covenant shall include the following:

1. A legal description of the property
2. Assessor parcel numbers
3. Project name
4. Project application/permit #
5. Parties responsible (including contact information) for maintenance and implementation of pollution source control measures
6. Language stating that the covenant shall run with the land and be binding on all successors and assigns
7. A requirement that the responsible parties maintain the stormwater facilities in accordance with the attached project Maintenance and Source Control Manual
8. A requirement that the responsible parties implement pollution source control measures in the attached Maintenance and Source Control Manual
9. A requirement that the responsible parties keep and maintain a log of maintenance activity that indicates what actions were taken, and that the log be made available for inspection by the city
10. Language that prohibits unauthorized modifications, unless approved by the city
11. Language that provides for a city approval process and allows modification to the covenant, or to the Maintenance and Source Control Manual
12. Language that provides for a city process (remedies) for situations where the responsible party fails to perform the required maintenance or fails to implement the pollution source control measures

13. Language that provides access authority to the city for purposes of inspection, maintenance, and repair

14. Language that provides for reimbursement to the city by the responsible party in the event that the city incurs costs related to maintenance or repair

15. The location of the approved Drainage Control Plan

16. The Maintenance and Source Control Manual as an attachment.

Drainage Control Plan Appendices

The previous sections outline the required documentation for Drainage Control Plan submittals. Where the project warrants additional technical documentation, or where the SDM Administrator determines that additional information is necessary, that information may be included as appendices to the Drainage Control Plan. Note that some of the appendices may be most suitable as additions to the Drainage Report, while others may be additions to the overall Drainage Control Plan. The plan preparer is responsible for packaging the information in a manner that facilitates project review. The following highlights potential Drainage Control Plan appendices.

Drainage Report Appendix 1 – Design Calculations

Provide complete calculations for the conveyance, flow control, and water quality facilities, including printouts of the continuous modeling computation files and any other computer printouts or manual calculations used in the stormwater design. Present the calculations in a clear and orderly manner, labeled and annotated as needed, to facilitate an efficient review and approval process. For example, the appendix should include continuous modeling inputs (e.g., screenshot) and an annotated printout of results to highlight and clarify key results and conclusions. As noted in Drainage Report Section 4, the project applicant must also include digital copies of the model with files sufficient to re-run the model and include input parameters, as well as model output files to the city.

Drainage Report Appendix 2 – Soil Management Plan

If Postconstruction Soil Quality and Depth BMP is used on site (refer to Chapter 7, Section 7.4.1), a Soil Management Plan must be included in the project submittal. The Soil Management Plan must include the following:

- A site map showing areas to be fenced and left undisturbed during construction, and areas that will be amended at the turf or planting bed rates

- Determination of soil conditions

- Identified soil quality implementation option

- Calculations of the amounts of compost, compost amended topsoil, and mulch to be used on the site.

General guidance on these procedures can be found in the Building Soil manual (Stenn et al. 2012), available at <www.buildingsoil.org>.

Drainage Report Appendix 3 – Supplemental Reports and Information

Depending on site and vicinity characteristics, various special reports and studies may be required to provide supplemental information.

The various types of supplemental reports and information may include:

- Wetland Delineation and Description
- Floodplain delineation
- Flood protection facility conformance
- Critical areas analysis and delineation
- Geotechnical/geology
- Groundwater quality and/or hydrogeology
- Slope protection/stability

3.4 Plans Required After Stormwater Site Plan Approval

3.4.1 Stormwater Site Plan Changes

If the designer wishes to make changes or revisions to the originally approved Stormwater Site Plan, the proposed revisions shall be submitted to the city for approval prior to construction. The submittals shall include the following:

1. Substitute pages of the originally approved Stormwater Site Plan that include the proposed changes.
2. Revised drawings showing any structural changes.
3. Any other supporting information that explains and supports the reason for the change.

3.4.2 Final Corrected Plan Submittal

If the project included construction of conveyance systems, treatment facilities, flow control facilities, or structural source control BMPs (i.e., this does not extend to construction of on-site stormwater management BMPs), the applicant shall submit a final corrected plan ("as-builts") to the city when the project is completed. These should be engineering drawings that accurately represent the project as constructed. These corrected drawings must be professionally drafted revisions that are stamped, signed, and dated by a licensed civil engineer registered in the state of Washington.

Appendix 3A – Construction Stormwater Pollution Prevention Plan (SWPPP) "Short Form"

All projects must comply with Core Requirement #2 to address erosion and sediment control, starting prior to initial land disturbance and continuing until final stabilization of the entire project site. This "Short Form" is for small projects that are not required to complete a full Construction Stormwater Pollution Prevention Plan (SWPPP)*.

Please submit a completed Short Form to the City of Lacey along with a basic site illustration showing existing and proposed site features including SWPPP BMPs. Refer to the City of Lacey 2016 Stormwater Design Manual for further information. Please type or print clearly.

Background Information

Project Name: _____

Project Address or Location: _____

Parcel Number: _____

Parcel Owner: _____

Address (if different from above): _____ Phone: _____

Erosion Control Supervisor: _____

Company: _____ Mobile Phone: _____

Form Completed By:

_____

(printed name) (signature) (date)

Project Description: _____

_____

Total Parcel Area: _____ square feet (sq. ft.)

Total Project Area: _____ square feet (sq. ft.)

Total Area of Land Disturbance: _____ sq. ft. (must be <7,000 sq. ft.)*

Hard Surface Areas (e.g., roofs, driveways, sidewalks, pavement, etc.):

Existing Hard Surface = _____ sq. ft. (total, before project)

Proposed Hard Surface = _____ sq. ft. (total, after project)

Hard Surface to be Replaced = _____ sq. ft. (total, after project)

Roof Area of Structures:

Existing Roof Area = _____ sq. ft. (total, before project)

Proposed New Roof = _____ sq. ft. (total, after project)

Roof to be Replaced = _____ sq. ft. (total, after project)

Total of New + Replaced Hard Surfaces = _____ sq. ft. (must be <2,000 sq. ft.)*

* *Note: If project exceeds the size thresholds, you cannot use this Short Form and must complete a full SWPPP.*

What types of vegetation are present at the project site before the project begins?

Trees/Forest	☐ No	☐ Yes, covering approx. _____	% of project site
Pasture/Brush	☐ No	☐ Yes, covering approx. _____	% of project site
Lawn/Landscaping	☐ No	☐ Yes, covering approx. _____	% of project site

Which of these conditions or features are present at the project site?

Slopes >20%	☐ No	☐ Yes, covering approx. _____	% of project site		
Creek or Stream	☐ No	☐ Yes, covering approx. _____	% of project site		
Wetlands	☐ No	☐ Yes, covering approx. _____	% of project site		
Buffer Zones	☐ No	☐ Yes, covering approx. _____	% of project site		
Lakes and Ponds	☐ No	☐ Yes, covering approx. _____	% of project site		
Springs and Seeps	☐ No	☐ Yes	If yes, along frontage only?	☐ No	☐ Yes
Ditches or Swales	☐ No	☐ Yes	If yes, along frontage only?	☐ No	☐ Yes
Storm Drain Grates	☐ No	☐ Yes	If yes, along frontage only?	☐ No	☐ Yes
Existing Utilities	☐ No	☐ Yes	If yes, along frontage only?	☐ No	☐ Yes
Easements	☐ No	☐ Yes	If yes, along frontage only?	☐ No	☐ Yes

Describe locations of features: _____

_____

Describe the drainage flow path downstream from the site to the nearest surface water:

_____

_____

Describe the estimated schedule of start dates and end dates for site construction activities:

Construction Activity	Estimated Start Date	Estimated End Date
Mark Clearing Limits	_____	_____
Establish Construction Access	_____	_____
Install Erosion and Sediment Controls	_____	_____
Demolition/Clearing/Grading	_____	_____
Utility Construction	_____	_____
Asphalt/Concrete Paving	_____	_____
House/Building/Structure Construction	_____	_____
Landscaping and Final Site Stabilization	_____	_____
Completion of Project Site Work (Removal of Sediment Controls)	_____	_____

Common Elements Applicable to Small Sites – Construction Stormwater Pollution Prevention Plan

All land-disturbing projects are required to consider all 13 elements identified in the City of Lacey 2016 Stormwater Design Manual (SDM), Chapter 5. However, small sites that use this Short Form should pay particular attention to the following five **Minimum Erosion and Sediment Control Objectives**:

1. Protection of Adjacent Properties, Drainage Systems, Surface Waters, and Buffers (Elements #1–#9 below)
   Protect adjacent off-site areas from surface water flows and sediment deposition by appropriate use of Best Management Practices (BMPs) such as silt fencing, straw wattles, mulching, inlet protection, etc. Apply BMPs prior to initial land-disturbance, and maintain until site work is finished and site is stabilized.

2. Prevent Soil Track-out Onto Streets (Element #2 below)
   Stabilize access route with quarry spalls or crushed rock (or pavement) to minimize the tracking of soils and debris onto public roads. Limit vehicle access to work site to one route.

3. Stabilization of Cleared Areas (Elements #5, #6, and #8 below)
   Stabilize all exposed soils through application of BMPs to prevent erosion and movement of sediments. At all times, contractor should have sufficient labor, materials, and equipment on-site to apply BMPs and stabilize all exposed soils within 12 hours as site and weather conditions dictate. Seasonal restrictions under Element #5 below apply to all sites. Permanently stabilize site at project completion.

4. Apply and Maintain BMPs (Elements #11 and #12 below)
   Control any adverse effects due to site work with appropriate erosion and sediment control BMPs, and regularly inspect and maintain all erosion and sediment control BMPs to ensure continued performance of their intended functions. Remove temporary BMPs at project completion.

5. Protect Low Impact Development BMPs (Element #13 below)
   Protect LID BMPS from soil compaction and sedimentation through careful site planning, equipment operation, erosion and sediment control, and site restoration.

Checklist: 13 Elements of Construction Site Erosion and Sediment Control

Note: Each of the 13 Elements must be considered for applicability to your project. Review each element and identify all BMPs that are likely to be implemented on your site. Note the City of Lacey 2016 Stormwater Design Manual (SDM) Chapter 5 includes supplemental information for each element that must also be considered for your site. See Chapter 5 for more information on these and other construction-phase BMPs.

The 2016 SDM is available online at <http://www.ci.lacey.wa.us/stormwater-design-manual>.

Required Elements	General Requirements	Best Management Practices (BMPs) (check all that are likely to be implemented)
Element #1: Clearing Limits	Prior to beginning land-disturbing activities, mark clearing limits and delineate sensitive areas and their buffers with high-visibility fencing.	☐ BMP C101: Preserve Natural Vegetation ☐ BMP C102: Buffer Zones ☐ BMP C103: High-Visibility Plastic or Metal Fence ☐ BMP C233: Silt Fence
Element #2: Construction Access	Establish stabilized access to project site (quarry spalls, etc.). Clean the public road if sediment is tracked off site.	☐ BMP C105: Stabilized Construction Entrance ☐ BMP C106: Wheel Wash ☐ BMP C107: Construction Road/ Parking Area Stabilization
Element #3: Control Flow Rates	Prevent erosion and protect off-site and downstream areas by controlling the volume, velocity and peak flow rate of site runoff.	☐ BMP C203: Water Bars ☐ BMP C207: Check Dams ☐ BMP C209: Outlet Protection ☐ BMP C235: Wattles ☐ BMP C240: Sediment Trap ☐ BMP C241: Temp. Sediment Pond
Element #4: Sediment Controls	Install sediment controls to prevent sediment movement and to keep sediment from leaving site.	☐ BMP C231: Brush Barrier ☐ BMP C233: Silt Fence ☐ BMP C234: Vegetated Strip ☐ BMP C235: Wattles ☐ BMP C240: Sediment Trap ☐ BMP C241: Temp. Sediment Pond ☐ BMP C250: Construction Stormwater Chemical Treatment ☐ BMP C251: Construction Stormwater Filtration
Element #5: Stabilize Soils	All unworked and exposed soils shall be stabilized to prevent erosion. During the "wet season" (October 1 through April 30) no soils shall remain exposed and unworked for more than 2 days. From May 1 to September 30, no soils shall remain exposed and unworked for more than 7 days.	☐ BMP C120: Temporary and Permanent Seeding ☐ BMP C121: Mulching ☐ BMP C122: Nets and Blankets ☐ BMP C123: Plastic Covering ☐ BMP C124: Sodding ☐ BMP C125: Topsoiling/Composting ☐ BMP C126: Polyacrylamide (PAM) for Soil Erosion Protection ☐ BMP C130: Surface Roughening ☐ BMP C131: Gradient Terraces ☐ BMP C140: Dust Control

Element #6: Protect Slopes	Design and construct cut and fill slopes to minimize erosion.	☐ BMP C120: Temporary and Permanent Seeding ☐ BMP C121: Mulching ☐ BMP C122: Nets and Blankets ☐ BMP C130: Surface Roughening ☐ BMP C131: Gradient Terraces ☐ BMP C200: Interceptor Dike and Swale ☐ BMP C201: Grass-Lined Channels ☐ BMP C203: Water Bars ☐ BMP C204: Pipe Slope Drains ☐ BMP C205: Subsurface Drains ☐ BMP C206: Level Spreader ☐ BMP C207: Check Dams ☐ BMP C208: Triangular Silt Dike (TSD) (Geotextile-encased Check Dam)
Element #7: Protect Drain Inlets	Protect conveyance system from sediment by filtering or treating stormwater prior to flow entering inlets.	☐ BMP C220: Storm Drain Inlet Protection Note: Never put anything other than stormwater into a storm drain. "Only rain down the drain."
Element #8: Stabilize Channels and Outlets	All conveyance channels and outlets shall be constructed and stabilized to prevent erosion.	☐ BMP C202: Channel Lining ☐ BMP C122: Nets and Blankets ☐ BMP C207: Check Dams ☐ BMP C209: Outlet Protection
Element #9: Control Pollutants	Handle, store and dispose of concrete washout and construction debris in closed container or by removal from site so it does not contaminate stormwater. Apply spill prevention and cleanup to vehicle and equipment activities.	☐ BMP C151: Concrete Handling ☐ BMP C152: Sawcutting and Surfacing Pollution Prevention ☐ BMP C153: Material Delivery, Storage and Containment ☐ BMP C154: Concrete Washout Area ☐ BMP C250: Construction Stormwater Chemical Treatment ☐ BMP C251: Construction Stormwater Filtration
Element #10: Control Dewatering	Manage dewatering water to prevent sediment discharge from site. Manage turbid water separately from stormwater.	☐ BMP C203: Water Bars ☐ BMP C206: Level Spreaders ☐ BMP C236: Vegetative Filtration
Element #11: Maintain BMPs	Inspect, maintain and repair BMPs as needed to keep them in fully functional condition.	☐ BMP C150: Materials On Hand
Element #12: Manage the Project	Phase project to prevent soil erosion and transport. Avoid soil disturbance from October 1 through April 30. Certified Erosion and Sediment Control Lead (CESCL) to inspect and monitor BMPs on sites over 1 acre in area.	☐ BMP C150: Materials On Hand ☐ BMP C162: Scheduling

Element #13: Protect Low Impact Development (LID) BMPs	Protect all LID BMPs from sedimentation and compaction through preventative measures, as well as installation and maintenance of construction SWPPP BMPs on portions of the site that drain to the LID BMPs.	☐ BMP C102: Buffer Zone ☐ BMP C103: High Visibility Fence ☐ BMP C200: Interceptor Dike and Swale ☐ BMP C201: Grass-Lined Channels ☐ BMP C207: Check Dams ☐ BMP C208: Triangular Silt Dike (TSD) (Geotextile-Encased Check Dam) ☐ BMP C231: Brush Barrier ☐ BMP C233: Silt Fence ☐ BMP C234: Vegetated Strip

►Submit completed form to the City of Lacey with a basic site illustration showing existing and proposed site features including SWPPP BMPs, property boundaries, north arrow, and adjacent streets.

Notes:

Appendix 3B – Stormwater Facility Maintenance Guide

Maintenance Standards

The following pages contain facility-specific maintenance standards, which are intended to be observable conditions for determining whether maintenance actions are required.

Maintaining Stormwater Facilities

All stormwater facilities need to be maintained. Regular maintenance ensures proper functioning and keeps the facility aesthetically appealing. This Stormwater Facility Maintenance Guide was designed to help explain how stormwater facilities work and provide user-friendly guidance on how to maintain facilities to keep them functional and up to standards.

As a facility owner or homeowner's association, you are responsible for regularly maintaining your privately-owned drainage facilities such as ponds, infiltration systems, rain gardens, catch basins, and pipes. (The City of Lacey maintains stormwater facilities located in the public right-of-way.)

Most large development sites (typically projects larger than one single-family property) will have developed a detailed Maintenance and Source Control Manual as part of the site development (refer to Drainage Control Plan Maintenance and Source Control Manual requirements in Chapter 3, Section 3.3.3 of the City of Lacey Stormwater Design Manual). The city requires that the Maintenance and Source Control Manual is transferred with the property to the new owner(s) and responsible parties. The Maintenance and Source Control Manual will provide extensive information on the project, the stormwater facilities on the site, maintenance responsibilities, and maintenance activities that may include or reference the maintenance checklists found in this appendix. Be sure to locate the Maintenance and Source Control Manual for your project and follow the information presented therein. Where you believe a Maintenance and Source Control Manual exists for your property but is not available, please contact the city to request a copy.

For sites that do not have a Maintenance and Source Control Manual (typically smaller, single-family sites), the following instructions and helpful tips for successful facility inspections and maintenance are provided.

Maintenance Checklists

The checklists in this guide are for you to use when inspecting and maintaining the stormwater facilities that you are responsible for. If you are missing a particular checklist, or if you have additional facilities not identified or addressed in this guide, please contact your site developer, design engineer, or the city.

The checklists are in table format for ease of use and brevity. Each checklist tells you what part of the feature to check, how often to check, what to check for, and the desired outcome after maintenance is performed. Log sheets are included to help you keep track of when you last surveyed the stormwater drainage system.

Although it is not intended for the inspection to involve anything too difficult or strenuous, there are a few tools that will make the job easier and safer. These tools include:

- Gloves
- A flashlight (to look into catch basins, manholes or pipes)
- A long pole or broom handle (see below)

- Some kind of pry bar or lifting tool for pulling manhole and grate covers
- Standard yard tools, such as a rake and a shovel
- Measuring tool

A listing of resources is also included within this packet (see next page). Here you will find the phone numbers of the agencies referred-to in the tables.

Safety Warning:

For your safety and per OSHA regulations, you should never stick your head or any part of your body into a manhole or other type of confined space. When looking into a manhole or catch basin, stand above it and use the flashlight to help you see. Use a pole or broom handle that is long enough when you are checking sediment depths in confined spaces. Always properly replace grates and lids.

NO PART OF YOUR BODY SHOULD BREAK THE PLANE OF THE OPEN HOLE.

Checklist Instructions

The following pages contain maintenance checklists covering most of the needs for the components of your drainage system, as well as for some components that you may not have (you can ignore those checklists that don't apply to your system). Let city staff know if there are any components of your drainage system that you do not recognize or are missing from these pages.

Refer to the City of Lacey Stormwater Code, LMC 14.25 for additional stormwater maintenance requirements, including required maintenance frequency.

Using photocopies of these checklists and the log sheet, check off the problems that you look for each time you do an inspection. Add comments regarding problems found and actions taken on the log sheet. Keep the completed forms in your files for future reference.

You may call the City of Lacey at (360) 491-5600 for technical guidance. Please do not hesitate to call, especially if you are unsure whether a situation you have discovered may be a problem.

Resource Listing

If you are unsure whether a problem exists, please contact the city at the number below and ask for technical assistance with your situation. Other resources are listed for your convenience and as references associated with the checklists.

Lacey Public Works Department
(360) 491-5600 <http://www.ci.lacey.wa.us/city-government/city-departments/public-works/water-resources/storm-and-surface-water-programs/private-facilities>.

City of Lacey Spill Response Team
(360) 491-5644 <www.ci.lacey.wa.us/report-a-spill>.

Thurston County Environmental Health
Hazardous Waste Disposal (oil, paint, pesticides, etc.)
(360) 754-4111 <http://www.co.thurston.wa.us/HEALTH/ehhw/index.html>.

Solid Waste Disposal (yard waste, construction waste, contaminated soils, etc.)
(360) 786-5136 <http://www.co.thurston.wa.us/HEALTH/ehsw/index.html>.

WSU Thurston Co. Extension (Water Resource Ed. Programs, Envir. Stewardship info.)
(360) 786-5445 <http://thurston.wsu.edu/water/>.

Log Sheet

Use copies of this log sheet to keep track of when maintenance inspections occur and what items, if any, are repaired or replaced. The completed sheets will serve as a record of past maintenance activities and will provide valuable information on how your facilities are operating. Keep all log sheets in a designated area so others can easily access them.

Location: _____ **Date Checked:**

Checked By: _____ _____

Name: _____

Address: _____ **Phone:**

City: _____ **Zip:** _____ _____

Facility	Component Checked	Observations

Stormwater Facility Inspection and Maintenance Procedure

Stormwater facilities play an important role in managing the 4 feet of rainfall we receive in Lacey in an average year. The term "stormwater facility" refers to any landscaped or structural feature that collects, conveys, cleans or infiltrates runoff water. There are many types of stormwater facilities, ranging from simple swales and ponds to more complicated filter systems and flow control devices. Your on-site stormwater facilities work together to control runoff water, reduce flooding, and prevent pollution.

Owners of commercial property, multifamily residential property, or single-family residential properties with privately-owned drainage and stormwater facilities are required by City of Lacey Codes to maintain their facilities to established standards for full functionality (City of Lacey Stormwater Code, LMC 14.25). Facility owners are responsible for performing inspections of stormwater facilities, and for performing any maintenance identified by the inspections.

Basic maintenance work may be performed by the owner or property manager, although some tasks are best left to an experienced contractor. The inspection of stormwater facilities and any required maintenance work must be completed and reported annually to the City of Lacey Public Works Department by the date specified on the *Stormwater Facilities Inspection and Maintenance Annual Reporting Form* obtainable on the city's web site at <http://www.ci.lacey.wa.us/city-government/city-departments/public-works/water-resources/storm-and-surface-water-programs/private-facilities>).

Again, note that most large development sites will also have a Maintenance and Source Control Manual that was prepared as part of the site development, and should have been provided to the property owners. Look to your site's Maintenance and Source Control Manual for information on the project, the facilities on the site, maintenance responsibilities, and maintenance activities. Where a Maintenance and Source Control Manual is not available, the following steps are provided as general guidance:

Step 1. Identify

The first step is facility identification, so you know what types of stormwater facilities you have. Look on the site plan of your property, and note the main facility types indicated (such as rain gardens and infiltration trenches), along with related drainage components (such as catch basins, pipes, and debris barriers). Locate the various facilities on the ground.

Note that most drainage systems consist of components for four main purposes: stormwater collection (e.g., catch basins), conveyance (e.g., pipes and swales), water quality treatment (e.g., wet ponds) and flow control (via infiltration and/or surface discharge).

To assist you in identifying components, refer to the definitions and illustrations on the pages that follow.

Step 2. Inspect

For all facility components that you have identified, conduct an inspection. You may conduct the inspection yourself and/or with co-owners, or you may use a property manager or vendor to perform the inspection. Refer to the following Stormwater Facility Maintenance Checklists, which describe the maintenance standards for each component, and also identify and describe defects and their remedies.

For each facility, note on the Inspection and Maintenance Checklist the condition of the facility (good, fair or poor), and any problems or other observations.

Step 3. Maintain

For all facility components, if the inspection indicates maintenance is needed, have the work performed by competent personnel. Basic maintenance tasks may be performed by the property owner(s) or property manager, but difficult or potentially dangerous tasks should be performed by a qualified vendor. Be safe! Use caution when inspecting and working on or near facilities, and stay out of confined spaces such as catch basins and manholes.

Note the action taken and the date, and record this information on the Log Sheet. Mark the check boxes on the Inspection and Maintenance Checklist corresponding to the maintenance accomplished on each facility.

Step 4. Submit

Submit the completed *Stormwater Facilities Inspection and Maintenance Annual Reporting Form* by August 15 each year to: Lacey Water Resources, 420 College Street SE, Lacey, WA 98503. The completed checklist may be mailed, e-mailed (if available) or delivered in person to Lacey City Hall.

Common Stormwater Facilities: Identification and Actions

Note: General actions are described for each facility type below. Please refer to the Stormwater Facility Maintenance Standards for further details.

Detention Pond:

A shallow bowl-like depression in the land, with an area to collect and temporarily store stormwater. The pond is generally lined with grass and is intended to store stormwater to reduce runoff volumes during storms.

Actions to keep detention ponds functioning:

- Remove litter, sediment, yard debris, and problem vegetation such as Scotch broom.
- Maintain a healthy grass cover to prevent erosion and weed growth.
- Repair erosion, and replace rock riprap at pipe ends.
- Inspect pond berms for any structural deficiencies

Infiltration Basin ("Dry Pond"):

A shallow bowl-like depression in the land, with a broad, flat bottom area to collect, temporarily store, and infiltrate stormwater. An infiltration basin is designed to receive treated water and allow it to infiltrate into the soil. The infiltration basin is usually lined with grass and drains "dry" between rain events. Some playfields (as in photo below, left) double as infiltration basins by design.

Actions to keep infiltration basins functioning:

- Remove litter, yard debris, and problem vegetation such as Scotch broom.
- Maintain a healthy grass cover to prevent erosion and weed growth.
- Repair erosion, and replace rock riprap at pipe ends.
- Avoid activities within the basin that could cause erosion or soil compaction.
- Avoid using herbicides or pesticides within the basin area.
- Aerate the soil in the bottom area as needed to preserve and enhance infiltration.

Biofiltration Swale:

A longitudinally sloped, wide, shallow, vegetation-lined channel with gently sloping sides and a flat bottom designed to remove pollutants by means of sedimentation, filtration, soil sorption, and/or plant uptake. Some water also infiltrates into the soil as it slowly flows along the swale.

Actions to keep swales functioning:

- Remove debris, litter, and flow obstructions from the swale.
- Mow the swale and maintain healthy grass cover.
- Prevent dirt, rocks, and weeds from accumulating, but avoid use of herbicides (remove manually).
- Do not fill-in the swale with rocks, bark, etc.
- Aerate the soil to preserve infiltration capacity.

Wet Pond:

A constructed pond with an impermeable liner to maintain a permanent pool of water, which provides for water quality treatment by settling and retention of sediment particles and other pollutants. The cleaner surface water is then conveyed to a nearby infiltration facility (such as a "dry detention pond") or surface discharge. A wet pond provides a basic level of treatment, and is common in many neighborhoods.

Actions to keep wet ponds functioning:

- Remove litter and yard debris from within and around the pond.
- Check inflow and outflow systems, and remove any obstructions.
- Remove excess vegetation such as cattails from within the pond.
- Remove noxious weeds, but do not use herbicides (contact city for advice).

Stormwater Wetland:

A created wetland with a permanent pool of water, similar to a wet pond but generally shallower and with aquatic emergent plants which provide for a higher level of water quality treatment of collected stormwater through biological processes.

Actions to keep stormwater wetlands functioning:

- Remove litter and yard debris from within and around the wetland.
- Check inflow and outflow systems, and remove any obstructions.
- Remove excess vegetation such as cattails from within the wetland.
- Remove noxious weeds, but do not use herbicides (contact city for advice).

Bioretention Cell:

A shallow stormwater system with a designed soil mix and plants. Bioretention is a "low-impact development" (LID) practice that is integrated into a site to retain stormwater near its source. Bioretention cells are designed to mimic a forested condition by controlling stormwater through detention, infiltration, and evapotranspiration. They also provide water quality treatment through sedimentation, filtration, adsorption, and phytoremediation. Bioretention cells function by storing stormwater as surface ponding before it filters through the underlying amended soil.

Actions to keep bioretention cells functioning:

- Remove litter, weeds and fallen leaves. Do not use herbicides or pesticides.
- Check inflow and outflow systems, and remove any obstructions.

- Repair erosion, cover bare spots with organic mulch.
- Perform plant maintenance as needed, such as pruning branches.
- Remove dead vegetation and replace dead plants with same varieties.

Rain Garden:

Non-engineered, shallow, landscaped depressions with compost amended native soils and adapted plants that collect, absorb, and filter stormwater runoff from roof tops, driveways, patios, and other hard surfaces. Rain gardens are sized to pond and temporarily store stormwater runoff and allow stormwater to pass through the amended soil profile.

Actions to keep rain gardens functioning:

- Remove litter, weeds and fallen leaves. Do not use herbicides or pesticides.
- Check inflow and outflow systems, and remove any obstructions.
- Repair erosion, cover bare spots with organic mulch.
- Perform plant maintenance as needed, such as pruning branches.
- Remove dead vegetation and replace dead plants with same varieties.

Permeable Pavement:

Permeable pavement (also known as pervious and porous pavement) looks very much like ordinary pavement but includes additional "void" spaces where water can pass through. After water drains through permeable pavement wearing course, it is held in a storage reservoir bed (made up of aggregate rock, or drain rock), and then infiltrates into the native soils.

Actions to keep permeable pavement functioning:

- Clean surface to remove trash, sediment, vegetation, and other accumulated debris.
- Check inflow and outflow systems and underdrains, and remove any obstructions.
- Use vacuum to remove fine sediments.
- If pavers are used, check for damaged or missing pavers and replace as needed.
- If paving grids are used, check for loss of soil, grass, and/or gravel material and replace as needed.

Downspout, Sheet Flow, and Concentrated Flow Dispersion:

A gravel trench or splashblock followed by a vegetated flowpath (or dispersion area) used to disperse flow and reduce runoff from impervious surfaces. Dispersion attenuates peak runoff flows by slowing the runoff entering into the conveyance system, allowing some infiltration, and providing some water quality benefits.

Actions to keep downspout, sheet flow, and concentrated flow dispersion functioning:

- Ensure that vegetation is not blocking flow, and perform plant maintenance as needed.
- Remove and replace dead vegetation to ensure that runoff is received in a well-vegetated area.
- Avoid activity in dispersion area to avoid compaction.
- Check for erosion of the dispersion trench or dispersal area and replace and restore gravel and/or soil.

Downspout Infiltration:

Includes an infiltration trench or drywell intended only for use in infiltrating runoff from roof surfaces. Infiltration trenches and drywells are backfilled with washed drain rock, allowing for temporary storage of stormwater runoff in the voids of the drain rock material. Stored runoff gradually infiltrates into the surrounding soil.

Actions to keep downspout infiltration functioning:

- Remove litter, leaves, debris, and obstructions from the infiltration trench or drywell.
- Stabilize adjacent landscaped areas to avoid runoff from eroding and mobilizing soil into the surface inlet.

Detention Tank:

An underground storage facility typically constructed with large diameter corrugated metal or HDPE pipe.

Actions to keep detention tanks functioning:

- Remove litter, leaves, debris, and obstructions from inlet and outlet.
- Check tank for cracks or leaks.
- Clean out any sediment or debris accumulated inside the tank.

Ditch:

A V-shaped channel, usually along the side of a road that collects and conveys runoff.

Actions to keep ditches functioning:

- Remove debris, litter and flow obstructions from the ditch.
- Do not fill-in the ditch – prevent dirt, rocks, and weeds from accumulating.
- Repair erosion on ditch side-slopes.

Culvert:

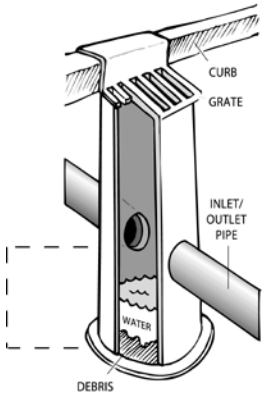
A pipe that continues conveyance flow from a ditch or swale under the ground surface, typically under driveways and cross-streets. Usually connects ("daylights") to another ditch, swale or pond. The end of a pipe or culvert is often surrounded by rock "riprap" (as in photo below, right) to prevent soil erosion.

Actions to keep culverts functioning:

- Remove debris, litter, and obstructions from the openings at the culvert ends.
- Remove soil, sod, and vegetation buildup from the culvert openings.
- Replace rock riprap at the culvert ends.
- Repair any damage to the culvert ends.

Catch Basin:

An underground concrete box structure with a slotted metal grate on top that collects runoff water from the ground surface. Typically located within pavement in parking lots and in the street gutter, usually next to a curb. Grate on top lets water in and keeps larger debris out. Sediment settles in the sump in the bottom (below the pipe openings) and must be removed periodically. Catch basins have an outlet pipe between the grate and the sump, to let the cleaner water flow out to a storm pond or other location. Some catch basins have both inflow and outflow pipes, to convey collected runoff water through.



Actions to keep catch basins functioning:

- Remove litter, leaves, debris, and obstructions from catch basin grates.
- Hire a professional to remove sediment buildup from sump (if road is privately owned; catch basins in the public right-of-way are maintained by the city).

Debris Barriers and Trash Racks:

A structural device with metal bars, to prevent debris from entering a pipe, spillway, or hydraulic structure.

Actions to keep debris barriers and trash racks functioning:

- Remove trash, debris, vegetation, and dirt from around the structure.
- Check inflow and outflow, and remove any flow obstructions.
- Remove plants such as alder and willow that tend to grow near the pipe ends.
- Check for structural integrity; hire a professional to fix broken bars or racks.

Group 1 – Flow Control and Treatment Facilities

1a. Detention Ponds

Detention ponds are earthen excavations that are "dry" except during and after rains, when they contain stormwater temporarily. Detention ponds store water while releasing it gradually.

Detention Ponds					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
General	Trash and Debris	Accumulated trash and debris. Dumping of yard wastes such as grass clippings and branches into pond. Presence of glass, plastic, metal, foam, or paper. In general, there should be no visual evidence of dumping.		No trash or debris present. Remove and properly dispose of all trash and debris.	
	Poisonous Vegetation and Noxious Weeds	Any poisonous or nuisance vegetation which may constitute a hazard to the public (such as Scotch broom or blackberry vines, poison oak, tansy ragwort, stinging nettles, or devil's club). Any evidence of noxious weeds as defined in the Thurston County Noxious Weeds List.		Eliminate danger of poisonous vegetation where maintenance personnel or the public might normally be. Completely remove invasive, noxious, or nonnative vegetation according to applicable regulations. *(Coordinate with Thurston County Health Department.)* Do not spray chemicals on vegetation without guidance or city approval. It is strongly encouraged that herbicides and pesticides not be used in order to protect water quality. (Apply requirements of adopted integrated pest management policies for the use of herbicides.) *Complete eradication of noxious weeds may not be possible.*	
	Contamination and Pollution	Presence of contaminants such as oil, gasoline, concrete slurries, paint, obnoxious color, odor, or sludge.		Locate the source of the pollution and remove contaminants or pollutants present. *Report and coordinate source control, removal, and/or cleanup with City of Lacey Spill Response Team (360) 491-5644, Moderate Risk Waste Program at Thurston County Environmental Health (360) 754-4111 and/or Dept. of Ecology Spill Response (800) 424-8802.*	

Detention Ponds					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
General (continued)	Rodent Holes	If the facility is constructed with a dam or berm, look for rodent holes or any evidence of water piping through the dam or berm. Water should not be able to flow through the rodent holes.		Remove rodents and repair the dam or berm. *(Coordinate with the Thurston County Health Department; coordinate with Ecology Dam Safety Office if pond exceeds 10 acre-feet.)*	
	Beaver Dam	Beaver dam results in an adverse change in the functioning of the facility		Return facility to design function. (*Contact WDFW Region 6 to identify the appropriate Nuisance Wildlife Control Operator.)*	
	Insects	Insects such as wasps and hornets interfering with maintenance activities, or mosquitoes becoming a nuisance.		Remove or remove insects. For mosquito control, eliminate stagnant water. *Apply insecticides in compliance with adopted integrated pest management policies.*	
	Overgrown Vegetation Around Pond	Tree grown and dense vegetated impedes inspection, maintenance access or interferes with maintenance activity with the facility function or maintenance (i.e., slope mowing, silt removal, vactoring, or equipment movements).		Prune or maintain trees and vegetation so they do not to hinder inspection or maintenance activities. If trees are not interfering with access or maintenance, do not remove.	
	Hazard Trees	If dead, diseased, or dying trees are identified (Use a certified Arborist to determine health of tree or removal requirements).		Remove hazard trees.	
Side Slopes	Erosion	Maintenance is needed where eroded damage is over 2 inches deep and where there is potential for continued erosion or where any erosion is observed on a compacted berm embankment. Check all pond areas, particularly around inlets and outlets, as well as at berms for signs of sliding or settling.		Try to determine what has caused the erosion and fix it. Stabilize slopes by using appropriate erosion control measure(s); e.g., reinforcing the slope with rock, planting grass, or compacting the soil. Contact the City of Lacey for assistance. *If erosion is occurring on compacted berms, a professional engineer should be consulted to resolve source of erosion.*	

Detention Ponds					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Pond Storage Area	Sediment Accumulation	Accumulated sediment that exceeds 10 percent of the designed pond depth unless otherwise specified or affects inlets or outlets of the facility.		Clean out sediment and aerate and/or re-seed the pond if deemed necessary to improve infiltration and control erosion. *(If sediment contamination is a potential problem, sediment should be tested regularly to determine leaching potential prior to disposal.)*	
	PVC Pond Liner	An indicator of a torn liner could be the pond no longer holds water. Check to see if the pond holds water during dry periods (during long dry periods the water may evaporate), and the liner is not exposed. Maintenance is needed if liner is visible and has more than three 0.25-inch holes.		Repair or replace liner as needed. Liner is fully covered.	
	Clay Liner	An indicator of a torn liner could be the pond no longer holds water. Check to see if the pond holds water during dry periods (during long dry periods the water may evaporate).		Repair or replace liner as needed.	
Dikes or Berms	Settlement	Any part of the dike or berm that has settled more than 4 inches lower than designed.		Build the dike or berm back to the design elevation. *If settlement is significant, a professional engineer should be consulted to determine the cause of the settlement.*	
	Seepage	Check for water flowing through the pond berm and ongoing erosion with potential for erosion to continue.		Repair berm to eliminate seepage and erosion. *Recommend a geotechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.*	
Emergency Overflow Spillway	Rocks Missing	Check to see that the riprap protective area is intact. Maintenance is need if only one layer of rock exists above native soil in area 5 square feet or larger, or any exposure of native soil at the top of outflow path of spillway.		Restore rocks and pad depth to design standards. (Riprap on inside slopes need not be replaced.) If any native soil is exposed, cover soil with rock riprap.	

Detention Ponds					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Emergency Overflow Spillway (continued)	Tree Growth	Check emergency spillways for tree growth that creates blockage problems and may cause failure of the berm due to uncontrolled overtopping.		Remove trees on emergency spillway. *If root system is small (base less than 4 inches) the root system may be left in place. Otherwise, the roots should be removed and the berm restored. A professional engineer should be consulted for proper berm/spillway restoration.*	
	Erosion	Maintenance is needed where eroded damage is over 2 inches deep and where there is potential for continued erosion. Maintenance is needed where any erosion is observed on a compacted berm embankment. Check all pond areas, particularly around inlets and outlets, as well as at berms for signs of sliding or settling.		Try to determine what has caused the erosion and fix it. Stabilize slopes by using appropriate erosion control measure(s); e.g., reinforcing the slope with rock, planting grass, or compacting the soil. Contact the City of Lacey for assistance. *If erosion is occurring on compacted berms, a professional engineer should be consulted to resolve source of erosion.*	

1b. Infiltration Ponds, Trenches, and Galleries

Infiltration ponds, trenches, and galleries are earthen excavations or underground structures that are "dry" except during and after rains, when they contain stormwater temporarily. Infiltration ponds, trenches, and galleries store water while gradually percolating water into the ground.

Infiltration Ponds, Trenches, and Galleries					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
General	Trash and Debris	Accumulated trash and debris. Dumping of yard wastes such as grass clippings and branches into pond. Presence of glass, plastic, metal, foam, or paper. In general, there should be no visual evidence of dumping.		No trash or debris present. Remove and properly dispose all trash and debris.	
	Poisonous Vegetation and Noxious Weeds	Any poisonous or nuisance vegetation which may constitute a hazard to the public (such as Scotch broom or blackberry vines, poison oak, tansy ragwort, stinging nettles, or devil's club). Any evidence of noxious weeds as defined in the Thurston County Noxious Weeds List.		Eliminate danger of poisonous vegetation where maintenance personnel or the public might normally be. Completely remove invasive, noxious, or nonnative vegetation in accordance with applicable regulations. *(Coordinate with Thurston County Health Department.)* Do not spray chemicals on vegetation without guidance or city approval. It is strongly encouraged that herbicides and pesticides not be used in order to protect water quality. (Apply requirements of adopted integrated pest management policies for the use of herbicides.) *Complete eradication of noxious weeds may not be possible.*	
	Contamination and Pollution	Presence of contaminants such as oil, gasoline, concrete slurries, paint, obnoxious color, odor, or sludge.		Locate the source of the pollution and remove contaminants or pollutants present. *Report and coordinate source control, removal, and/or cleanup with City of Lacey Spill Response Team (360) 491-5644, Moderate Risk Waste Program at Thurston County Environmental Health (360) 754–4111, and/or Dept. of Ecology Spill Response (800) 424-8802.*	

Infiltration Ponds, Trenches, and Galleries					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
General (continued)	Rodent Holes	If the facility is constructed with a dam or berm, look for rodent holes or any evidence of water piping through the dam or berm. Water should not be able to flow through the rodent holes.		Remove rodents and repair the dam or berm. *(Coordinate with Thurston County Health Department; coordinate with Ecology Dam Safety Office if pond exceeds 10 acre-feet.)*	
	Beaver Dam	Beaver dam results in an adverse change in the functioning of the facility.		Return facility to design function. (*Contact WDFW Region 6 to identify the appropriate Nuisance Wildlife Control Operator.)*	
	Insects	Insects such as wasps and hornets interfering with maintenance activities, or mosquitoes becoming a nuisance.		Remove insects. For mosquito control, eliminate stagnant water. *Apply insecticides in compliance with adopted integrated pest management policies.*	
	Hazard Trees	If dead, diseased, or dying trees are identified (Use a certified Arborist to determine health of tree or removal requirements).		Remove hazard trees.	
	Tree Growth and Dense Vegetation	Tree growth and dense vegetation, which impedes inspection, maintenance access or interferes with maintenance activity (i.e., slope mowing, silt removal, vactoring, or equipment movements).		Trees and vegetation do not hinder inspection or maintenance activities. Harvested trees should be recycled into mulch or other beneficial uses (e.g., alders for firewood).	
Storage Area	Water Not Infiltrating	Check for water ponding in infiltration basin after rainfall ceases and appropriate time allowed for infiltration. Treatment basins should infiltrate Water Quality Design Storm Volume within 48 hours, and empty within 24 hours after cessation of most rain events. (Maintenance is required if a percolation test pit or test of facility indicates facility is only working at 90 percent of its designed capabilities, or if 2 inches or more sediment is present, remove).		Facility infiltrates as designed. Sediment is removed and/or facility is cleaned so that infiltration system works according to design.	
Filter Bags (if applicable)	Filled with Sediment and Debris	Maintenance is required if sediment and debris fill bag more than one-half full.		Replace filter bag or redesign system. Filter bag must be less than one-half full.	

Infiltration Ponds, Trenches, and Galleries					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Rock Filters	Sediment and Debris	By visual inspection, little or no water flows through filter during heavy rain storms.		Replace gravel in rock filter if needed. Water must flow through filter.	
Trenches	Observation Well (use surface of trench if well is not present)	Water ponds at surface during storm events. Less than 90 percent of design infiltration rate.		Remove and replace/clean rock and geomembrane.	
Galleries	Chambers	Check inlet and outlets and interior of chambers for deficiencies, cracks, debris, and sediment.		Remove any debris and sediment and replace or restore chambers as needed.	
Ponds	Vegetation	Exceeds 18 inches.		Mow grass or groundcover to a height no greater than 6 inches.	
		Bare spots.		Revegetate and stabilize immediately. No bare spots should be present.	
Side Slopes	Erosion	Maintenance is needed where eroded damage is over 2 inches deep and where there is potential for continued erosion or where any erosion is observed on a compacted berm embankment. Check all pond areas, particularly around inlets and outlets, as well as at berms for signs of sliding or settling.		Try to determine what has caused the erosion and fix it. Stabilize slopes by using appropriate erosion control measure(s); e.g., reinforcing the slope with rock, planting grass, or compacting the soil. Contact the City of Lacey for assistance. *If erosion is occurring on compacted berms, a professional engineer should be consulted to resolve source of erosion.*	
Dikes or Berms	Settlement	Any part of the dike or berm that has settled more than 4 inches lower than designed.		Build the dike or berm back to the design elevation. *If settlement is significant, a professional engineer should be consulted to determine the cause of the settlement.*	
	Seepage	Check for water flowing through the pond berm and ongoing erosion with potential for erosion to continue.		Repair berm to eliminate seepage and erosion. *Recommend a geotechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.*	

Infiltration Ponds, Trenches, and Galleries					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Dikes or Berms (continued)	Tree Growth	Tree growth on berms over 4 feet in height may lead to piping through the berm, which could lead to failure of the berm.		Remove trees on berms. *If root system is small (base less than 4 inches) the root system may be left in place. Otherwise, the roots should be removed and the berm restored. A professional engineer should be consulted for proper berm/spillway restoration.*	
Emergency Overflow Spillway	Rocks Missing	Check to see that the riprap protective area is intact. Maintenance is need if only one layer of rock exists above native soil in area 5 square feet or larger, or any exposure of native soil at the top of outflow path of spillway.		Restore rocks and pad depth to design standards. (Riprap on inside slopes need not be replaced.) If any native soil is exposed, cover soil with rock riprap.	
	Tree Growth	Check emergency spillways for tree growth that creates blockage problems and may cause failure of the berm due to uncontrolled overtopping.		Remove trees on emergency spillway. *If root system is small (base less than 4 inches) the root system may be left in place. Otherwise, the roots should be removed and the berm restored. A professional engineer should be consulted for proper berm/spillway restoration.*	
	Erosion	Maintenance is needed where eroded damage is over 2 inches deep and where there is potential for continued erosion. Maintenance is needed where any erosion is observed on a compacted berm embankment. Check all pond areas, particularly around inlets and outlets, as well as at berms for signs of sliding or settling.		Try to determine what has caused the erosion and fix it. Stabilize slopes by using appropriate erosion control measure(s); e.g., reinforcing the slope with rock, planting grass, or compacting the soil. Contact the City of Lacey for assistance. *If erosion is occurring on compacted berms, a professional engineer should be consulted to resolve source of erosion.*	
	Screen Clogged or Missing	The bar screen over the outlet should be intact and clear of debris. Water should flow freely through the outlet pipe.		Replace screen if it is not attached. Remove any trash or debris and dispose of properly. Clean out the end pipe if necessary.	

Infiltration Ponds, Trenches, and Galleries					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Presettling Ponds and Vaults	Facility or Sump Filled with Sediment and/or Debris	6 inches or designed sediment trap depth of sediment.		Remove sediment. No sediment should be present in presettling pond or vault.	
	Inadequate Sediment Settling Area	Stormwater should not enter the infiltration area without some method of settling-out solids.		Add a sediment trapping area by constructing a sump or berm for settling of solids. This area should be separate from the rest of the facility. Contact City of Lacey for guidance.	
Drain Rock	Water Ponding	If water enters the facility from the surface, inspect to see if water is ponding at the surface during storm events. If buried drain rock, observe drawdown through observation port or cleanout.		Clear piping through facility when ponding occurs. Replace rock material/sand reservoirs as necessary. Tilling of subgrade below reservoir may be necessary (for trenches) prior to backfill. No water ponding should be present on surface during storm events.	

For manufactured infiltration galleries, designers must review and apply the most current manufacturer guidelines and recommendations for facility operation and maintenance.

1c. Detention Tanks and Vaults

These types of storage structures are usually underground and accessed via a manhole. DO NOT ENTER ANY TANK OR VAULT without proper training, certification and equipment.

Detention Tanks and Vaults					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Storage Area	Plugged Air Vents	One-half of the cross section of a vent is blocked at any point or the vent is damaged.		Vents open and functioning. Remove blockage or replace air vent if damaged.	
	Debris and Sediment	Accumulated sediment depth exceeds 10 percent of the diameter of the storage area for 50 percent of the length of storage vault or any point depth exceeds 15 percent of diameter. (Example: 72-inch storage tank would require cleaning when sediment reaches depth of 7 inches for more than 50 percent of the length of tank.)		No debris or sediment present. All sediment and debris removed from storage area.	
	Joints Between Tank/Pipe Section	Any openings or voids allowing material to be transported into facility. (Will require engineering analysis to determine structural stability).		All joint between tank/pipe sections are sealed.	
	Tank Pipe Bent Out of Shape	Any part of tank/pipe is bent out of shape more than 10 percent of its design shape. (Review required by engineer to determine structural stability).		Tank/pipe repaired or replaced to design.	
	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 0.5 inch and any evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determines that the vault is not structurally sound.		Vault replaced or repaired to design specifications and is structurally sound.	

Detention Tanks and Vaults					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Storage Area (continued)	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 0.5 inch at the joint of any inlet/outlet pipe or any evidence of soil particles entering the vault through the walls.		No cracks more than 0.25-inch wide at the joint of the inlet/outlet pipe.	
Manhole	Cover Not in Place	Cover is missing or only partially in place. Any open manhole requires maintenance.		Manhole access cover/lid is in place and secure.	
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 0.5 inch of thread (may not apply to self-locking lids)		Mechanism opens with proper tools.	
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. Intent is to keep cover from sealing off access to maintenance.		Cover can be removed and reinstalled by one maintenance person.	
	Ladder Rungs Unsafe	Maintenance person judges that ladder is unsafe due to missing rungs, misalignment, rust, or cracks. Ladder must be fixed or secured immediately.		Ladder meets design standards and allows maintenance persons safe access.	
Catch Basins	See “Catch Basins”	See “Catch Basins.”		See “Catch Basins.”	

1d. Wet Vaults

These types of storage structures are usually underground and accessed via a manhole. DO NOT ENTER ANY TANK OR VAULT without proper training, certification and equipment.

Wet Vaults					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Vault	Trash and Debris	Accumulated trash and debris in vault, pipe or inlet/outlet (includes floatables and non-floatables).		No trash or debris present. Remove and properly dispose of all trash and debris.	
	Sediment Accumulation	Sediment accumulation in vault bottom exceeds the depth of the sediment zone plus 6 inches.		Remove sediment from vault. *(If sediment contamination is a potential problem, sediment should be tested regularly to determine leaching potential prior to disposal.)*	
	Damaged Pipes	Inlet/outlet piping damaged or broken and in need of repair.		Pipe repaired and/or replaced.	
	Access Cover Damaged/ Not Working	Cover cannot be opened or removed, especially by one person.		Pipe repaired or replaced to proper working specifications.	
	Ventilation	Ventilation area blocked or plugged.		Blocking material removed or cleared from ventilation area. A specified percentage of the vault surface area must provide ventilation to the vault interior (see design specifications).	
	Vault Structure Damage – Includes Cracks in Walls Bottom, Damage to Frame and/or Top Slab	Maintenance/inspection personnel determine that the vault is not structurally sound.		Vault replaced or repairs made so that vault meets design specifications and is structurally sound.	
		Cracks wider than 0.5 inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.		Vault repaired so no cracks exist wider than 0.25 inch at the joint of the inlet/outlet pipe.	
	Baffles	Baffles corroding, cracking warping and/or showing signs of failure as deemed by maintenance/inspection staff.		Baffles repaired or replaced to specifications.	
	Access Ladder Damage	Ladder is corroded or deteriorated, not functioning properly, not attached to structure wall, missing rungs, has cracks and/or misaligned. Confined space warning sign missing.		Ladder replaced or repaired to specifications, and is safe to use as determined by inspection personnel. Replace sign warning of confined space entry requirements. Ladder and entry notification complies with OSHA standards.	

1e. Wet Ponds

Wet ponds are designed to improve water quality. They have a permanent pool of water, which slows incoming stormwater flows causing sediments and pollutants to settle-out. Wet ponds are typically deeper than other water quality BMPs, such as stormwater wetlands, and utilize the pool volume to reduce pollutant loads.

Wet Ponds					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
General	Water Level	First cell is empty, doesn't hold water.		Line the first cell to maintain at least 4 feet of water. Second cell may drain, but the first cell must remain full to control turbulence of the incoming flow and reduce sediment resuspension.	
	Trash and Debris	Accumulated trash and debris. Dumping of yard wastes such as grass clippings and branches into pond. Presence of glass, plastic, metal, foam, or paper. In general, there should be no visual evidence of dumping.		No debris or sediment present. Remove and properly dispose of all trash and debris.	
	Inlet/Outlet Pipe	Inlet/Outlet pipe clogged with sediment and/or debris material.		No clogging or blockage in the inlet and outlet piping.	
	Sediment Accumulation on Pond Bottom	Accumulated sediment on pond bottom that exceeds the depth of sediment zone plus 6 inches, usually in the first cell.		Sediment removed from pond bottom.(*If sediment contamination is a potential problem, sediment should be tested regularly to determine leaching potential prior to disposal.)*	
	Oil Sheen on Water	Visible and prevalent oil sheen.		Oil removed from water using oil-absorbent pads or Vactor truck. Locate and correct oil source. If chronic low levels of oil persist, plant wetland plants such as *Juncus effusus* (soft rush) which can uptake small concentrations of oil.	
	Erosion	Erosion of the pond's side slopes and/or scouring of pond bottom that exceeds 6 inches, or where continued erosion is prevalent.		Slopes stabilized using proper erosion control measures and repair methods.	
	Settlement of Pond Dike/Berm	Any part of these components that has settled 4 inches or lower than the design elevation, or inspector determines dike/berm is unsound.		Dike/berm is repaired to specifications.	

Wet Ponds					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
General (continued)	Internal Berm	Berm dividing cells should be level.		Berm surface is leveled so that water flows evenly over entire length of berm.	
	Overflow Spillway	Rock is missing and soil is exposed at top of spillway or outside slope.		Rocks replaced to specifications.	
	PVC Pond Liner	Check to see if liner is visible and has more than three 0.25-inch holes, is exposed and/or torn. An indicator of a torn liner could be the pond no longer holds water (during long dry periods the water may evaporate)		Repair or replace liner as needed. Note: wet ponds usually have liners.	
	Clay Liner	Check to see if pond is holding water (during long dry periods the water may evaporate).		Repair liner to design state.	
	Poisonous Vegetation and Noxious Weeds	Any poisonous or nuisance vegetation which may constitute a hazard to the public (such as Scotch broom or blackberry vines, poison oak, tansy ragwort, stinging nettles, or devil's club). Any evidence of noxious weeds as defined in the Thurston County Noxious Weeds List.		Eliminate danger of poisonous vegetation where maintenance personnel or the public might normally be. Completely remove invasive, noxious, or nonnative vegetation in accordance with applicable regulations. *(Coordinate with Thurston County Health Department.)* Do not spray chemicals on vegetation without guidance or city approval. It is strongly encouraged that herbicides and pesticides not be used in order to protect water quality. (Apply requirements of adopted integrated pest management policies for the use of herbicides.) *Complete eradication of noxious weeds may not be possible.*	
	Vegetation Not Growing or Overgrown Within Pond	Presence of invasive species or sparse/excessive growth of plants.		Remove invasive species and reestablish vegetation as designed.	

1f. Stormwater Wetlands

Stormwater wetlands are designed to improve water quality. They are designed with emergent aquatic plants to provide biological treatment and filtering of runoff water.

Stormwater Wetlands					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
General	Trash and Debris	Accumulated trash and debris. Dumping of yard wastes such as grass clippings and branches into pond. Presence of glass, plastic, metal, foam, or paper. If there is less than the threshold, remove all trash and debris as part of the next scheduled maintenance.		No debris or sediment present. Remove and properly dispose all trash and debris.	
	Poisonous Vegetation and Noxious Weeds	Any poisonous or nuisance vegetation which may constitute a hazard to maintenance personnel or the public (such as Scotch broom or blackberry vines, poison oak, tansy ragwort, stinging nettles, or devil's club). Any evidence of noxious weeds as defined in the Thurston County Noxious Weeds List.		Eliminate danger of poisonous vegetation where maintenance personnel or the public might normally be. *(*Completely remove invasive, noxious, or nonnative vegetation in accordance with applicable regulations. (*Coordinate with Thurston County Health Department.)* Do not spray chemicals on vegetation without guidance or city approval. It is strongly encouraged that herbicides and pesticides not be used in order to protect water quality. (Apply requirements of adopted integrated pest management policies for the use of herbicides.) *Complete eradication of noxious weeds may not be possible.*	
	Oil Sheen on Water	Prevalent and visible oil sheen.		Oil removed from water using oil-absorbent pads or Vactor truck. Source of oil located and corrected. *If chronic low levels of oil persist, plant emergent wetland plants such as Juncus effusus (soft rush) which can assist filtering small concentrations of oil.*	
	Inlet/Outlet Pipe	Inlet/Outlet pipe clogged with sediment and/or debris material or damaged.		No clogging or blockage in the inlet and outlet piping.	

Stormwater Wetlands					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
General (continued)	Rodent Holes	If the facility is constructed with a dam or berm, look for rodent holes or any evidence of water piping through the dam or berm. Water should not be able to flow through the rodent holes.		Remove rodents and repair the dam or berm. *(Coordinate with Thurston County Health Department; coordinate with Ecology Dam Safety Office if pond exceeds 10 acre-feet.)*	
	Beaver Dams	Beaver dam results in an adverse change in the functioning of the facility.		Return facility to design function. *Evaluate using beaver deceiver and leveler devices. If beaver removal is necessary, contact WDFW Region 6 to coordinate with a Nuisance Wildlife Control Operator.*	
	Tree Growth and Hazard Trees	Tree growth that impedes maintenance access.		Remove hazard trees. Trees do not hinder maintenance activities. Harvested trees should be recycled into mulch or other beneficial uses (e.g., firewood or construction).	
	Tree Growth and Hazard Trees	If dead, diseased, or dying trees are identified, use a certified Arborist to determine the health of tree and whether removal is required.		Remove hazard trees.	
	Liner	Check to see if liner is visible and has more than three 0.25-inch holes, or if it is exposed and or torn. An indicator of a torn liner could be the wetland no longer holds water. (during long dry periods the water may evaporate).		Repair or replace liner as needed. Liner is fully covered.	
Forebay	Sediment Accumulation	Sediment accumulation in forebay exceeds the design depth of the sediment zone plus 6 inches.		Remove accumulated sediment from forebay bottom to the design depth of the sediment zone.	
Side Slopes of Wetland	Erosion	Maintenance is needed where eroded damage is over 2 inches deep and where there is potential for continued erosion. Check all wetland areas, particularly around inlets and outlets, as well as at berms for signs of sliding or settling.		Try to determine what has caused the erosion and fix it. Stabilize slopes by using appropriate erosion control measure(s); e.g., reinforcing the slope with rock, planting grass, or compacting the soil. Contact the City of Lacey for assistance.	
Side Slopes of Wetland	Erosion	Any erosion observed on a compacted berm embankment.		*If erosion is occurring on compacted berms a professional engineer should be consulted to resolve source of erosion.*	

Stormwater Wetlands					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Wetland Cell	Wetland Vegetation	20 percent or more of the stormwater wetland area has dead or dying vegetation, as measured by stem counts relative to the design plant coverage.		Plants in wetland cell surviving and not interfering with wetland function. Dead or dying vegetation is replaced by like species, unless recommended otherwise by the Wetlands Consultant and approved by the city. *(Watering, physical support, mulching, and weed removal may be required on a regular basis especially during the first 3 years.)*	
	Wetland Vegetation	Percent vegetated cover of stormwater wetland bottom area, excluding exotic and invasive species, is less than 50 percent after 2 years.		Exotic/invasive species removed. Additional plantings may be required.	
	Wetland Vegetation	Decaying vegetation produces foul odors.		Decaying vegetation is removed, preferably in late summer.	
	Wetland Vegetation	Wetland vegetation is blocking flow paths causing flow back-up and flooding.		Areas of blocking vegetation are cut back sufficient to allow design flows and prevent flooding.	
	Wetland Vegetation	Water quality monitoring indicates that wetland vegetation is contributing phosphorus and metals to downstream waters rather than sequestering them.		Water quality monitoring indicates improved water quality. To maximize removal of wetland pollutants, wetland vegetation must be periodically harvested, particularly with respect to phosphorus and metals removal. Harvesting should occur by mid-summer before plants begin to transfer phosphorus from the aboveground foliage to subsurface roots, or begin to lose metals that desorb during plant die off. Every 3 to 5 years the entire plant mass including roots should be harvested because the belowground biomass constitutes a significant reservoir (as much as half) of the nutrients and metals that are removed from stormwater by plants.	
	Sediment Accumulation	Sediment accumulation inhibits growth of wetland plants or reduces wetland volume (greater than 1 foot of sediment accumulation).		Wetland dredged to remove sediment accumulation.	

Stormwater Wetlands					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Wetland Berms (dikes)	Settlements	Any part of berm that has settled 4 inches lower than the design elevation. If settlement is apparent, measure berm to determine amount of settlement. Settling can be an indication of more severe problems with the berm or outlet works.		Dike restored to the design elevation. *A professional engineer should be consulted to determine the source of the settlement.*	
	Seepage	Check for water flowing through the pond berm and ongoing erosion with potential for erosion to continue.		Repair berm to eliminate seepage and erosion. *Recommend a geotechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.*	
Wetland Berms Over 4 Feet in Height (dikes)	Tree Growth	Tree growth on berms over 4 feet in height may lead to piping through the berm, which could lead to failure of the berm.		Remove trees on berms. *If root system is small (base less than 4 inches) the root system may be left in place. Otherwise, the roots should be removed and the berm restored. A professional engineer should be consulted for proper berm/spillway restoration.*	
Emergency Overflow/ Spillway	Obstruction	Tree growth or other blockage on emergency spillways may cause failure of the berm due to uncontrolled overtopping.		Remove obstruction on emergency spillway. *A professional engineer should be consulted for proper berm/spillway restoration.*	
	Rock Missing	Check to see that the riprap protective area is intact. Only one layer of rock exists above native soil in an area 5 square feet or larger, or any exposure of native soil at the top of out flow path of spillway.		Restore rocks and pad depth to design standards. (Riprap on inside slopes need not be replaced.)	
	Erosion	Maintenance is needed where eroded damage is over 2 inches deep and where there is potential for continued erosion. Maintenance is needed where any erosion is observed on a compacted berm embankment. Check all wetland areas, particularly around inlets and outlets, as well as at berms for signs of sliding or settling.		Try to determine what has caused the erosion and fix it. Stabilize slopes by using appropriate erosion control measure(s); e.g., reinforcing the slope with rock, planting grass, or compacting the soil. Contact the City of Lacey for assistance. *If erosion is occurring on compacted berms a professional engineer should be consulted to resolve source of erosion.*	

1g. Basic and Compost-Amended Biofiltration Swale

A gently-sloped channel with gentle side slopes, lined with grass (and sometimes other vegetation) to slow the flow and allow for water quality treatment and infiltration.

Basic and Compost-Amended Biofiltration Swale					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
General	Sediment Accumulation on Grass	Sediment depth exceeds 2 inches or inhibits vegetation growth in 10 percent or more of swale.		Remove sediment deposits on grass treatment area of the biofiltration swale. When finished, swale should be level from side to side and drain freely toward outlet. There should be no areas of standing water once inflow has ceased.	
	Standing Water	When water stands in the swale between storms and does not drain freely.		Swale must drain freely and not contain standing water between storms. Any of the following may apply: remove sediment or trash blockages, improve grade from head to foot of swale, remove clogged check dams, add underdrains or convert to a wet biofiltration swale.	
	Flow Spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed through entire swale width.		Level the spreader and clean so that flows are spread evenly over entire swale width.	
	Constant Baseflow	Small quantities of water continually flow through the swale, even when it has been dry for weeks, and an eroded, muddy channel has formed in the swale bottom.		Base flow removed from swale. Add a low-flow pea-gravel drain the length of the swale or by-pass the baseflow around the swale.	
	Poor Vegetation Coverage	Grass is sparse or bare or eroded patches occur in more than 10 percent of the swale bottom.		Swale has no bare spots and grass is thick and healthy. Determine why grass growth is poor and correct that condition. Re-plant with plugs of grass from the upper slope: plant in the swale bottom at 8-inch intervals. Or re-seed into loosened, fertile soil.	
	Vegetation	When the grass becomes excessively tall (higher than 10 inches); when nuisance weeds and other vegetation start to take over.		Mow vegetation or remove nuisance vegetation so that flow not impeded. Grass should be mowed to a height of 3 to 4 inches. Remove grass clippings.	
	Excessive Shading	Grass growth is poor because sunlight does not reach swale.		If possible, trim back over-hanging limbs and remove brushy vegetation on adjacent slopes.	

Basic and Compost-Amended Biofiltration Swale					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Swale	Inlet/Outlet	Inlet/outlet areas clogged with sediment and/or debris.		Remove material so that there is no clogging or blockage in the inlet and outlet area.	
	Trash and Debris Accumulation	Trash and debris accumulated in the biofiltration swale.		No debris or sediment present. Remove trash and debris from biofiltration swale.	
	Erosion/ Scouring	Eroded or scoured swale bottom due to flow channelization, or higher flows.		No eroded or scoured areas in biofiltration swale. Cause of erosion or scour addressed. For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with crushed gravel. If bare areas are large, generally greater than 12 inches wide, the swale should be re-graded and re-seeded. For smaller bare areas, overseed when bare spots are evident, or take plugs of grass from the upper slope and plant in the swale bottom at 8-inch intervals.	
	Poisonous Vegetation and Noxious Weeds	Any poisonous or nuisance vegetation which may constitute a hazard to the public. Any evidence of noxious weeds as defined in the Thurston County Noxious Weeds List.		Eliminate danger of poisonous vegetation where maintenance personnel or the public might normally be. Completely remove invasive, noxious, or nonnative vegetation in accordance with applicable regulations. (*Coordinate with Thurston County Health Department.)* Do not spray chemicals on vegetation without guidance or city approval. It is strongly encouraged that herbicides and pesticides not be used in order to protect water quality. (Apply requirements of adopted integrated pest management policies for the use of herbicides.) *Complete eradication of noxious weeds may not be possible.*	

1h. Wet and Continuous Inflow Biofiltration Swales

Similar to a basic biofiltration swale (previous pages), but with modifications due to saturated soil conditions (such as, specific plants that can tolerate wet conditions).

Wet and Continuous Inflow Biofiltration Swales					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Swale	Sediment Accumulation	Sediment depth exceeds 2 inches in 10 percent of the swale treatment area.		Remove sediment deposits in treatment area.	
	Water Depth	Water not retained to a depth of about 4 inches during the wet season.		Build up or repair outlet berm so that water is retained in the wet swale.	
	Wetland Vegetation	Vegetation becomes sparse and does not provide adequate filtration, OR vegetation is crowded out by very dense clumps of cattail, which do not allow water to flow through the clumps.		Wetland vegetation fully covers bottom of swale. Cause of lack of vigor of vegetation addressed. Replant as needed. Determine cause of lack of vigor of vegetation and correct. Replant as needed. Remove cattails and compost off site. Note: normally wetland vegetation does not need to be harvested unless die-back is causing oxygen depletion in downstream waters.	
	Inlet/Outlet	Inlet/outlet area clogged with sediment and/or debris.		Remove clogging or blockage in the inlet and outlet areas.	
	Trash and Debris Accumulation	Any plastic, paper or other waste or debris.		No debris or sediment present. Remove trash and debris from wet biofiltration swale.	
	Erosion/ Scouring	Swale has eroded or scoured due to flow channelization, or higher flows.		No eroded or scoured areas in biofiltration swale. Check design flows to ensure swale is large enough to handle flows. By-pass excess flows or enlarge swale. Replant eroded areas with fibrous-rooted plants such as *Juncus effusus* (soft rush) in wet areas or snowberry (*Symphoricarpos albus*) in dryer areas.	

Wet and Continuous Inflow Biofiltration Swales					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Swale (continued)	Poisonous Vegetation and Noxious Weeds	Any poisonous or nuisance vegetation which may constitute a hazard to the public. Any evidence of noxious weeds as defined in the Thurston County Noxious Weeds List.		Eliminate danger of poisonous vegetation where maintenance personnel or the public might normally be. Completely remove invasive, noxious, or nonnative vegetation in accordance with applicable regulations. *(Coordinate with Thurston County Health Department.)* Do not spray chemicals on vegetation without guidance or city approval. It is strongly encouraged that herbicides and pesticides not be used in order to protect water quality. (Apply requirements of adopted integrated pest management policies for the use of herbicides.) *Complete eradication of noxious weeds may not be possible.*	

1i. Filter Strip (Basic and CAVFS)

A basic filter strip is a flat grassy area that provides treatment of unconcentrated sheet flow runoff from adjacent pavement. Can provide enhanced treatment for metals in runoff water when soil is amended with organic compost and grass is sufficiently dense.

Filter Strip (basic and CAVFS)					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
General	Sediment Accumulation on Grass	Sediment depth exceeds 2 inches.		Remove sediment deposits, re-level so slope is even and flows pass evenly through strip.	
	Vegetation	When the grass becomes excessively tall (greater than 10 inches); when nuisance weeds and other vegetation starts to take over.		Mow grass, control nuisance vegetation, such that flow not impeded. Grass should be mowed to a height between 3 to 4 inches.	
	Trash and Debris Accumulation	Trash and debris accumulated on the filter strip.		No trash or debris present. Remove trash and debris from filter.	
	Erosion/ Scouring	Eroded or scoured areas due to flow channelization, or higher flows.		No eroded or scoured areas, cause of erosion or scour addressed. For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with crushed gravel. The grass will creep in over the rock in time. If bare areas are large, generally greater than 12 inches wide, the filter strip should be re-graded and re-seeded. For smaller bare areas, overseed when bare spots are evident.	
	Flow Spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed through entire filter width.		Level the spreader and clean so that flows are spread evenly over entire filter width.	

1j. Sand Filter (aboveground/open)

A typical open sand filter consists of a pretreatment system to remove sediments, a flow spreader, a sand bed, and underdrain piping. See also Sand Filter (belowground/closed).

Sand Filter (aboveground/open)					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Aboveground (open sand filter)	Sediment and Silt Accumulation on top layer	Sediment and silt depth exceeds 0.5 inch over 10 percent of surface area of sand filter.		No sediment deposit on grass layer of sand filter that would impede permeability of the filter section. Silt scraped off during dry periods using steel rakes or other devices. Surface layer of the media striated.	
	Trash and Debris Accumulations	Trash and debris accumulated on sand filter bed.		No trash or debris present. Trash and debris removed from sand filter bed.	
	Sediment/ Debris in Clean-Outs	When the clean-outs become full or partially plugged with sediment and/or debris.		Sediment removed from cleanouts and/or drainpipes.	
	Sand Filter Media	Drawdown of water through the sand filter media takes longer than 24-hours, flow through the overflow pipes occurs frequently, or hydraulic conductivity is less than 1 inch per hour.		Sand filter infiltrates as designed. Top several inches of sand are scraped. May require replacement of entire sand filter depth depending on extent of plugging (a sieve analysis is helpful to determine if the lower sand has too high a proportion of fine material).	
	Prolonged Flows	Sand is saturated for prolonged periods of time (several weeks) and does not dry out between storms due to continuous base flow or prolonged flows from detention facilities. (Consider 4- to 8-hour drawdown tests).		Low, continuous flows are limited to a small portion of the facility by using a low wooden divider or slightly depressed sand surface.	
	Short Circuiting	Drawdown greater than 12 inches per hour. When flows become concentrated over one section of the sand filter rather than dispersed.		Flow and percolation of water through sand filter is uniform and dispersed across the entire filter area. No leaks in the cleanouts or underdrains.	
	Erosion Damage to Slopes	Erosion over 2 inches deep where cause of damage is prevalent or potential for continued erosion is evident.		Slopes stabilized using proper erosion control measures.	
	Rock Pad Missing or Out of Place	Soil beneath the rock is visible.		Rock pad replaced or rebuilt to design specifications.	

Sand Filter (aboveground/open)					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Aboveground (open sand filter) (continued)	Flow Spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed across sand filter. Rills and gullies on the surface of the filter can indicate improper function of the inlet flow spreader.		Spreader leveled and cleaned so that flows are spread evenly over sand filter.	
	Damaged Pipes	Any part of the piping that is crushed or deformed more than 20 percent or any other failure to the piping.		Pipe repaired or replaced.	

1k. Sand Filter (belowground/closed)

Similar to an open sand filter, but installed below grade within a vault.

Sand Filter (belowground/closed)					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Vault	Sediment Accumulation on Sand Media Section	Sediment depth exceeds 0.5 inch.		No sediment deposits on sand filter section that would impede permeability of the filter section. Silt scraped off during dry periods using steel rakes or other devices. Surface layer of the media striated.	
	Sediment Accumulation in Presettling Portion of Vault	Sediment accumulation in vault bottom exceeds the depth of sediment zone plus 6 inches.		No sediment deposits in first chamber of vault.	
	Trash and Debris	Trash and debris accumulated in vault, or pipe inlet/outlet, floatables and non-floatables.		No trash or debris present. Trash and debris removed from vault and inlet/outlet piping.	
	Sediment in Drain Pipes/ Cleanouts	When drain pipes, cleanouts become full with sediment and/or debris.		No sediment or debris present. Any sediment and debris removed from cleanouts and/or drainpipes.	
	Clogged Sand Filter Media	Drawdown of water through the sand filter media takes longer than 24-hours, and/or flow through the overflow pipes occurs frequently, and/or hydraulic conductivity is less than 1 inch per hour.		Sand filter infiltrates as designed. Top several inches of sand are scraped. May require replacement of entire sand filter depth depending on extent of plugging and influent suspended solids loads (a sieve analysis is helpful to determine if the lower sand has too high a proportion of fine material). *Other options include removal of thatch, aerating the filter surface, tilling the filter surface, replacing the top 4 inches of filter media, and inspecting geotextiles for clogging.*	
	Short Circuiting	Drawdown greater than 12 inches per hour. When seepage/flow occurs along the vault walls and corners. Sand eroding near inflow area. (Consider 4- to 8-hour drawdown tests.)		Sand filter media section re-laid and compacted along perimeter of vault to form a semi-seal. Erosion protection added to dissipate force of incoming flow and curtail erosion. No leaks in the cleanouts or underdrains.	

Sand Filter (belowground/closed)					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Vault (continued)	Access Cover Damaged/ Not Working	Cover cannot be opened, corrosion/deformation of cover. Maintenance person cannot remove cover using normal lifting pressure.		Cover repaired to proper working specifications or replaced.	
	Flow Spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed across sand filter.		Spreader leveled and cleaned so that flows are spread evenly over sand filter.	
	Ventilation	Ventilation area blocked or plugged.		Blocking material removed/cleared from ventilation area. A specified percentage of the vault surface area must provide venting to the vault interior (per design specifications).	
	Vault Structure Damaged; Includes Cracks in Walls, Bottom, Damage to Frame and/or Top Slab.	Cracks wider than 0.5 inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound.		Vault replaced or repairs made so that vault meets design specifications and is structurally sound.	
	Vault Structure Damaged; Includes Cracks in Walls, Bottom, Damage to Frame and/or Top Slab.	Cracks wider than 0.5 inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.		Vault repaired so that no cracks exist wider than 0.25 inch at the joint of the inlet/outlet pipe.	
	Baffles/ Internal walls	Baffles or walls corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.		Baffles repaired or replaced to specifications.	
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.		Ladder replaced or repaired to specifications, and is safe to use as determined by inspection personnel.	
Pipes	Damaged Pipes	Inlet or outlet piping damaged or broken, in need of repair.		Pipe repaired and/or replaced.	

1I. Media Filter Drains

A filter treatment device that is typically sited along highway side slopes (conventional design) and medians (dual media filter drains), borrow ditches, or other linear depressions. Media filter drains have basic components: a gravel no-vegetation zone, a grass strip, the MFD mix bed, and a conveyance system for flows leaving the media filter drain mix.

Media Filter Drains					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
No Vegetation Zone Adjacent to Pavement	Erosion, Scour, or Vehicular Damage	No vegetation zone uneven or clogged so that flows are not uniformly distributed.		Area leveled and cleaned so that flows are spread evenly.	
	Sediment Accumulation on Edge of Pavement	Flows no longer sheet flowing off of roadway. Sediment accumulation on pavement edge exceeds top of pavement elevation.		No sediment accumulation on pavement edge that impedes sheet flow. Sediment deposits removed such that flows can sheet flow off of roadway.	
Vegetated Filter	Sediment Accumulation on Grass	Sediment depth exceeds 2 inches.		Sediment deposits removed, slope is re-leveled so that flows pass evenly through media filter drain.	
	Excessive Vegetation or Undesirable Species	When the grass becomes excessively tall (greater than 10 inches); when nuisance weeds and other vegetation starts to take over or shades out desirable vegetation growth characteristics. See also the Thurston County Noxious Weeds List.		Grass mowed and nuisance vegetation controlled such that flow not impeded. *Grass should be mowed to a height that encourages dense even herbaceous growth.*	
	Erosion, Scour, or Vehicular Damage	Eroded or scoured areas due to flow channelization, high flows or vehicular damage.		No eroded or scoured areas. *For ruts or bare areas less than 12 inches wide, repair the damaged area by filling with suitable topsoil. The grass will creep in over the rock in time. If bare areas are large, generally greater than 12 inches wide, the filter strip should be re-graded and re-seeded. For smaller bare areas, overseed when bare spots are evident.*	

Media Filter Drains					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Media Bed	Erosion, Scour, or Vehicular Damage	Eroded or scoured areas due to flow channelization, high flows or vehicular damage.		No eroded or scoured areas. *For ruts or areas less than 12 inches wide, repair the damaged area by filling with suitable media. If bare areas are large, generally greater than 12 inches wide, the media bed should be re-graded.*	
	Sediment Accumulation on Media Bed	Sediment depth inhibits free infiltration of water.		Sediment accumulation does not impeded infiltration. Sediment deposits removed and slope is re-leveled so that flows pass freely through Media Bed.	
Underdrains	Sediment	Depth of sediment within perforated pipe exceeds 0.5 inch.		Depth of sediment within perforated pipe does not exceed 0.5 inch. Flush underdrains through access ports and collect flushed sediment.	
General	Trash and Debris Accumulation	Accumulated trash and debris. If there is less than the threshold, remove all trash and debris as part of the next scheduled maintenance.		No trash or debris present. Remove trash and debris from media filter.	
	Flows are Bypassing Media Filter Drain	Evidence of significant flows downslope (rills, sediment, vegetation damage, etc.) of media filter drain.		Facility functions as designed. Sediment deposits removed and slope is re-leveled so that flows pass evenly through media filter drain. If media filter drain is completely clogged, it may require a more extensive repair or replacement.	
	Media Filter Drain Mix Replacement	Water is seen on surface of the media filter drain mix from storms that are less than the 91st percentile 24-hour rain event (approximately 1.25 inches in 24 hours). Maintenance also needed on a 10-year cycle and during a preservation project.		No water ponded on surface after design storm. *Excavate and replace all of the media filter drain mix contained within the media filter drain.*	

1m. Bioretention Cells, Swales, and Planter Boxes

Bioretention areas are shallow stormwater systems with a designed soil mix and plants adapted to the local climate and soil moisture conditions. They are designed to mimic a forested condition by controlling stormwater through detention, infiltration, and evapotranspiration. Most routine maintenance procedures are typical landscape care activities.

Bioretention Cells, Swales, and Planter Boxes					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
General	Trash	Trash and debris present.		No trash and debris present. Remove and properly dispose of all trash and debris.	
Concrete Sidewalls	Cracks or Failure in Concrete Planter Reservoir	Cracks wider than 0.5 inch or maintenance/inspection personnel determine that the planter is not structurally sound.		Concrete repaired or replaced.	
Rockery Sidewalls	Unstable Rockery	Rock walls are insecure.		Rockery sidewalls are stable (may require consultation with professional engineer, particularly for walls 4 feet or greater in height).	
Earthen Side Slopes and Berms	Failure in Earthen Reservoir (embankments, dikes, berms, and side slopes)	Erosion (gullies/rills) greater than 2 inches around inlets, outlet, and alongside slopes.		Source of erosion eliminated and damaged area stabilized (regrade, rock, vegetation, erosion control blanket). For deep channels or cuts (over 3 inches in ponding depth), temporary erosion control measures are in place until permanent repairs can be made.	
		Erosion of sides causes slope to become a hazard.		The hazard is eliminated and slopes are stabilized.	
		Settlement greater than 3 inches (relative to undisturbed sections of berm).		The design height is restored with additional mulch.	
		Downstream face of berm or embankment wet, seeps or leaks evident.		Holes are plugged and berm is compacted. May require consultation with professional engineer, particularly for larger berms.	
		Any evidence of rodent holes or water piping around holes if facility acts as dam or berm.		Rodents (see “Pests: Insects/Rodents”) removed and berm repaired/compacted.	

Bioretention Cells, Swales, and Planter Boxes					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Ponding Area	Sediment or Debris Accumulation	Accumulation of sediment or debris to extent that infiltration rate is reduced (see "Ponded water") or surface storage capacity significantly impacted.		Sediment cleaned out to restore facility shape and depth. Damaged vegetation is replaced and mulched. Source of sediment identified and controlled (if feasible).	
	Leaf Accumulation	Accumulated leaves in facility.		No leaves clogging outlet structure or impeding water flow.	
	Basin Inlet via Surface Flow	Soil is exposed or signs of erosion are visible.		Erosion sources repaired and controlled.	
Curb Cut Inlet	Sediment or Debris Accumulation	Sediment, vegetation, or debris partially or fully blocking inlet structure.		Curb cut is clear of debris. Source of the blockage is identified and action is taken to prevent future blockages.	
Splashblock Inlet	Water Not Properly Directed to Facility	Water is not being directed properly to the facility and away from the inlet structure.		Blocks are reconfigured to direct water to facility and away from structure.	
	Erosion	Water disrupts soil media.		Splashblock is reconfigure/repaired.	
Inlet/ Outlet Pipe	Damaged Pipe	Pipe is damaged.		Pipe is repaired/replaced. No cracks more than 0.25 inch wide at the joint of inlet/outlet pipes exist.	
	Clogged Pipe	Pipe is clogged.		Pipe is clear of roots or debris. Source of the blockage is identified and action is taken to prevent future blockages.	
Inlets/ Outlet and Access Pathways	Blocked Access	Maintain access for inspections.		Vegetation is cleared within 1 foot of inlets and outlets. Access pathways are maintained.	
Ponding Area	Erosion	Water disrupts soil media.		No eroded or scoured areas in bioretention area. Cause of erosion or scour addressed. A cover of rock or cobbles or other erosion protection measure maintained (e.g., matting) to protect the ground where concentrated water enters or exits the facility (e.g., a pipe, curb cut, or swale).	
Trash Rack	Trash or Debris Accumulation	Trash or debris present on trash rack.		No trash or debris on trash rack. Clean and dispose trash.	
	Damaged Trash Rack	Bar screen damaged or missing.		Barrier repaired or replaced to design standards.	

Bioretention Cells, Swales, and Planter Boxes					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Check Dams and Weirs	Sediment or Debris Accumulation	Sediment, vegetation, or debris accumulated at or blocking (or having the potential to block) check dam, weir, or orifice.		Blockage is cleared. Identify the source of the blockage and take actions to prevent future blockages.	
	Erosion	Erosion and/or undercutting is present.		No eroded or undercut areas in bioretention area. Cause of erosion or undercutting addressed. Check dam or weir is repaired.	
	Unlevel Top of Weir	Grade board or top of weir damaged or not level.		Weir restored to level position.	
Flow Spreader	Sediment Accumulation	Sediment blocks 35 percent or more of ports/notches or, sediment fills 35 percent or more of sediment trap.		Sediment removed and disposed of.	
	Damaged or Unlevel Grade Board/Baffle	Grade board/baffle damaged or not level.		Board/baffle removed and reinstalled to level position.	
Overflow/ Emergency Spillway	Sediment or Debris Accumulation	Overflow spillway is partially or fully plugged with sediment or debris.		No sediment or debris in overflow.	
	Erosion	Native soil is exposed or other signs of erosion damage are present.		Erosion repaired and surface of spillway stabilized.	
	Missing Spillway Armament	Spillway armament is missing.		Armament replaced.	
Underdrain	Blocked Underdrain	Plant roots, sediment or debris reducing capacity of underdrain. Prolonged surface ponding (see “Bioretention Soil”).		Underdrains and orifice are free of sediment and debris.	
Bioretention Soil	Ponded Water	Excessive ponding water: Water overflows during storms smaller than the design event or ponded water remains in the basin 48 hours or longer after the end of a storm.		Cause of ponded water is identified and addressed: 1. Leaf or debris buildup is removed 2. Underdrain is clear 3. Other water inputs (e.g., groundwater, illicit connections) investigated 4. Contributing area verified If steps #1–4 do not solve the problem, imported bioretention soil is replaced and replanted.	

Bioretention Cells, Swales, and Planter Boxes					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Bioretention Soil (continued)	Protection of Soil	Maintenance requiring entrance into the facility footprint.		Maintenance is performed without compacting bioretention soil media.	
Vegetation	Bottom Swale and Upland Slope Vegetation	Less than 75 percent of swale bottom is covered with healthy/surviving vegetation.		Plants are healthy and pest free. Cause of poor vegetation growth addressed. Bioretention area is replanted as necessary to obtain 75 percent survival rate or greater. Plant selection is appropriate for site growing conditions.	
Trees and Shrubs	Causing Problems for Operation of Facility	Large trees and shrubs interfere with operation of the basin or access for maintenance.		Trees and shrubs do not hinder facility performance or maintenance activities. Prune or remove large trees and shrubs.	
	Dead Trees and Shrubs	Standing dead vegetation is present.		Trees and shrubs do not hinder facility performance or maintenance activities. Dead vegetation is removed and cause of dead vegetation is addressed. Specific plants with high mortality rate are replaced with more appropriate species.	
Trees and Shrubs Adjacent to Vehicle Travel Areas (or areas where visibility needs to be maintained)	Safety Issues	Vegetation causes some visibility (line of sight) or driver safety issues.		Appropriate height for sight clearance is maintained. Regular pruning maintains visual sight lines for safety or clearance along a walk or drive. Tree or shrub is removed or transplanted if presenting a continual safety hazard.	
Emergent Vegetation	Conveyance Blocked	Vegetation compromises conveyance.		Sedges and rushes are clear of dead foliage.	
Mulch	Lack of Mulch	Bare spots (without much cover) are present or mulch covers less than 2 inches.		Facility has a maximum 3-inch layer of an appropriate type of mulch and mulch is kept away from woody stems.	
Vegetation	Accumulation of Clippings	Grass or other vegetation clippings accumulate to 2 inches or greater in depth.		Clippings removed.	
	Weeds	Weeds are present (unless on edge and providing erosion control).		Weed material removed and disposed of. It is strongly encouraged that herbicides and pesticides not be used in order to protect water quality.	

Bioretention Cells, Swales, and Planter Boxes					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Noxious Weeds	Poisonous Vegetation and Noxious Weeds	Any poisonous or nuisance vegetation which may constitute a hazard to the public. Any evidence of noxious weeds as defined in the Thurston County Noxious Weeds List.		Eliminate danger of poisonous vegetation where maintenance personnel or the public might normally be. Completely remove invasive, noxious, or nonnative vegetation in accordance with applicable regulations. *(Coordinate with Thurston County Health Department.)* Do not spray chemicals on vegetation without guidance or city approval. It is strongly encouraged that herbicides and pesticides not be used in order to protect water quality. (Apply requirements of adopted integrated pest management policies for the use of herbicides.) *Complete eradication of noxious weeds may not be possible.*	
Excessive Vegetation	Adjacent Facilities Compromised	Low-lying vegetation growing beyond facility edge onto sidewalks, paths, or street edge poses pedestrian safety hazard or may clog adjacent permeable pavement surfaces due to associated leaf litter, mulch, and soil.		Vegetation does not impede function of adjacent facilities or pose as safety hazard. Groundcovers and shrubs trimmed at facility edge. Excessive leaf litter is removed.	
	Causes Facility to Not Function Properly	Excessive vegetation density inhibits stormwater flow beyond design ponding or becomes a hazard for pedestrian and vehicular circulation and safety.		Pruning and/or thinning vegetation maintains proper plant density and aesthetics. Plants that are weak, broken, or not true to form are removed or replaced in-kind. Appropriate plants are present.	
Irrigation (if any)	NA	Irrigation system present.		Manufacturer's instructions for O&M are met.	
Plant Watering	Plant Establishment	Plant establishment period (1–3 years).		Plants are watered as necessary during periods of no rain to ensure plant establishment.	
Summer Watering (after establishment)	Drought Period	Longer term period (3+ years).		Plants are watered as necessary during drought conditions and trees are watered up to 5 years after planting.	

Bioretention Cells, Swales, and Planter Boxes					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Spill Prevention and Response	Spill Prevention	Storage or use of potential contaminants in the vicinity of facility.		Spill prevention measures are implemented whenever handling or storing potential contaminants.	
	Spill Response	Any evidence of contaminants such as oil, gasoline, concrete slurries, paint, etc.		Spills are cleaned up as soon as possible to prevent contamination of stormwater. No contaminants or pollutants present. *(Coordinate source control, removal, and/or cleanup with City of Lacey Spill Response Team (360) 491-5644, Moderate Risk Waste Program at Thurston County Environmental Health (360) 754–4111, and/or Dept. of Ecology Spill Response (800) 424-8802.)*	
Safety	Safety (slopes)	Erosion of sides causes slope to exceed 1:3 or otherwise becomes a hazard.		Actions taken to eliminate the hazard.	
	Safety (hydraulic structures)	Hydraulic structures (pipes, culverts, vaults, etc.) become a hazard to children playing in and around the facility.		Actions taken to eliminate the hazard (such as covering and securing any openings).	
Aesthetics	Aesthetics	Damage/vandalism/debris accumulation.		Facility restored to original aesthetic conditions.	
	Edging	Grass is starting to encroach on swale.		Edging repaired.	
Pest Control	Pests: Insects/ Rodents	Pest of concern is present and impacting facility function.		Pests removed and facility returned to original functionality. Do not use pesticides or *Bacillus thuringiensis israelensis (Bti).*	
	Mosquitoes	Standing water remains in the basin for more than three days following storms.		All inlets, overflows and other openings are protected with mosquito screens. No mosquito infestation present.	

1n. Rain Gardens

Rain gardens are shallow stormwater systems with compost amended soil or imported rain garden or bioretention soil and plants adapted to the local climate and soil moisture conditions. They are similar in function to bioretention cells, but have less onerous design requirements and are generally applicable to smaller sites.

Rain Gardens					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Facility – General Requirements	Mosquitoes	Standing water remains for more than three days following storms.		All inlets, overflows and other openings are protected with mosquito screens. No mosquito infestation present. Rain garden drains freely and there is no standing water between storms. Cause of the standing water is addressed (see "Ponded Water").	
Footprint Area	Trash	Trash and debris present.		No trash or debris present. Remove and properly dispose of all trash and debris.	
	Debris Accumulation	Accumulated leaves in facility.		No leaves clogging outlet structure or impeding water flow.	
Earthen Side Slopes and Berms	Erosion	Persistent soil erosion on slopes.		No eroded or scoured areas. Cause of erosion or scour is addressed.	
Rockery Sidewalls	Unstable Rockery	Rockery side walls are insecure.		Rockery sidewalls are stable (may require consultation with engineer, particularly for walls 4 feet or greater in height).	
Rain Garden Bottom Area	Sediment Accumulation	Visible sediment deposition in the rain garden that reduces drawdown time of water in the rain garden.		No sediment accumulation in rain garden, Source of sediment addressed.	
Mulch	Lack of Mulch	Bare spots (without mulch cover) are present or mulch depth less than 2 inches.		Facility has a minimum 2- to 3-inch layer of an appropriate type of mulch and is kept away from woody stems.	
Splashblock Inlet	Water Not Properly Directed to Rain Garden	Water is not being directed properly to the rain garden and away from the inlet structure. Water splashes adjacent buildings.		Blocks are reconfigured to direct water to rain garden and away from structure.	

Rain Gardens					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Pipe Inlet/ Outlet	Erosion	Rock or cobble is removed or missing and concentrated flows are contacting soil.		No eroded or scoured areas. Cause of erosion or scour is addressed. Cover of rock or cobbles protects the ground where concentrated water flows into the rain garden from a pipe or swale.	
	Accumulated Debris	Accumulated leaves, sediment, debris or vegetation at curb cuts, inlet or outlet pipe.		Blockage is cleared.	
	Damaged Pipe	Pipe is damaged		Pipe is repaired/replaced.	
	Clogged Pipe	Pipe is clogged.		Pipe is clear of roots and debris.	
Access	Blocked Access	Maintain access for inspections.		Vegetation is cleared or transplanted within 1 foot of inlets and outlets.	
Ponded Water	Ponded Water	Excessive ponding water: Ponded water remains in the rain garden more than 48 hours after the end of a storm.		Rain garden drains freely and there is no standing water in the rain garden between storms. Leaf litter/debris/sediment is removed.	
Overflow	Blocked Overflow	Capacity reduced by sediment or debris.		No sediment or debris in overflow.	
Vegetation	Blocking Site Distances and Sidewalks	Vegetation inhibits sight distances and sidewalks.		Sidewalks and sight distances along roadways and sidewalks are kept clear.	
	Vegetation Blocking Pipes	Vegetation is crowding inlets and outlets.		Inlets and outlets in the rain garden are clear of vegetation.	
	Unhealthy Vegetation	Yellowing: possible Nitrogen (N) deficiency Poor growth: possible Phosphorous (P) deficiency. Poor flowering, spotting or curled leaves, or weak roots or stems: possible Potassium (K) deficiency.		Plants are healthy and appropriate for site conditions.	
	Weeds	Presence of weeds.		Weeds are removed (manual methods preferred) and mulch is applied.	
Summer Watering (years 1–3)	Plant Establishment	Tree, shrubs and groundcovers in first 3 years of establishment period.		Plants are watered during plant establishment period (years 1–3).	

Rain Gardens					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Summer Watering (after establishment)	Drought Conditions	Vegetation requires supplemental water.		Plants are watered during drought conditions or more often if necessary during post-establishment period (after 3 years).	

1o. Trees

When designed in accordance with this Manual, trees can provide flow control via interception, transpiration, and increased infiltration. Most routine maintenance procedures are typical landscape care activities.

Trees					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Tree	Excess or Unhealthy Growth	Health of tree at risk, or tree in conflict with other infrastructure.		Tree pruned according to industry standards to promote tree health and longevity.	
	NA	Young tree (i.e., within first 3 years).		Tree provided with supplemental irrigation and fertilization (as needed) during first three growing seasons.	
	NA	Evidence of pest activity affecting tree health.		Pest management activities implemented to reduce or eliminate pest activity, and to restore tree health.	
	Dead or Declining	Dead, damaged or declining.		Tree is replaced per planting plan or acceptable substitute.	

1p. Permeable Pavement

Permeable pavement is a stormwater infiltration facility that is designed to accommodate pedestrian, bicycle, and auto traffic while allowing infiltration and storage of stormwater. Permeable pavement includes porous asphalt; pervious concrete; permeable pavers and aggregate pavers; and grid systems.

Permeable Pavement					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
All Pavement Types	Leaf and Debris Accumulation	Fallen leaves or debris.		Removed/disposed.	
	All Pavement Types	Sediment or debris accumulation between paver blocks, on surface of pavement, or in grid voids.		Sediment at surface does not inhibit infiltration. Remove/dispose of sediment.	
Facility – General Requirements	Unstable Adjacent Area	Runoff from adjacent pervious areas deposits soil, mulch, or sediment on paving.		No deposited soil or other materials on permeable pavement or other adjacent surfacing. All exposed soils that may erode to pavement surface mulched and/or planted.	
	Wearing Course Covered by Adjacent Vegetation	Vegetation growing beyond facility edge onto sidewalks, paths, and street edge.		Vegetation does not impede function of adjacent facilities or pose as safety hazard. Groundcovers and shrubs trimmed to avoid overreaching the sidewalks, paths and street edge.	
Porous Asphalt or Pervious Cement Concrete	NA	None. Maintenance to prevent clogging with fine sediment.		Conventional street sweepers equipped with vacuums, water, and brushes or pressure washer used to restore permeability. Vacuum or pressure wash the pavement two to three times annually.	
	NA	None. Maintenance to prevent clogging with fine sediment.		Use of sand and sealant application prohibited. Protect from construction runoff.	
	Cracks	Major cracks or trip hazards.		Potholes or small cracks filled with patching mixes. Large cracks and settlement addressed by cutting and replacing the pavement section.	
	NA	Utility cuts.		Any damage or change due to utility cuts replaced in kind.	
Interlocking Concrete Paver Blocks	Missing or Damaged Paver Block	Interlocking paver block missing or damaged.		Individual damaged paver blocks removed and replaced or repaired per manufacturer's recommendations.	

Permeable Pavement					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Interlocking Concrete Paver Blocks (continued)	Settlement	Settlement of surface. When deviation from original grade impedes function.		Original grade re-established. May require resetting.	
	Void Material is Missing or Low	Loss of aggregate material between paver blocks.		Refill per manufacturer's recommendations.	
Open-Celled Paving Grid with Gravel	Loss of Aggregate Material in Paving Grid	Loss of aggregate material in grid.		Aggregate gravel level maintained at the same level as the plastic rings or no more than 0.25 inch above the top of rings. Refill per manufacturer's recommendations.	
Open-Celled Paving Grid with Grass	Lack of Grass Coverage	Loss of soil and/or grass material in grid.		Refill and/or replant per manufacturer's recommendations. Growing medium restored, facility aerated and reseeded or planted, and vegetated area amended as needed.	
Inlet/Outlet Pipe	Pipe is Damaged	Pipe is damaged.		Pipe is repaired/replaced.	
	Pipe is Clogged	Pipe is clogged.		Roots or debris is removed.	
	Erosion	Native soil exposed or other signs of erosion damage present.		No eroded or scoured areas Cause of erosion or scour is addressed.	
Underdrain Pipe	Blocked Underdrain	Plant roots, sediment or debris reducing capacity of underdrain (may cause prolonged drawdown period).		Underdrains and orifice free of sediment and debris. Jet clean or rotary cut debris/roots from underdrain(s). If underdrains are equipped with a flow restrictor (e.g., orifice) to attenuate flows, the orifice must be cleaned regularly.	
Spill Prevention and Response	NA	Storage or use of potential contaminants in the vicinity of facility.		Spill prevention measures exercised whenever handling or storing potential contaminants.	

Permeable Pavement					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Spill Prevention and Response (continued)	Release of Pollutants	Any evidence of contaminants such as oil, gasoline, concrete slurries, paint, etc.		Spills are cleaned up as soon as possible to prevent contamination of stormwater. No contaminants or pollutants present. *(Coordinate source control, removal, and/or cleanup with City of Lacey Spill Response Team (360) 491-5644, Moderate Risk Waste Program at Thurston County Environmental Health (360) 754–4111, and/or Dept. of Ecology Spill Response (800) 424-8802.)*	

1q. Vegetated Roofs

Vegetated roofs are areas of living vegetation installed on top of buildings, or other above-grade impervious surfaces. Design components vary depending on the vegetated roof type and site constraints, but may include a waterproofing material, a root barrier, a drainage layer, a separation fabric, a growth medium (soil), and vegetation.

Vegetated Roofs					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Soil/ Growth Medium	Water is Not Infiltrating Properly	Water does not permeate growth media (runs off soil surface).		Facility infiltrates as designed. Aerate or replace media until stormwater infiltrates freely through growth media.	
	Water is Not Infiltrating Properly	Growth medium thickness is less than design thickness (due to erosion and plant uptake).		Facility infiltrates as designed. Supplement growth medium to design thickness.	
	Water is Not Infiltrating Properly	Fallen leaves or debris are present.		No leaves or debris present.	
	Erosion/ Scouring	Areas of potential erosion are visible.		Steps taken to repair or prevent erosion. Fill, hand tamp, or lightly compact, and stabilize with additional soil substrate/growth medium and additional plants.	
Erosion Control Measures	Erosion/ Scouring	Mat or other erosion control is damaged or depleted during plant establishment period.		Erosion control measures repaired/replaced until 90 percent vegetation coverage attained. Avoid application of mulch on extensive vegetated roofs.	
System Structural Components	Deteriorating Flashing, Gravel Stops, Utilities, or Other Structures on Roof	Flashing, utilities or other structures on roof are deteriorating (can serve as source of metal pollution in vegetated roof runoff).		Structural components inspected for deterioration or failure. Repair/replace as necessary.	
Roof Drain	Sediment, Vegetation, or Debris Accumulation	Sediment, vegetation, or debris blocks 20 percent or more of inlet structure.		Blockages cleared. Problems that led to blockage identified and corrected.	
	Damaged Inlet Pipe	Inlet pipe is in poor condition.		Repaired/replaced.	
	Clogged Inlet Pipe	Pipe is clogged.		Roots or debris removed.	

Vegetated Roofs					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Vegetation	Plant Coverage	Healthy vegetative coverage falls below 90 percent (unless design specifications stipulate less than 90 percent coverage).		Bare areas planted with vegetation If necessary, install erosion control measures until percent coverage goal is attained.	
Vegetation (sedums)	NA	Extensive roof with low density sedum population.		Sedums are mulch mowed, creating cuttings from existing plants to encourage colonization.	
Vegetation	Poisonous Vegetation and Noxious Weeds	Any poisonous or nuisance vegetation which may constitute a hazard to the public. Any evidence of noxious weeds as defined in the Thurston County Noxious Weeds List.		Eliminate danger of poisonous vegetation where maintenance personnel or the public might normally be. Completely remove invasive, noxious, or nonnative vegetation in accordance with applicable regulations. *(Coordinate with Thurston County Health Department.)*. Do not spray chemicals on vegetation without guidance or city approval. It is strongly encouraged that herbicides and pesticides not be used in order to protect water quality. *(Coordinate with Thurston County Health Department.) Complete eradication of noxious weeds may not be possible.*	
	Presence of Weeds	Weeds are present.		Weed material removed and disposed of, with roots manually removed with pincer-type weeding tools, flame weeders, or hot water weeders as appropriate. It is strongly encouraged that herbicides and pesticides not be used in order to protect water quality.	

Vegetated Roofs					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Vegetation (extensive vegetated roof)	Under Fertilization	Poor plant establishment and possible nutrient deficiency in growth medium.		Organic debris allowed to replenish and maintain long-term nutrient balance and growth medium structure. Conduct annual soil test 2 to 3 weeks prior to the spring growth flush to assess need for fertilizer. Utilize test results to adjust fertilizer type and quantity appropriately. Minimum amount slow-release fertilizer necessary to achieve successful plant establishment is applied. Apply fertilizer only after acquiring required approval from facility owner and operator. Note that extensive vegetated roofs are designed to require zero to minimal fertilization after establishment (excess fertilization can contribute to nutrient export).	
Vegetation (intensive vegetated roof)	Under Fertilization	Fertilization may be necessary during establishment period or for plant health and survivability after establishment.		Annual soil test conducted 2 to 3 weeks prior to the spring growth flush to assess need for fertilizer. Utilize test results to adjust fertilizer type and quantity appropriately. Apply minimum amount slow-release fertilizer necessary to achieve successful plant establishment. Apply fertilizer only after acquiring required approval from facility owner and operator. Intensive vegetated roofs may require more fertilization than extensive vegetated roofs.	
Vegetation (trees and shrubs on an intensive vegetated roof)	NA	Pruning as needed.		All pruning of mature trees performed by or under the direct guidance of an ISA certified arborist.	
Irrigation system (if any)	NA	Irrigation system is not working or routine maintenance is needed.		Manufacturer's instructions for O&M have been followed.	

Vegetated Roofs					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Vegetation (extensive vegetated roof)	NA	Summer watering – Plant establishment period (1 to 2 years).		Watered weekly during periods of no rain to ensure plant establishment (30 to 50 gallons per 100 square feet).	
	NA	Summer watering – Longer term period (2+ years).		Watered during drought conditions or more often if necessary to maintain plant cover (30 to 50 gallons per 100 square feet).	
	NA	Plant establishment period (1 to 2 years).		Watered deeply, but infrequently, so that the top 6 to 12 inches of the root zone is moist. Use soaker hoses or spot water with a shower type wand when irrigation system not present.	
Vegetation (intensive vegetated roof)	NA	Longer term period (2+ years).		Watered during drought conditions or more often if necessary to maintain plant cover.	
Spill Prevention and Response	NA	Storage or use of potential contaminants in the vicinity of facility.		Spill prevention measures exercised whenever handling or storing potential contaminants.	
	Release of Pollutants	Any evidence of contaminants such as oil, gasoline, concrete slurries, paint, etc.		Spills are cleaned up as soon as possible to prevent contamination of stormwater. No contaminants or pollutants present. *(Coordinate source control, removal, and/or cleanup with City of Lacey Spill Response Team (360) 491-5644, Moderate Risk Waste Program at Thurston County Environmental Health (360) 754–4111, and/or Dept. of Ecology Spill Response (800) 424-8802.)*	
Training and Documentation	NA	Training/written guidance is required for proper O&M.		Property owners and tenants provided with proper training and a copy of the Maintenance and Source Control Manual.	
Safety	NA	Insufficient egress/ingress routes and fall protection.		Egress and ingress routes maintained to design standards and fire codes. Ensure appropriate fall protection.	
Aesthetics	Poor Aesthetics	Damage/vandalism/debris accumulation.		Facility restored to original aesthetic conditions.	

Vegetated Roofs					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Pest Control	Mosquitoes	Standing water remains for more than three days following storms.		Standing water removed. Cause of the standing water identified, and appropriate actions taken to address the problem (e.g., aerate or replace medium, unplug drainage).	

1r. Downspout, Sheet Flow, Concentrated Flow Dispersion

Dispersion BMP components vary depending on the type of BMP used, but can consistent of a gravel filled trench, splashblock, transition zone, vegetated flow path, berms, and/or slotted drains. Dispersion BMPs reduce peak flows by slowing stormwater runoff entering into the conveyance system, allowing for some infiltration, and providing some water quality benefits.

Downspout, Sheet Flow, Concentrated Flow Dispersion					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Splashblock	Water Directed Toward Building	Water is being directed towards building structure.		Water directed away from building structure.	
	Water Causing Erosion	Water disrupts soil media.		Blocks are reconfigured/repaired and media is restored.	
Transition Zone	Erosion	Adjacent soil erosion; uneven surface creating concentrated flow discharge; or less than 2 feet of width.		No eroded or scoured areas. Cause of erosion or scour is addressed.	
Dispersion Trench	Concentrated Flow	Visual evidence of water discharging at concentrated points along trench (normal condition is a “sheet flow” from edge of trench; intent is to prevent erosion damage).		No debris on trench surface. Notched grade board or other distributor type is aligned to prevent erosion. Trench is rebuilt to standards, if necessary.	
Surface of Trench	Accumulated Debris	Accumulated trash, debris, or sediment on drain rock surface impedes sheet flow from facility.		No trash or debris present. Removed and properly dispose of all trash and debris.	
	Vegetation Impeding Flow	Vegetation/moss present on drain rock surface impedes sheet flow from facility.		Freely draining drain rock surface.	
Pipe(s) to Trench	Accumulated Debris in Drains	Accumulation of trash, debris, or sediment in roof drains, gutters, driveway drains, area drains, etc.		No trash or debris in roof drains, gutters, driveway drains, or area drains.	
	Accumulated Debris in Inlet Pipe	Pipe from sump to trench or drywell has accumulated sediment or is plugged.		No sediment or debris in inlet/outlet pipe screen or inlet/outlet pipe.	
	Damaged Pipes	Cracked, collapsed, broken, or misaligned drain pipes.		No cracks more than 0.25-inch wide at the joint of the inlet/outlet pipe.	

Downspout, Sheet Flow, Concentrated Flow Dispersion					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Sump	Accumulated Sediment	Sediment in the sump.		Sump contains no sediment.	
Access Lid	Hard to Open	Cannot be easily opened.		Access lid is repaired or replaced.	
	Buried	Buried.		Access lid functions as designed (refer to record drawings for design intent).	
	Missing Cover	Cover missing.		Cover is replaced.	
Rock Pad	Inadequate Rock Cover	Only one layer of rock exists above native soil in area 6 square feet or larger, or any exposure of native soil.		Rock pad is repaired/replaced to meet design standards.	
	Erosion	Soil erosion in or adjacent to rock pad.		Rock pad is repaired/replaced to meet design standards.	
Dispersal Area	Erosion	Erosion (gullies/rills) greater than 2 inches deep in dispersal area.		No eroded or scoured areas. Cause of erosion or scour is addressed.	
	Accumulated Sediment	Accumulated sediment or debris to extent that blocks or channelizes flow path.		No excess sediment or debris in dispersal area. Sediment source is addressed (if feasible).	
Ponded Water	Ponded Water	Standing surface water in dispersion area remains for more than 3 days after the end of a storm event.		System freely drains and there is no standing water in dispersion area between storms. The cause of the standing water (e.g., grade depressions, compacted soil) is addressed.	
Vegetation	Plant Survival	Dispersal area vegetation in establishment period (1 to 2 years, or additional 3rd year) during extreme dry weather).		Vegetation is healthy and watered weekly during periods of no rain to ensure plant establishment.	
	Lack of Vegetation Allowing Erosion	Poor vegetation cover such that erosion is occurring.		Vegetation is healthy and watered. No eroded or scoured areas are present. Cause of erosion or scour is addressed. Plant species are appropriate for the soil and moisture conditions.	
	Vegetation Blocking Flow	Vegetation inhibits dispersed flow along flow path.		Vegetation is trimmed, weeded, or replanted to restore dispersed flow path.	
	Presence of Noxious Weeds	Any noxious or nuisance vegetation which may constitute a hazard to county personnel or the public.		Noxious and nuisance vegetation removed according to applicable regulations. No danger of noxious vegetation where county personnel or the public might normally be.	

Downspout, Sheet Flow, Concentrated Flow Dispersion					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Pest Control	Mosquito Infestation	Standing water remains for more than three days following storms.		All inlets, overflows and other openings are protected with mosquito screens. No mosquito infestation present.	
Rodents	Presence of Rodents	Rodent holes or mounds disturb dispersion flow paths.		Rodents removed; holes are filled; and flow path is revegetated.	

1s. Downspout Infiltration

Downspout infiltration systems are trench or drywell designs intended only for use in infiltrating runoff from roof downspout drains.

Downspout Infiltration					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Rock Trench/Well	Inflow Disruption	Accumulated trash, debris, or sediment on drain rock surface impeding sheet flow into facility.		Sheet flow re-established. Material removed and disposed of in accordance with applicable solid waste requirements.	
	Inflow Disruption	Vegetation/moss present on drain rock surface impeding sheet flow into facility.		Material removed and sheet flow re-established.	
	Inflow Disruption	Water ponding at surface, or standing water in subgrade observation port.		Inflow to facility is consistent and no ponding is observed. Inlet piping is clear and/or rock or sand reservoirs have been replaced.	
Inlet/Outlet Pipe Conveyance	Conveyance Blockage	Accumulation of trash, debris, or sediment in roof drains, gutters, driveways drains, area drains, etc.		Conveyance systems are clear of debris and free-flowing.	
	Conveyance Blockage	Pipes to or from sump, trench, or drywell have accumulated sediment or is plugged.		Pipe systems are clear of debris and free-flowing.	
	Conveyance Damage	Pipes to or from sump, trench, or drywell is cracked, broken, or misaligned.		Pipe systems are undamaged and free-flowing.	
Roof Downspout	Splash Pad Malfunction	Splash pad missing or damaged.		Splash pad installed and functioning correctly	
	Overflow	Water overflows from the gutter or downspout during rain.		First try cleaning out the gutter and downspouts. If this doesn't solve the problem, a larger drywell may be needed. Contact the city before changing the design or upgrading to a larger drywell.	
Storage Sump	Sediment in Sump	Excess sediment accumulate in sump.		Material removed and disposed of in accordance with applicable solid waste requirements.	
	Access Lid Problems	Access lid cannot be opened or is missing.		Access lid is functioning as designed. Refer to record drawings to confirm type, function, and required components.	

Downspout Infiltration					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Roof	Moss	Moss and algae are taking over the shadier parts of the shingles.		Disconnect the flexible part of the downspout that leads to the drywell. Then perform moss removal as desired. Pressure wash or use fatty acid solutions instead of highly toxic pesticides or chlorine bleach. Install a zinc strip as a preventive.	

1t. Cisterns

Cisterns are designed to collect stormwater runoff from non-polluting surfaces (typically roofs), and to make use of the collected water. Reuse of the runoff can be for irrigation, potable, and non-potable uses, but requires different levels of storage and water quality treatment depending on the intended use.

Cisterns					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Roof/Gutter	Debris Accumulation in Cistern	Debris has accumulated.		No debris in cistern. Remove and properly dispose of all debris.	
	Debris Accumulation in Gutter	Debris has accumulated.		No debris in cistern or gutters. Remove and properly dispose of all debris.	
Screens at the Top of Downspout and Cistern Inlet	Debris Accumulation in Cistern	Screen has deteriorated.		Screen is in place and functions as designed.	
	NA	None. Preventive maintenance.		No debris in cistern or accumulated on screen. Remove and properly dispose of all debris.	
Low Flow Orifice	Cistern Overflows are too Frequent	Debris or other obstruction of orifice.		Low flow orifice is clean.	
Overflow Pipe	Overflow Pipe	Pipe is damaged.		Overflow pipe is watertight and does not leak. Repair/replace.	
	Overflow Pipe	Pipe is clogged.		Debris removed. Overflow pipe can convey overflow to point of discharge.	
Cistern	Accumulated Debris And/or Sediment	More than 6 inches of accumulation in bottom of cistern.		Accumulated debris and/or sediment removed.	
Training and Documentation	NA	Training/written guidance is required for proper O&M.		Property owners and tenants are provided with proper training and a copy of the Maintenance and Source Control Manual.	
Access and Safety	NA	Access to cistern required for maintenance or cleaning.		Any opening that could allow the entry of people is marked: “DANGER—CONFINED SPACE”.	
Pest Control	Mosquito Infestation	Standing water remains for more than 3 days following storms.		All inlets, overflows, and other openings are protected with mosquito screens. No mosquito infestation present.	

1u. Fencing/Shrubbery Screen/Other Landscaping

Fencing, shrubbery screening, and landscaping provide flow control via interception, transpiration, and increased infiltration as well as slope protection. Most routine maintenance procedures are typical landscape care activities.

Fencing/Shrubbery Screen/Other Landscaping					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
General	Missing or Broken Parts/Dead Shrubbery	Any defect in the fence or screen that permits easy entry to a facility.		Fence is mended or shrubs replaced to form a solid barrier to entry.	
	Erosion	Erosion has resulted in an opening under a fence that allows entry by people or pets.		Soil under fence replaced so that no opening exceeds 4 inches in height.	
	Unruly Vegetation	Shrubbery is growing out of control or is infested with weeds. See also Thurston County Noxious Weeds List.		Shrubbery is trimmed and weeded to provide appealing aesthetics. Do not use chemicals to control weeds.	
Fences	Damaged Parts	Posts out of plumb more than 6 inches.		Posts plumb to within 1.5 inches of plumb.	
		Top rails bent more than 6 inches.		Top rail free of bends greater than 1 inch.	
		Any part of fence (including posts, top rails, and fabric) more than 1 foot out of design alignment.		Fence is aligned and meets design standards.	
		Missing or loose tension wire.		Tension wire in place and holding fabric.	
		Missing or loose barbed wire that is sagging more than 2.5 inches between posts.		Barbed wire in place with less than 0.75-inch sag between posts.	
		Extension arm missing, broken, or bent out of shape more than 1.5 inches.		Extension arm in place with no bends larger than 0.75 inch.	
	Deteriorated Paint or Protective Coating	Part or parts that have a rusting or scaling condition that has affected structural adequacy.		Structurally adequate posts or parts with a uniform protective coating.	
	Openings in Fabric	Openings in fabric are such that an 8-inch-diameter ball could fit through.		No openings in fabric.	

1v. Manufactured Media Filters

Manufactured media filters are installed below grade and usually consist of a two-chambered vault that include a presettling basin and a filter bed with sand or filter media. This filter is accessed through a manhole. DO NOT ENTER ANY TANK OR VAULT without proper training, certification and equipment.

Manufactured Media Filters					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Media Filter Vault	Sediment Accumulation on Top of Filter Cartridges	Sediment accumulation exceeds 0.25 inches on top of cartridges.		No sediment deposits on top of cartridges. Sediment on cartridges likely indicates that cartridges are plugged and require maintenance.	
	Sediment Accumulation	Sediment accumulation in vault exceeds 6 inches. Look for other indicators of clogged cartridges or overflow.		No sediment accumulation in vault. *Sediment in vault should be removed. Cartridges should be checked and replaced or serviced as needed.*	
	Trash and Floatable Debris Accumulation	Trash and floatable debris accumulation in vault.		No trash or other floatable debris in filter vault.	
	Filter Cartridges Submerged	Filter vault does not drain within 24 hours following storm. Look for evidence of submergence due to backwater or excessive hydrocarbon loading.		Filter media checked and replaced if needed. *If cartridges are plugged with oil additional treatment or source control BMP may be needed.*	
Forebay	Sediment Accumulation	Sediment accumulation exceeds 6 inches or 33 percent (one third) of the available sump.		Sediment accumulation less than 6 inches.	
	Trash and Floatable Debris Accumulation	Trash and/or floatable debris accumulation.		No trash or other floatable debris accumulation in forebay. Trash and/or floatable debris should be removed during inspections. *Significant oil accumulation may indicate the need for additional treatment or source control.*	
Drain Pipes/ Cleanouts	Sediment in Drain Pipes/ Cleanouts	Accumulated sediment that exceeds 20 percent of the diameter.		No sediment or debris in drainpipes or cleanouts. Sediment and debris removed.	
Belowground Vault	Access Cover Damaged/ Not working	One maintenance person cannot remove lid after applying 80 pounds of lift, corrosion of deformation of cover.		Cover repaired to proper working specifications or replaced.	

Manufactured Media Filters					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Belowground Vault (continued)	Damaged Pipes	Any part of the pipes are crushed or damaged due to corrosion and/or settlement.		Pipe repaired or replaced.	
	Vault Structure has Cracks in Wall, Bottom, and Damage to Frame and/or Top Slab	Cracks wider than 0.5 inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound.		Vault repaired or replaced so that vaults meets design specifications and is structurally sound.	
		Cracks wider than 0.5 inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.		Vault repaired so that no cracks exist wider than 0.25 inch at the joint of inlet/outlet pipe.	
	Baffles	Baffles corroding, cracking, warping, and/or showing signs of failure as determined by maintenance/inspection person.		Baffles repaired or replaced to design specifications.	
	Ladder Rungs Unsafe	Maintenance person judges that ladder is unsafe due to missing rungs, misalignment, rust, or cracks. Ladder must be fixed or secured immediately.		Ladder meets design standards and allows maintenance persons safe access.	
Belowground Cartridge Type	Media	Drawdown of water through the media takes longer than 1 hour, and/or overflow occurs frequently.		Media cartridges replaced.	
	Short Circuiting	Flows do not properly enter filter cartridges.		Filter cartridges replaced.	

Designers must also review the most current manufacturer guidelines for any updates or additions to the following operation and maintenance requirements.

1w. Proprietary or Manufactured Products

- As with other stormwater BMPs in this appendix, proper maintenance of proprietary products such as media filters or vegetation-based treatment technologies is critical to proper facility performance. Regular maintenance ensures proper functioning and keeps the facility aesthetically appealing. Many of the same inspection and maintenance procedures outlined for the facilities described in this appendix also apply to proprietary technologies.

- Designers must review and apply the most current manufacturer guidelines and recommendations for facility operation and maintenance.

- The City of Lacey will inspect proprietary products in accordance with the applicable inspection standards to ensure that maintenance is performed properly.

Group 2 – Structures and Pretreatment

2a. Control Structures and Flow Restrictors

Flow control devices are usually placed within manholes, which may be locked. They typically consist of two pipes, one placed above the other. The lower pipe will typically have a cover and a small hole drilled in it to allow for slow release of water. The upper pipe is usually larger to provide an outlet for higher flows and emergency overflows.

Control Structures and Flow Restrictors					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Structure	Trash and Debris (includes sediment)	Material exceeds 25 percent of sump depth or 1 foot below orifice plate.		No trash or debris present. Control structure orifice is not blocked. Remove and properly dispose of all trash and debris.	
	Structural Damage	Structure is not securely attached to manhole wall.		Securely attach structure to wall and outlet pipe.	
		Structure is not in upright position (more than 10 percent from plumb)		Restore structure to correct position.	
		Connections to outlet pipe are not watertight and show signs of rust.		Pipe connections are water tight; structure repaired or replaced and works as designed.	
		Any holes in structure (other than designed holes).		Structure has no holes other than designed holes.	
Cleanout Gate	Damaged or Missing	Cleanout gate is not watertight or is missing.		Gate is watertight and works as designed.	
		Gate cannot be moved up and down by one maintenance person.		Gate moves up and down easily and is watertight.	
		Chain/rod leading to gate is missing or damaged.		Chain is in place and works as designed.	
		Gate is rusted over 50 percent of its surface area.		Gate is repaired or replaced to meet design standards.	
Orifice Plate	Damaged or Missing	Control device is not working properly due to missing, displaced, or bent orifice plate.		Plate is in place and works as designed.	
	Obstructions	Trash, debris, sediment or vegetation blocking the plate.		Plate is free of all obstructions and works as designed.	
Overflow Pipe	Obstructions	Any trash or debris blocking (or having the potential of blocking) the overflow pipe.		Pipe is free of all obstructions and works as designed.	
Manhole	Cover Not in Place	Cover is missing or only partially in place. Any open manhole requires maintenance.		Manhole access cover/lid is in place and secure.	

Control Structures and Flow Restrictors					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Manhole (continued)	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 0.5 inch of thread (may not apply to self-locking lids)		Mechanism opens with proper tools.	
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. Intent is to keep cover from sealing off access to maintenance.		Cover can be removed and reinstalled by one maintenance person.	
	Ladder Rungs Unsafe	Maintenance person judges that ladder is unsafe due to missing rungs, misalignment, rust, or cracks. Ladder must be fixed or secured immediately.		Ladder meets design standards and allows maintenance persons safe access.	
Catch Basin	See “Catch Basins”	See “Catch Basins.”		See “Catch Basins.”	

2b. Catch Basins

These structures are typically located in the streets. The City of Lacey is responsible for routine maintenance of the pipes and structures in the public rights-of-way, while the property owner or homeowners association is responsible for maintenance of pipes and catch basins in private areas and for keeping the grates clear of debris in all areas.

Catch Basins					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
General	Trash and Debris	Trash, leaves or debris which is located immediately in front of the catch basin opening or is blocking inflow capacity of the basin by more than 10 percent.		Remove trash, leaves and debris located directly in front of catch basin or on grate.	
		Trash or debris (in basin) that exceeds 60 percent of the sump depth as measured from bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches of clearance from the debris surface to the invert of the lowest pipe.		No trash or debris present. Remove and properly dispose of all trash and debris.	
		Trash or debris in any inlet or outlet pipe blocking more than 33 percent (one-third) of its height.		Inlet and outlet pipes free of trash or debris. Remove and properly dispose of all trash and debris.	
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).		Remove dead animals, etc., present within the catch basin.	
	Sediment	Sediment (in basin) exceeds 60 percent of sump depth as measured from the bottom of basin to invert of lowest pipe into or out of basin, but in no case less than a minimum of 6 inches of clearance from the sediment surface to the invert of lowest pipe.		No sediment in the catch basin.	
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 0.25 inch (intent is to make sure no material is running into basin).		Top slab is free of holes and cracks.	

Catch Basins					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
General (continued)	Structure Damage to Frame and/or Top Slab (continued)	Frame not sitting flush on top slab, i.e., separation of more than 0.75 inch of the frame from the top slab. Frame not securely attached		Frame is sitting flush on the riser rings or top slab and firmly attached.	
	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person determines structure is unsound.		Basin replaced or repaired to design standard	
		Grout fillet has separated or cracked wider than 0.5 inch and longer than 1 foot at the joint of any inlet/outlet pipe, or any evidence of soil entering basin.		Pipe regrouted and secure at basin wall.	
	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.		Replaced or repair to design standards.	
	Vegetation	Vegetation growing across and blocking more than 10 percent of the basin opening.		Remove vegetation blocking opening to basin.	
		Vegetation growing in inlet/outlet pipe joints that is more than 6 inches tall and less than 6 inches apart.		No vegetation or root growth present.	
	Contamination and Pollution	Presence of contaminants such as oil, gasoline, concrete slurries, paint, obnoxious color, odor, or sludge.		Locate the source of the pollution and remove contaminants or pollutants present. *Report and coordinate source control, removal, and/or cleanup with City of Lacey Spill Response Team (360) 491-5644, Moderate Risk Waste Program at Thurston County Environmental Health (360) 754–4111, and/or Dept. of Ecology Spill Response (800) 424-8802.*	
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.		Catch basin cover is in place and secured.	
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 0.5 inch of thread.		Mechanism opens with proper tools.	

Catch Basins					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Catch Basin Cover (continued)	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. (Intent is keep cover from sealing off access to maintenance.)		Cover can be removed by one maintenance person.	
Ladder	Ladder Rungs Unsafe	Maintenance person judges that ladder is unsafe due to missing rungs, misalignment, rust, or cracks. Ladder must be fixed or secured immediately.		Ladder meets design standards and allows maintenance persons safe access.	
Metal Grates (if applicable)	Grate Opening Unsafe	Grate with opening wider than 0.875 (7/8) inch.		Grate opening meets design standards.	
	Trash and Debris	Trash and debris that is blocking more than 20 percent of grate surface inletting capacity.		Grate free of trash and debris. Remove and properly dispose of all trash and debris.	
	Damaged or Missing	Grate missing or broken member(s) of the grate.		Grate is in place and meets design standards.	

2c. Debris Barriers (trash racks)

A metallic screen or similar structural device used to prevent debris from entering a pipe, spillway or other hydraulic structure.

Debris Barriers (trash racks)					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
General	Trash and Debris	Trash or debris that is plugging more than 20 percent of the openings in the barrier.		Barrier cleared to receive design flow capacity.	
Metal	Damaged/ Missing Bars	Bars are bent out of shape more than 3 inches.		Bars in place with no bends more than 0.75 inch.	
		Bars are missing or entire barrier missing.		Bars in place according to design.	
		Bars are loose and rust is causing 50 percent deterioration to any part of barrier.		Barrier replaced or repaired to design standards.	
	Inlet/Outlet Pipe	Debris barrier missing or not attached to pipe.		Barrier firmly attached to pipe.	

2d. Energy Dissipators

Typically a rock splash pad at a pipe end or other discharge location, to reduce the velocity and energy of flowing water and prevent erosion. Other means of energy dissipation include drop manholes, stilling basins, and check dams.

Energy Dissipators					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
External:					
Rock Pad	Missing or Moved Rock	Only one layer of rock exists above native soil in area 5 square feet or larger, or any exposure of native soil.		Rock pad replaced to design standards.	
	Erosion	Soil erosion in or adjacent to rock pad.		Rock pad replaced to design standards.	
Dispersion Trench	Pipe Plugged with Sediment	Accumulated sediment that exceeds 20 percent of the design depth.		Pipe cleaned/flushed so it matches design.	
	Not Discharging Water Properly	Visual evidence of water discharging at concentrated points along trench (normal condition is a “sheet flow” of water along trench). Intent is to prevent erosion damage.		Trench redesigned or rebuilt to standards. Water discharges from feature by sheet flow.	
	Perforations Plugged	Over half of perforations in pipe are plugged with debris and sediment.		Perforated pipe cleaned or replaced. Perforations freely discharge flow.	
	Water Flows Out Top of “Distributor” Catch Basin	Maintenance person observes or receives credible report of water flowing out during any storm less than the design storm or its causing or appears likely to cause damage.		Facility rebuilt or redesigned to standards. No flow discharges from distributor catch basin.	
	Receiving Area Over-Saturated	Water in receiving area is causing or has potential of causing landslide problems.		No danger of landslides.	
Internal:					
Manhole/ Chamber	Worn or Damaged Post, Baffles, Side of Chamber	Structure dissipating flow deteriorates to 50 percent of original size or any concentrated worn spot exceeding 1 square foot, which would make structure unsound.		Structure replaced to design standards. Structure in no danger of failing.	

Energy Dissipators					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Manhole/ Chamber (continued)	Trash and Debris	Trash or debris (in basin) that exceeds 60 percent of the sump depth as measured from bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6-inch clearance from the debris surface to the invert of the lowest pipe.		No trash or debris present. Remove and properly dispose of all trash and debris.	
		Trash or debris in any inlet or outlet pipe blocking more than 33 percent of its height.		Inlet and outlet pipes free of trash or debris. Remove and properly dispose of all trash and debris.	
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).		Remove dead animals, etc., present within the catch basin.	
	Sediment	Sediment (in basin) exceeds 60 percent of sump depth as measured from the bottom of basin to invert of lowest pipe into or out of basin, but in no case less than a minimum of 6-inch clearance from the sediment surface to the invert of lowest pipe.		No sediment in the catch basin.	
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 0.25 inch (Intent is to make sure no material is running into basin).		Top slab is free of holes and cracks.	
		Frame not sitting flush on top slab, i.e., separation of more than 0.75 inch of the frame from the top slab. Frame not securely attached		Frame is sitting flush on the riser rings or top slab and firmly attached.	
	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person determines structure is unsound.		Basin replaced or repaired to design standard	
		Grout fillet has separated or cracked wider than 0.5 inch and longer than 1 foot at the joint of any inlet/outlet pipe, or any evidence of soil entering basin.		Pipe regrouted and secure at basin wall.	
	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.		Replaced or repair to design standards.	

Energy Dissipators					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Manhole/ Chamber (continued)	Contamination and Pollution	Presence of contaminants such as oil, gasoline, concrete slurries, paint, obnoxious color, odor, or sludge.		Locate the source of the pollution and remove contaminants or pollutants present. *Report and coordinate source control, removal, and/or cleanup with City of Lacey Spill Response Team (360) 491-5644, Moderate Risk Waste Program at Thurston County Environmental Health (360) 754–4111, and/or Dept. of Ecology Spill Response (800) 424-8802.*	
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.		Catch basin cover is in place and secured.	
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 0.5 inch of thread.		Mechanism opens with proper tools.	
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. (Intent is keep cover from sealing off access to maintenance.)		Cover can be removed by one maintenance person.	

2e. Baffle Oil/Water Separators (API type)

An underground vault or tank designed to separate oil from runoff water via baffles.

Baffle Oil/Water Separators (API type)					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
General	Dirty Discharge Water	Inspect discharge water for obvious signs of poor water quality.		Effluent discharge from vault should be clear without thick visible sheen.	
	Sediment Accumulation	Sediment depth in bottom of vault exceeds 6 inches in depth.		Remove sediment deposits that would impede flow through the vault and reduce separation efficiency.	
	Trash and Debris Accumulation	Trash and debris accumulation in vault, or pipe inlet/outlet, floatables and non-floatables.		No trash or debris present. Remove and properly dispose of all trash and debris from vault and inlet/outlet piping.	
	Oil Accumulation	Oil accumulations at the surface of the water or 6 inches of sludge in the sump.		Extract oil from vault by vactoring. Disposal must be in accordance with state and local rules and regulations. No visible oil depth on water.	
Structure	Damaged Pipes	Inlet or outlet piping damaged or broken and in need of repair.		Pipe repaired or replaced.	
	Access Cover Damaged/ Not Working	Cover cannot be opened, corrosion/deformation of cover.		Cover repaired to proper working specifications or replaced.	
	Vault Structure Damage – Cracks in Walls or Bottom, Damage to Frame and/or Top Slab	Maintenance person determines structure is unsound.		Vault replaced or repairs made so that vault meets design specifications and is structurally sound.	
		Grout fillet has separated or cracked wider than 0.5 inch at the joint of any inlet/outlet pipe, or any evidence of soil entering basin.		Top slab is free of holes and cracks.	
	Baffles	Baffles corroding, cracking, warping and/or show signs of failure as determined by maintenance/inspection person.		Baffles repaired or replaced to specifications.	
	Access Ladder Damaged	Ladder is corroded or deteriorated, not securely attached to structure wall, missing rungs, cracks, or misaligned.		Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection.	

An oil/water separator vault is a confined space. Visual inspections should be performed aboveground. If entry is required, it should be performed by qualified personnel.

2f. Coalescing Plate Oil/Water Separators

An underground vault or tank designed to separate oil from runoff water via gravity.

Coalescing Plate Oil/Water Separators					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
General	Dirty Discharge Water	Inspect discharge water for obvious signs of poor water quality.		Effluent discharge from vault should be clear with no thick visible sheen.	
	Sediment Accumulation	Sediment depth in bottom of vault exceeds 6 inches in depth and/or visible signs of sediment on plates.		Remove sediment deposits on vault bottom and plate media that would impede flow through the vault and reduce separation efficiency.	
	Trash and Debris	Trash and debris accumulated in vault, or pipe inlet/outlet, floatables and non-floatables.		No trash or debris present. Remove and properly dispose of all trash and debris from vault and inlet/outlet piping.	
	Oil Accumulation	Oil accumulation at the water surface.		Oil is extracted from vault using vactoring methods. Dispose of in accordance with state and local rules and regulations. Coalescing plates are cleaned by thoroughly rinsing and flushing. Direct wash-down effluent to the sanitary sewer system where permitted. There should be no visible oil depth on water.	
Structure	Damaged Coalescing Plates	Plate media broken, deformed, cracked and/or showing signs of failure.		A portion of the media pack or the entire plate pack is replaced depending on severity of failure.	
	Damaged Pipes	Inlet or outlet piping damaged or broken or in need of repair.		Pipe repaired and or replaced.	
	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.		Baffles repaired or replaced to specifications.	
	Vault Structure Damage – Includes Cracks. Damage to Frame and/or Top Slab	Cracks wider than 0.5 inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound.		Vault replaced or repairs made so that vault meets design specifications and is structurally sound.	

Coalescing Plate Oil/Water Separators					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Structure (continued)	Vault Structure Damage – Includes Cracks. Damage to Frame and/or Top Slab	Cracks wider than 0.5 inch at the joint of any inlet/outlet pipe or soil particles entering through the cracks.		Vault repaired so that no cracks exist wider than 0.25 inch at the joint of the inlet/outlet pipe.	
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.		Replace or repair ladder so it meets specifications and is safe to use as determined by inspection.	

2g. Catch Basin Inserts

A structure within a catch basin, with a filter containing a pollutant-removal medium. Generally considered as an alternative to oil-water separators, these are not commonly used for permanent installations, as they tend to be maintenance-intensive.

Catch Basin Inserts					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
General	Sediment Accumulation	When sediment forms a cap over the insert media of the insert and/or unit.		No sediment cap on the insert media and its unit.	
	Trash and Debris Accumulation	Trash and debris accumulates on insert unit creating a blockage/restriction.		No trash or debris present. Runoff freely flows into catch basin. Remove and properly dispose of all trash and debris removed from insert unit.	
	Media Insert Not Removing Oil	Effluent water from media insert has a visible sheen.		Effluent water from media insert is free of oils and has no visible sheen.	
	Media Insert Water Saturated	Catch basin insert is saturated with water and no longer has the capacity to absorb.		Remove and replace media insert.	
	Media Insert-Oil Saturated	Media oil saturated due to petroleum spill that drains into catch basin.		Remove and replace media insert.	
	Media Insert Use Beyond Normal Product Life	Media has been used beyond the typical average life of media insert product.		Remove and replace media at regular intervals, depending on insert product.	

Group 3 – Miscellaneous Facilities and Features

3a. Conveyance Pipes, Culverts, Ditches, and Swales

These features contain and direct the flow of water from one location to another.

Conveyance Pipes, Culverts, Ditches, and Swales					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Pipes	Sediment, Debris, and Vegetation	Accumulated sediment should not exceed 20 percent of the diameter of the pipe. Vegetation should not reduce free movement of water through pipes. Ensure that the protective coating is not damaged or rusted. Dents should not significantly impede flow. Pipe should not have major cracks or flaws allowing water to leak out.		Clean out pipes of all sediment and debris. Remove all vegetation so that water flows freely through pipes. Repair or replace pipe.	
Open Ditches	Trash and Debris	There should not be any yard waste or litter in the ditch.		No trash or debris present. Remove and properly dispose of all trash and debris.	
	Sediment Buildup	Accumulated sediment should not exceed 20 percent of the depth of the ditch.		Clean out ditch of all sediment and debris.	
Open Ditches and Swales	Overgrowth of Vegetation	Check for vegetation (e.g., weedy shrubs or saplings) that reduces the free movement of water through ditches or swales.		Clear blocking vegetation so that water moves freely through the ditches. Grassy vegetation should be left alone.	
	Erosion	Check around inlets and outlets for signs of erosion. Check slopes for signs of sloughing or settling. Action is needed where eroded damage is over 2 inches deep and where there is potential for continued erosion.		Eliminate causes of erosion. Stabilize slopes by using the appropriate erosion control procedure (e.g., compact the soil, plant grass, reinforce with rock).	
	Missing Rocks	Native soil beneath the rock splash pad, check dam, or lining should not be visible.		Replace rocks to design standard.	
Swales	Vegetation	Grass cover is sparse and weedy, or areas are overgrown with woody vegetation.		Aerate soils and re-seed and mulch bare areas. Keep grass less than 8 inches high. Remove woody growth, re-contour and re-seed as necessary.	

Conveyance Pipes, Culverts, Ditches, and Swales					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
Swales (continued)	Homeowner Conversion	Swale has been filled in or blocked by shed, woodpile, shrubbery, etc.		Speak with the homeowner and request that the swale area be restored. Contact the city to report the problem if not rectified voluntarily.	
	Swale Does Not Drain	Water stands in the swale, or flow velocity is very slow. Stagnation occurs.		A survey may be needed to check grades. Grades should be in 1 to 5 percent range if possible. If grade is less than 1 percent, underdrains may need to be installed.	

3b. Access Roads and Easements

These features provide access to drainage facilities for inspection and/or maintenance.

Access Roads and Easements					
Drainage System Feature	**Problem or Defect**	**Conditions To Check For**	**√ Check**	**What To Do for Desired Condition**	**√ Done**
General	Access	Check to determine if there is adequate access to your stormwater facilities for maintenance vehicles.		If there is not adequate access, check with the city to determine whether an easement exists. If so, a maintenance road may need to be constructed there.	
Access Road	Blocked Roadway	Debris that could damage vehicle tires (glass or metal).		Clear all potentially damaging material.	
	Blocked Roadway	Any obstructions that reduce clearance above and along the road to less than the required width (minimum of 15 feet).		Clear above and along roadway so there is enough clearance.	
Road Surface	Bad Road Conditions	Check for potholes, ruts, mushy spots, or woody debris that limits access by maintenance vehicles.		Add gravel or remove wood as necessary.	
Shoulders and Ditches	Erosion	Check for erosion along roadway.		Repair erosion with additional soil or gravel.	

Appendix 3C – O&M Cost Estimate Calculations

This appendix includes supplemental requirements and examples to aid in developing Section 8 of the Maintenance and Source Control Manual (Attachment 4 of the Drainage Control Plan), Annual Cost of Maintenance. The Cost Estimate for Operation and Maintenance shall be prepared by the design engineer, with the intention of assisting the postdevelopment owners of stormwater facilities in understanding and budgeting for long-term facility operation and maintenance costs.

The Cost Estimate for Operation and Maintenance should follow this general format:

- Introduction
- Part I: Inventory of On-Site Stormwater Facilities
- Part II: Routine Operation and Maintenance Assumptions
- Part III: Routine Operation and Maintenance Estimated Annual Costs
- Part IV: Estimated Annual Partial Replacement Cost
- Part V: Estimated Monthly Contribution to Stormwater Facilities Operation and Maintenance Account

Each section of the Cost Estimate for Operation and Maintenance is described in more detail below. The Cost Estimate for Operation and Maintenance may be in tabular format, so long as adequate annotations are provided.

Introduction

The Introduction should briefly describe what drainage facility the cost estimate is for, where it is located, what information the estimate provides, and how to understand and use it.

Part I: Inventory of On-Site Stormwater Facilities

Part I is an Inventory of all stormwater management facilities and drainage system components that are included in the analysis, and are the responsibility of the owners to operate and maintain. The Inventory should be accompanied by a plan map of facility locations and detail drawings.

Part II: Routine Operation and Maintenance Assumptions

Part II lists the assumptions that are made in estimating the cost for routine operation and maintenance, including the frequency of routine maintenance tasks, which tasks will be performed by whom, and assumed cost of each maintenance activity.

Part III: Routine Operation and Maintenance Estimated Annual Cost

Part III provides detailed cost breakdowns for the routine operation and maintenance of the facility. The sum of these cost breakdowns is the estimated annual cost of routine operation and maintenance, which is used in Part V.

Part IV: Estimated Annual Partial Replacement Cost

Part IV provides an estimate of the cost to replace a portion of the stormwater system in the future and an estimated annual contribution to the operation and maintenance account to cover the partial system replacement. These costs take inflation and interest into account. The annual payment for partial system replacement is used in Part V.

Part V: Estimated Monthly Contribution to Stormwater Facilities Operation and Maintenance Account

Part V provides an estimate of the monthly contributions from each lot owner to the operation and maintenance account. These contributions are intended to cover the routine operation and maintenance costs (Part III) and the Partial Replacement Cost (Part IV).

* * * * *

On the following pages are three examples of a Cost Estimate for Operation and Maintenance. The examples address the five requirements above, except maps of the facilities are not included. *The facilities, assumptions, and values in the following examples are fictitious*. The design engineer preparing an actual estimate for actual facilities will need to provide *actual site information* and *current, realistic values* in the calculations.

EXAMPLE 1

Residential Development with Centralized Stormwater Treatment Facility

(i.e., Wet Pond and Infiltration Basin)

Cost Estimate for Operation and Maintenance *for the Stormwater System at "Stormy Estates"*

Introduction:

The following are assumptions, estimates and recommendations for funds to set aside for routine maintenance costs and future replacement costs for the stormwater facilities that are the responsibility of the *Stormy Estates* Homeowners' Association. The sinking fund estimate is an approximation of the annual funding needed over the next 20 years to keep the stormwater system fully functional.

The initial value of the facilities, the annual maintenance costs (assuming all work is performed by a contractor), occasional improvements, and factors such as inflation over time are incorporated in the "sinking fund" calculation of future costs and the annual funding reserve amount needed. The calculations take into account the expected life of the materials, structures, and facilities, and include a summary of the amount of money suggested to be set aside annually for the fund as well as the annual charge per lot owner to equal the annual set-aside. The example assumes that each of the lot owners is an equal co-owner of the common stormwater facilities. In this example, the bottom-line estimate of total annual funding needed is divided equally among the lot owners.

Note that the sinking fund calculations are only a "best estimate" using approximated values. The homeowners' association should use these computations as a guide, and modify as needed to more accurately reflect actual costs as routine maintenance is conducted.

Part I: ON-SITE STORMWATER FACILITIES INVENTORY			Part II: ROUTINE O&M ASSUMPTIONS		Part III: ROUTINE O&M ESTIMATED ANNUAL COST	
Facility	**Quantity**	**Unit**	**Activity**	**Maintenance Frequency**	**Unit Price[a]**	**Annual Cost[b]**
			Annual Report	Annual	$300	$300
Catch Basin	8	Each	Sediment removal with Vactor truck	Annual	$170	$1,360
Pipes	400	LF	Clean pipe ends as part of catch basin maintenance	Include with catch basins	$–	$–
Wet Pond	1,100	SF	Vegetation management	Annual	$0.18	$202
			Sediment removal including hauling, planting with shrubs and seeding mix, and site restoration	Once every 15 years	$2.25	$164
Infiltration Basin	3,100	SF	Mowing	Every 2 weeks	$0.05	$4,350
			Rehabilitation (sediment removal, repair, tilling, and reseeding)	Once every 15 years	$0.25	$51
					ANNUAL TOTAL:	**$6,400**

Notes:

CONTINUE TO PART IV

[a] Cost to maintain each unit based on estimate from maintenance contractor or literature values.

[b] Product of multiplying quantity by frequency by unit price.

O&M = operation and maintenance

LF = linear feet

SF = square feet

EXAMPLE

Part IV: ESTIMATED PARTIAL REPLACEMENT COST		
Assumptions		**Notes**
Annual Inflation Rate	4%	Annual inflation of construction cost.
Annual Interest Rate	2%	Estimate of how fast the account balance will grow.
Years in Calculation	20	Duration of calculation.
Percent of System Replaced in 20 Years	20%	Assumes 20% of the system will need replacement during the calculation period.
Present Value of Stormwater System	$170,000	Initial construction cost of the stormwater system.
Initial Reserves	$0	Initial balance in the O&M account.
Number of Owners	22	Number of lot owners.
Using Above Assumptions, Calculate Future Replacement Cost for 20% of System and Required Annual Payments		
Description	**Cost**	**Notes**
Present Value of 20% of Stormwater System (portion requiring replacement)	$34,000	Present value of the stormwater system x percent of the system that requires replacement.
Future Replacement Cost for 20% of Stormwater System	$74,498	Cost to replace the 20% of the system in the future, i.e., Present Value adjusted to account for inflation.
Annual Payment for Future Replacement	$3,066	Annual account contributions required to cover the future replacement cost. Accounts for interest.

Part V: ESTIMATED MONTHLY CONTRIBUTION TO STORMWATER FACILITIES O&M ACCOUNT		
Description	**Cost**	**Notes**
Annual Payment for Routine O&M	$6,400	Result of Part III.
Annual Payment for Future Replacement	$3,066	Result of Part IV.
Total *Annual* Cost for O&M and Repair	$9,466	Sum of above values.
Total *Monthly* Cost for O&M and Repair	$789	Annual cost divided by 12 months.
Monthly Cost per Lot Owner	**$36**	Monthly cost divided by 22 lot owners.

O&M = operation and maintenance

Because operation and maintenance costs will vary and are also subject to inflation, they should also be adjusted over time. Owners should evaluate actual operation and maintenance needs and costs each year, and adjust set-aside funds for the following year's cost projection.

EXAMPLE

EXAMPLE 2

1-Acre Commercial Development with Bioretention

Cost Estimate for Operation and Maintenance *for the Stormwater System at "McStormy's Fast Food Restaurant"*

Introduction:

The following are assumptions, estimates and recommendations for funds to set aside for routine maintenance costs and future replacement costs for the drainage facilities that are the responsibility of the *McStormy's Fast Food Restaurant*. The sinking fund estimate is an approximation of the annual funding needed over the next 20 years to keep the drainage system fully functional.

The initial value of the facilities, the annual maintenance costs (assuming all work is by hired workers), occasional improvements, and factors such as inflation over time are incorporated in the "sinking fund" calculation of future costs and the annual funding reserve amount needed. The calculations take into account the expected life of the materials, structures, and facilities, and include a summary of the amount of money to be set aside annually for the fund and the annual charge per lot owner to equal the annual set-aside.

Note that the sinking fund calculations are only a "best estimate" using approximated values. The owner should use these computations as a guide, and modify as needed to more accurately reflect actual costs as routine maintenance is conducted.

Part I: ON-SITE STORMWATER FACILITIES INVENTORY			Part II: ROUTINE O&M ASSUMPTIONS		Part III: ROUTINE O&M ESTIMATED ANNUAL COST	
Facility	**Quantity**	**Unit**	**Activity**	**Frequency**	**Unit Price[a]**	**Annual Cost[b]**
			Annual Report	Annual	$300	$300
Catch Basin	5	Each	Sediment Removal with Vactor Truck	Annual	$170	$850
Bioretention	3,200	SF	Watering, sediment removal, vegetation management, mulching, and pest control	Annual	$2.00	$6,400
					ANNUAL TOTAL:	**$7,600**

Notes:

CONTINUE TO PART IV

[a] Cost to maintain each unit based on estimate from maintenance contractor or literature values.

[b] Product of multiplying quantity by frequency by unit price.

O&M = operation and maintenance

SF = square feet

EXAMPLE

Part IV: ESTIMATED PARTIAL REPLACEMENT COST		
Assumptions		**Notes**
Annual Inflation Rate	4%	Annual inflation of construction cost.
Annual Interest Rate	2%	Estimate of how fast the account balance will grow.
Years in Calculation	20	Duration of calculation.
Percent of System Replaced in 20 Years	20%	Assumes 20% of the system will need replacement during the calculation period.
Present Value of Stormwater System	$90,000	Initial construction cost of the stormwater system.
Initial Reserves	$0	Initial balance in the O&M account.
Number of Owners	1	Number of lot owners.
Using Above Assumptions, Calculate Future Replacement Cost for 20% of System and Required Annual Payments		
Description	**Cost**	**Notes**
Present Value of 20% of Stormwater System (portion requiring replacement)	$18,000	Present value of the stormwater system x percent of the system that requires replacement.
Future Replacement Cost for 20% of Stormwater System	$39,440	Cost to replace the system in the future, i.e., Present Value adjusted to account for inflation.
Annual Payment for Future Replacement	$1,623	Annual account contributions required to cover the future replacement cost. Accounts for interest.

Part V: ESTIMATED MONTHLY CONTRIBUTION TO STORMWATER FACILITIES O&M ACCOUNT		
Description	**Cost**	**Notes**
Annual Payment for Routine O&M	$7,600	Result of Part III.
Annual Payment for Future Replacement	$1,623	Result of Part IV.
Total *Annual* Cost for O&M and Repair	$9,223	Sum of above values.
Total *Monthly* Cost for O&M and Repair	$769	Annual cost divided by 12 months.
Monthly Cost per Lot Owner	**$769**	Monthly cost divided by a single owner.

O&M = operation and maintenance

Because operation and maintenance costs will vary and are also subject to inflation, they should also be adjusted over time. Owners should evaluate actual operation and maintenance needs and costs each year, and adjust set-aside funds for the following year's cost projection.

EXAMPLE

EXAMPLE 3

10-Acre Commercial Development with Permeable Pavement

Cost Estimate for Operation and Maintenance *for the Stormwater System at "Storm-Co Wholesale"*

Introduction:

The following are assumptions, estimates and recommendations for funds to set aside for routine maintenance costs and future replacement costs for the drainage facilities that are the responsibility of the *Storm-Co Wholesale*. The sinking fund estimate is an approximation of the annual funding needed over the next 20 years to keep the drainage system fully functional.

The initial value of the facilities, the annual maintenance costs (assuming all work is by hired workers), occasional improvements, and factors such as inflation over time are incorporated in the "sinking fund" calculation of future costs and the annual funding reserve amount needed. The calculations take into account the expected life of the materials, structures, and facilities, and include a summary of the amount of money to be set aside annually for the fund and the annual charge per lot owner to equal the annual set-aside.

Note that the sinking fund calculations are only a "best estimate" using approximated values. The owner should use these computations as a guide, and modify as needed to more accurately reflect actual costs as routine maintenance is conducted.

Part I: ON-SITE STORMWATER FACILITIES INVENTORY			Part II: ROUTINE O&M ASSUMPTIONS		Part III: ROUTINE O&M ESTIMATED ANNUAL COST	
Facility	**Quantity**	**Unit**	**Activity**	**Frequency**	**Unit Price[a]**	**Annual Cost[b]**
			Annual Report	Annual	$300	$300
Permeable Pavement	283,000	SF	Regenerative Vacuum Sweeping	Twice per Year	$0.03	$17,000
					ANNUAL TOTAL:	**$17,300**

Notes:

CONTINUE TO PART IV

[a] Cost to maintain each unit based on estimate from maintenance contractor or literature values.

[b] Product of multiplying quantity by frequency by unit price.

O&M = operation and maintenance

SF = square feet

EXAMPLE

Part IV: ESTIMATED PARTIAL REPLACEMENT COST		
Assumptions		**Notes**
Annual Inflation Rate	4%	Annual inflation of construction cost.
Annual Interest Rate	2%	Estimate of how fast the account balance will grow.
Years in Calculation	20	Duration of calculation.
Percent of System Replaced in 20 Years	20%	Assumes 20% of the system will need replacement during the calculation period.
Present Value of Stormwater System	$1,500,000	Initial construction cost of the stormwater system.
Initial Reserves	$0	Initial balance in the O&M account.
Number of Owners	1	Number of lot owners.
Using Above Assumptions, Calculate Future Replacement Cost for 20% of System and Required Annual Payments		
Description	**Cost**	**Notes**
Present Value of 20% of Stormwater System (portion requiring replacement)	$300,000	Present value of the stormwater system x percent of the system that requires replacement
Future Replacement Cost for 20% of Stormwater System	$657,337	Cost to replace the system in the future, i.e., Present Value adjusted to account for inflation.
Annual Payment for Future Replacement	$27,054	Annual account contributions required to cover the future replacement cost. Accounts for interest.

Part V: ESTIMATED MONTHLY CONTRIBUTION TO STORMWATER FACILITIES O&M ACCOUNT		
Description	**Cost**	**Notes**
Annual Payment for Routine O&M	$17,300	Result of Part III.
Annual Payment for Future Replacement	$27,054	Result of Part IV.
Total *Annual* Cost for O&M and Repair	$44,354	Sum of above values.
Total *Monthly* Cost for O&M and Repair	$3,696	Annual cost divided by 12 months.
Monthly Cost per Lot Owner	**$3,696**	Monthly cost divided by a single owner.

O&M = operation and maintenance

Because operation and maintenance costs will vary and are also subject to inflation, they should also be adjusted over time. Owners should evaluate actual operation and maintenance needs and costs each year, and adjust set-aside funds for the following year's cost projection.

EXAMPLE