GUIDANCE DOCUMENT

WESTERN WASHINGTON LOW IMPACT DEVELOPMENT (LID) OPERATION AND MAINTENANCE (O&M)

Prepared for
Washington State Department of Ecology
Water Quality Program

Prepared by
Herrera Environmental Consultants, Inc.
and
Washington Stormwater Center

Note:
Some pages in this document have been purposely skipped or blank pages inserted so that this document will copy correctly when duplexed.

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Prepared for
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Water Quality Program
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(*Note: The examples provided in the appendices were included as examples based on format only; the content of these examples has not been reviewed for consistency with the 2013-2018 Permit requirements or the material included in this guidance document.*)

TABLES

ACKNOWLEDGMENTS

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INTRODUCTION

Purpose

As local governments in western Washington implement the Washington State Department of Ecology (Ecology) National Pollutant Discharge Elimination System (NPDES) Municipal Stormwater permits (Permits), our region will increasingly rely on low impact development (LID) practices to protect water quality and aquatic natural resources. LID is a stormwater and land use management strategy that strives to mimic the pre-disturbance hydrologic processes of infiltration, filtration, storage, evaporation and transpiration by emphasizing conservation, use of on-site natural features, site planning, and distributed stormwater management practices that are integrated into a project design. LID best management practices (BMPs), such as bioretention and permeable pavements, are also commonly known as green stormwater infrastructure, integrated management practices, and on-site stormwater management BMPs.

This guidance provides recommendations on LID operations and maintenance (O&M) to help ensure that LID BMPs continue to function as designed in the long-term and is intended to support municipal stormwater Permittees in implementing their LID maintenance programs. While intended for a municipal audience, some guidance in this document may also be useful for private entities. Ecology encourages local governments to draw on this document to educate developers, homeowners' associations, and private property owners who are responsible for the O&M of LID BMPs.

Ecology Requirements for LID BMP Maintenance

The Phase I and Western Washington Phase II Municipal Stormwater Permits (Phase I Permit and Phase II Permit, or "Permits"), effective from August 2013 to July 2018, include provisions for municipalities to adopt and implement O&M programs and to facilitate proper O&M of LID BMPs. The Permit maintenance-related requirements for "On-site Stormwater Management BMPs" differ depending on if they are classified as "Stormwater Treatment and Flow Control BMPs/Facilities[1]". The side bars below highlight the distinctions made for Stormwater Treatment and Flow Control BMPs/Facilities. In general, the O&M Permit requirements for Stormwater Treatment and Flow Control BMPs/Facilities are more extensive and include, for example, long-term inspection and maintenance obligations that do not apply to other LID BMPs. The Phase I and Phase II Permits provisions that apply to LID BMPs are summarized in the following sections.

[1] This document does not include guidance for traditional end of pipe treatment and detention facilities; though these facilities are included in the definition of "Stormwater Treatment and Flow Control BMPs/Facilities".

Phase I Permit Special Conditions

The Phase I Permit[2] (Ecology 2012a) special conditions that pertain to LID BMP maintenance are listed below:

- **S5.C.5.a.v.(4)** – Requires municipalities to inspect all permitted development sites, that meet certain thresholds, upon completion of construction and prior to final approval or occupancy to ensure proper installation of permanent storm water facilities. It also requires identification of a party responsible for maintenance, and verification of a maintenance plan for all Stormwater Treatment and Flow Control BMPs/Facilities.
- **S5.C.9.a.** – Requires adoption of maintenance standards that are at least as protective of facility function as those in Chapter 4 of Volume V of the 2012 Stormwater Management Manual for Western Washington (2012 SWMMWW).
- **S5.C.9.b.i.** – Requires adoption of an ordinance or other enforceable mechanism requiring maintenance of all permanent Stormwater Treatment and Flow Control BMPs/Facilities regulated by the Permittee.
- **S5.C.9.b.ii.** – Requires annual inspections of all Stormwater Treatment and Flow Control BMPs/Facilities regulated by the Permittee. Permittees must enforce compliance with the adopted maintenance standards as needed based on inspection.

"On-site Stormwater Management BMPs"

"On-site Stormwater Management BMPs" (also known as LID BMPs) used to meet Permit Minimum Requirement #5 (On-site Stormwater Management) include:

- Rain Gardens (BMP T5.14A)
- Bioretention (BMP T5.14B)
- Permeable Pavement (BMP T5.15)
- Vegetated Roofs (BMP T5.17)
- Downspout Full Infiltration (BMP T5.10B)
- Downspout Dispersion (BMP T5.10A)
- Concentrated Flow Dispersion (BMP T5.11)
- Sheet Flow Dispersion (BMP T5.12)
- Compost-amended soils (BMP T5.13)

Permit requirements for On-site Stormwater Management BMPs that are not also Stormwater Treatment and Flow Control BMPs/Facilities are less extensive and include, for example, construction inspections to ensure proper installation.

"Stormwater treatment and flow control BMPs/facilities"

The LID BMPs listed below are considered to be "Stormwater Treatment and Flow Control BMPs/Facilities" if they are used to help meet Minimum Requirements #6 (Treatment) and/or #7 (Flow Control):

- Bioretention (BMP T5.14B)
- Permeable Pavement (BMP T5.15)
- Vegetated Roofs (BMP T5.17)

Permit requirements for Stormwater Treatment and Flow Control BMPs/Facilities are more extensive and include, for example, long-term inspection and maintenance obligations.

[2] The special conditions listed in this document are for city and county permittees. Secondary permittees should refer Section S6 of the permit for their special conditions that pertain to LID BMP maintenance.

- **S5.C.9.b.iii.** – Requires inspection of all permanent Stormwater Treatment and Flow Control BMPs/Facilities and catch basins regulated by the Permittee every 6 months during construction of residential developments until 90 percent of the lots are constructed (or when construction is stopped and the site is fully stabilized). Permittees must identify maintenance needs and enforce compliance with maintenance standards as needed.

- **S5.C.9.c.i.** – Requires annual inspection of all permanent Stormwater Treatment and Flow Control BMPs/Facilities owned or operated by the Permittee. Permittees are to implement appropriate maintenance action(s) in accordance with adopted maintenance standards.

- **S5.C.9.c.ii.** – Requires spot checks of potentially damaged permanent Stormwater Treatment and Flow Control BMPs/Facilities after major storm events. If spot checks indicate widespread damage/maintenance needs, inspect all Stormwater Treatment and Flow Control BMPs/Facilities that may be affected. Conduct repairs or perform maintenance in accordance with the standards established under S5.C.9.a.

Phase II Permit Special Conditions

The Phase II Permit[3] (Ecology 2012b) special conditions that pertain to LID BMP maintenance are listed below:

- **S5.C.4.b.iv.** – Requires municipalities to inspect all permitted development sites upon completion of construction and prior to final approval or occupancy to ensure proper installation of permanent stormwater facilities. Municipalities must require identification of a party responsible for maintenance, and a maintenance plan for all Stormwater Treatment and Flow Control BMPs/Facilities.

- **S5.C.4.c.** – Requires a program to verify adequate operation and maintenance of Stormwater Treatment and Flow Control BMPs/Facilities that have been and will be approved and built under local code requirements adopted to comply with the 2007, 2012, and 2013 NPDES municipal stormwater Permits. The program must include:

    i) Implementation of an ordinance or other enforceable mechanism that requires identification of a party responsible for maintenance, and requires inspections of facilities in accordance with ii) through iv) below.

    ii) Requires establishment of maintenance standards that are at least as protective of facility function as those in Chapter 4 of Volume V of the 2012 SWMMWW.

    iii) Requires annual inspection of all Stormwater Treatment and Flow Control BMPs/Facilities that discharge to the MS4 and were permitted according to S5.C.4.b. including those permitted pursuant to the 2007 – 2012 Permit.

[3] The special conditions listed in this document are for city and county permittees. Secondary permittees should refer Section S6 of the permit for their special conditions that pertain to LID BMP maintenance.

iv) Requires inspections of permanent Stormwater Treatment and Flow Control BMPs/Facilities and catch basins every 6 months during construction of residential developments until 90 percent of the lots are constructed (or when construction is stopped and the site is fully stabilized).

- **S5.C.5.a.** – Requires implementation of maintenance standards that are at least as protective of facility function as those in Chapter 4 of Volume V of the 2012 SWMMWW.
- **S5.C.5.b.** – Requires annual inspections of all municipally owned or operated permanent Stormwater Treatment and Flow Control BMPs/Facilities, and taking appropriate maintenance actions in accordance with the adopted maintenance standards.
- **S5.C.5.c.** – Requires spot checks of potentially damaged permanent Stormwater Treatment and Flow Control BMPs/Facilities after major storm events. If spot checks indicate widespread damage/maintenance needs, inspect all "storm water treatment and flow control BMPs" that may be affected. Conduct repairs or perform maintenance in accordance with the standards established under S5.C.5.a.

Summary

Both Phase I and Phase II municipal Permittees bear long-term inspection and enforcement responsibilities to require proper maintenance of Stormwater Treatment and Flow Control BMPs/Facilities. Although the On-site Stormwater Management BMPs that are not Stormwater Treatment and Flow Control BMPs/Facilities do not require long-term inspections, municipalities are obligated to inspect these BMPs upon completion of construction to ensure proper installation.

The Permits also require Permittees to adopt site planning requirements (Western Washington Phase II Permit – S5.C.4.a.ii; Western Washington Phase I Permit – S5.C.5.a.ii). They can choose to use the site planning requirements in the 2012 SWMMWW, or they can adopt requirements that protect water quality, reduce the discharge of pollutants to the maximum extent practicable (MEP), and satisfy the "all known, available and reasonable" provisions of State statute (Chapter 90.48 RCW). The 2012 SWMMWW site planning guidance includes information on the production, submission and recording of legal documents that provide both design information and maintenance instructions for each On-site Stormwater Management BMP, and help allow local government access to these BMPs.

Ecology encourages local governments to use the guidance in this document to meet their Permit obligation to adopt maintenance standards for LID BMPs. Additionally, they can use the guidance to gain an understanding of the procedures, equipment, materials, legal documents and staffing they will need to meet their inspection and maintenance responsibilities.

How to Use this Guidance Document

This guidance document is organized into two sections. The first section, "Maintaining LID BMPs," provides detailed maintenance guidance for LID BMPs, recommendations for equipment and materials, and information on what types of skills and staffing may be needed. The second section, "Programmatic and Administrative Guidance," includes guidance to support jurisdictions in administering their LID maintenance programs.

Maintaining LID BMPs Section

The "Maintaining LID BMPs" section is intended to be used by municipal maintenance staff and private parties who are responsible for LID BMP O&M. The tables and guidance in this document may be used:

- To create O&M manuals for Stormwater Treatment and Flow Control BMPs/Facilities
- As maintenance instructions that can be submitted as part of the stormwater site plan for LID BMPs that are not Stormwater Treatment and Flow Control BMPs/Facilities
- As a reference to help homeowners maintain on-site LID BMPs

The guidance provides support by:

- Explaining how LID BMPs function (e.g., how water moves through the facility and the importance of key facility components) to provide a framework for the maintenance standards and procedures, and support smart maintenance decisions in the field
- Providing clear guidance on LID BMP maintenance frequencies, standards and procedures in an easy-to-use table. These tables can easily be reformatted as maintenance checklists.
- Providing a comprehensive equipment and materials list for each BMP
- Providing information on staff skills needed for O&M
- Providing information on the level of effort required to maintain bioretention, permeable pavement, and vegetated roofs

The maintenance standards and procedures presented in this guidance should be used by municipalities for the long-term inspection and maintenance of Stormwater Treatment and Flow Control BMPs/Facilities. While not required, long-term observation of all on-site systems by municipal inspectors is recommended, particularly when the property is subject to inspection for Stormwater Treatment and Flow Control BMPs/Facilities.

Programmatic and Administrative Guidance Section

The Programmatic and Administrative Guidance section is intended to be used by municipal staff responsible for developing and implementing LID BMP maintenance programs. The guidance provides support by:

- Presenting Ecology's requirements that relate to LID BMP maintenance programs, such as systems for permitting, plan review, inspections, enforcement and record keeping
- Providing guidance regarding administrative tools for implementing these requirements, such as municipal stormwater codes, stormwater manuals, legal agreements, financial surety measures, inspection programs, and mapping systems
- Providing examples of administrative tools, including covenants and easements, and private property owner education

Definitions/Acronyms

- **Applicant:** Individuals, associations, organizations, partnerships, firms, corporations, developers, or other entities applying for a development proposal, permit, or approval.
- **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 the project's drainage plan and in compliance with all local government requirements. Bonds can also be used to protect and guarantee the performance of a stormwater BMP after construction.
- **Codes:** Collections of laws and regulations which have been codified based on the activities they regulate. These laws are ordinances that are enforced locally in addition to state and federal law. City or county stormwater codes may include laws regulating the requirements for maintenance of private stormwater facilities, the right of the jurisdiction to intervene in maintenance or repair of the facility, or any documents or contracts required for the construction of a stormwater facility.
- **Covenants:** Binding legal documents in which a person (commonly a property owner) promises the local government to either engage in or refrain from a certain action. A jurisdiction's code, at the jurisdiction's option, may require a covenant or easement agreement for the construction of a stormwater facility. The agreement may require the facility owner to perform certain maintenance activities and grants the jurisdiction limited authority to access the site (through an easement or agreement) for facility inspection, maintenance, or repair work.
- **Developer:** A person who purchases and develops property, primarily by preparing a site for residential or commercial use.
- **Director:** Typically the Public Works Director, Planning and Development Services Director, or Natural Resources and Parks Director (depending on the organization of the City or County and what department the stormwater program is included in) or an appointed representative or designee with an appropriate background.
- **Green stormwater infrastructure:** A synonym for Low Impact Development BMPs (see definition below).

- **Integrated management practices:** Used in the LID Technical Guidance Manual for Puget Sound as a synonym for Low Impact Development BMPs (see definition below).
- **Low impact development (LID):** A stormwater and land use management strategy that strives to mimic pre-disturbance hydrologic processes of infiltration, filtration, storage, evaporation and transpiration by emphasizing conservation, use of on-site natural features, site planning, and distributed stormwater management practices that are integrated into a project design.
- **LID best management practices (BMPs):** Distributed stormwater management practices, integrated into a project design, that emphasize pre-disturbance hydrologic processes of infiltration, filtration, storage, evaporation and transpiration. LID BMPs include, but are not limited to, bioretention/rain gardens, permeable pavements, roof downspout controls, dispersion, soil quality and depth, vegetated roofs, minimum excavation foundations, and water re-use.
- **On-site Stormwater Management BMPs:** A synonym for Low Impact Development BMPs.
- **Pollution-generating surfaces:** Any hard or impervious surface considered to be a significant source of pollutants in stormwater runoff, or any pervious surface that is subject to rainfall and vehicular use, industrial activities, storage of erodible or leachable materials, wastes, or chemicals, or use of pesticides or fertilizers, or loss of soil.
- **Property owner:** The person who is the legal record owner of the parcel.
- **Responsible party:** The parties (e.g., property owners, homeowners' associations, corporations, public agencies) responsible for maintaining stormwater features at a site and/or in a public right-of-way.
- **Stormwater Treatment and Flow Control BMPs:** Detention facilities, treatment BMPs/facilities, bioretention, vegetated roofs, and permeable pavements that help meet Appendix 1 Minimum Requirements #6 (treatment), #7 (flow control), or both.
- **Surety:** A surety is a bond or other security signed by the contractor and a surety company that assures the project owner or municipality the contract will be completed. A surety can include bonds or assignment of accounts (also called assignment of savings).

MAINTAINING LID BMPS

This section is organized by BMP type and includes guidance for the following LID BMPs:

- Bioretention facilities
- Rain gardens
- Permeable pavement
- Vegetated roofs
- Downspout full infiltration systems
- Downspout, sheet flow, and concentrated dispersion systems
- Compost-amended soils

Each BMP section includes the following information:

- **BMP Description:** brief description of the BMP and how the facility functions (i.e., how water moves through the facility).
- **Key Maintenance Considerations:** summary of key facility maintenance considerations for each main BMP components, such as inlets, aggregate, soil, vegetation.
- **Key Operations to Preserve Facility Function:** operational considerations that may reduce routine maintenance needs and prevent the need for corrective maintenance.
- **Maintenance Standards and Procedures:** a table providing detailed guidance for regular maintenance (e.g., bioretention vegetation care) and some guidance for corrective maintenance (e.g., bioretention soil replacement). The table lists the recommended inspection frequency, conditions when maintenance is needed (maintenance "standards") and the associated maintenance actions triggered by those conditions (maintenance "procedures").
- **Equipment and Material List:** a sample list of equipment and materials that field crews can take into the field.
- **Skills and Staffing:** a list of the skills needed for routine and corrective maintenance, and summary of the staffing resources recommended for BMP maintenance based on input from local jurisdictions and other nationally-recognized LID programs (for the Stormwater Treatment and Flow Control BMPs/Facilities only).

This section's detailed maintenance guidance can be pared down to meet project-specific needs. For example, tables can be tailored to show only site-specific BMPs and their subcomponents (e.g., underdrains). Additionally, the routine maintenance frequencies should

be tailored to minimize a site's need for corrective maintenance (e.g., specify more frequent sweeping of permeable pavement located under deciduous tree canopies).

Jurisdictions may also want to consider tailoring the tables to address "level of service" (i.e., the BMP conditions that trigger maintenance procedures). As an example, the City of Seattle maintains public facilities to levels of service "A" through "D", with level A being the highest degree of maintenance. Lower levels of service require only maintenance activities that preserve facility function (not aesthetics). While this guidance document includes recommended quantitative thresholds for some BMP maintenance actions (e.g., supplemental planting is triggered when bioretention vegetative coverage falls below 75 percent), jurisdictions may wish to develop their own maintenance triggers and/or establish ranges of triggers based on higher levels of service. Such decisions will affect the maintenance resources required to maintain public projects.

The maintenance standards provided in this section are not intended to be a measure of the facility's required condition at all times between inspections. However, the inspection and maintenance schedules should be adjusted to minimize the length of time that a facility is in a condition that requires a maintenance action.

All LID BMPs

The maintenance recommendations included in this section are applicable to all LID BMPs.

Maintenance Standards and Procedures

Table 1 provides the recommended maintenance frequencies, standards, and procedures for spill prevention, spill response, and pest management actions common to all LID BMP facilities included in this guidance document.

Table 1. Maintenance Standards and Procedures for All LID BMPs.				
	Recommended Frequency			
Category	Inspection	Routine Maintenance	Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
General				
Facility presence	All visits		None (ongoing inspections)	Inspect to ensure the facility is present on site as shown on the as-built (or record drawings) and previous photos.
Spill Prevention and Response				
Spill prevention	Ongoing		None (ongoing inspections)	All sites must implement BMPs to prevent hazardous or solid wastes or excessive oil and sediment from contaminating stormwater.
Spill cleanup	As needed		Release of pollutants	• Call your local or regional hotline number to report any spills or other illicit discharges • Clean up spills as soon as possible to prevent contamination of stormwater • Restore BMP facility design and function per the record drawings
Pests				
Pest management	As needed		Pest of concern is present and impacting BMP facility function	• Pesticide use should be generally discouraged, even conditionally prohibited in some cases • Pesticides include the following: herbicides, fungicides, insecticides, rodenticides, and pediculicides • If pesticide use is planned in or near LID BMPs, make sure to check the following current regulations: 1) Federal- Environmental Protection Agency (EPA) Federal Insecticide and Rodenticide Act 2) State- Ecology, Washington State Department of Agriculture, Washington Department of Fish and Wildlife, Natural Resources Conservation Services 3) Local city or county ordinances/codes, and/or applicable Integrated Pest Management (IPM) plan • For the protection of health and safety, check the following: 1) Washington State Department of Labor & Industries 2) Washington State Department of Health (local branch if applicable)

Equipment and Materials

Table 2 includes recommendations for equipment and materials common to all LID BMPs included in this guidance document.

Table 2. Equipment and Materials List for All LID BMPs.

- ☐ **Camera**
- ☐ **Safety gear/equipment (including boots, long sleeves and pants, gloves, eye and ear protection, and/or high visibility safety vest)**
- ☐ **Shovel (to check depth and condition of soils)**
- ☐ **Measuring tape**
- ☐ **Photos, reports, and/or checklists from past maintenance visits (to help identify changes such as thinning plants and changing pavement conditions)**
- ☐ **Copy of the site's O&M manual or maintenance plan**
- ☐ **O&M checklist**
- ☐ **As-built (i.e., record) drawings of the facility, including site drawings with facility location(s)**
- ☐ **Manufacturer information (if applicable)**

Skills

The required skills common to maintenance of all LID BMPs are listed in the text box to the right.

Skills Needed for Maintenance of all LID BMPs

- Understanding of as-built (or record) drawings of the facility
- Understanding of facility design and intent (to identify issues that would inhibit function)
- General labor (manual tool skills)

Bioretention Facilities

Bioretention facilities are engineered facilities that store and treat stormwater by filtering it through a specified soil profile. Water that enters the facility ponds in an earthen depression or other basin (e.g., concrete planter) before it infiltrates into the underlying bioretention soil. Stormwater that exceeds the surface storage capacity overflows to an adjacent drainage system. Treated water is either infiltrated into the underlying native soil or collected by an underdrain and discharged. Bioretention facilities are considered Stormwater Treatment and Flow Control BMPs/Facilities when used to help meet Minimum Requirements #6 (treatment), #7 (flow control), or both.

Key Maintenance Considerations

The main components of bioretention facilities are listed below with descriptions of their function and key maintenance considerations.

- **Inlet**: Stormwater can flow into a bioretention facility in a number of ways including: dispersed flow across vegetated areas, sheet flow across impervious areas, or concentrated flow through curb cuts and/or piped flow inlets. Inlets must be maintained to be unobstructed to ensure that stormwater enters the facility as designed. Erosion control measures must also be maintained in areas of concentrated flows (e.g., pipes inlets or narrow curb cuts).
- **Facility footprint**: The facility footprint is typically an earthen depression or another type of basin (e.g., concrete planter box) that provides surface storage for stormwater before it infiltrates into the underlying bioretention soil. If the facility is located on a slope, low permeability check dams may be included (oriented perpendicular to the slope) to encourage ponding. Key maintenance considerations for the facility footprint include the following:
    - The integrity of earthen berms and basin walls must be maintained, soil areas must be protected from erosion, and accumulated sediment must be removed.
    - Bioretention facilities are designed to infiltrate all ponded water within a 24- to 48-hour "drawdown" time after the end of a storm. This allows the soil to dry out periodically in order to restore the hydraulic capacity of the system and prevent conditions supportive of mosquito breeding. Slower drawdown times may indicate that the underdrain (if present) is plugged or the bioretention soil is overly compacted, clogged, or does not meet design specifications. Corrective maintenance may include clearing underdrain obstructions or partial or complete replacement of bioretention soil to restore bioretention facility function.
- **Bioretention soil**: Infiltration of stormwater through the engineered bioretention soil mix provides water quality treatment. All maintenance activities must be performed in a manner to prevent compaction of the bioretention soil.
- **Mulch**: The bioretention soil is covered by a layer of mulch, comprised of arborist wood chips, compost, and/or rocks. Mulch reduces weed establishment. Organic

mulches regulate soil temperatures and moisture, and add organic matter to soil. The mulch layer must be supplemented regularly.

- **Vegetation**: Bioretention systems rely on vegetation (i.e., grasses, shrubs, and sometimes trees) to intercept, uptake, and evapotranspire stormwater. In addition, plant roots improve soil structure and increase infiltration capacity. Regular maintenance activities associated with vegetation include weeding and pruning. Plants also require irrigation during the first 2 to 3 years of establishment and during extended dry periods.
- **Overflow**: Flows exceeding the capacity of the facility are discharged via an overflow structure (e.g., pipe, curb cut, earthen channel). It is important to maintain clear outlet pipes and overflow structures to ensure that stormwater can be safely conveyed to a designated discharge point (e.g., storm drain system).
- **Underdrains (optional)**: Underdrains are optional components of a bioretention facility that may be included in bioretention systems where, for example, infiltration to underlying soil is not prudent or feasible. Underdrains are installed under the bioretention soil layer to collect and convey treated water. An underdrain system can be comprised of perforated or slotted pipe, wrapped in an aggregate blanket. It is important to maintain clear drains so that water moves through system as designed. Maintenance may include occasional cleaning to remove plant roots or debris. If underdrains are equipped with a flow restrictor (e.g., orifice) to attenuate flows, the orifice must be inspected and cleaned regularly.

Nutrient sensitivity of the receiving water is also an important maintenance consideration, particularly in watersheds draining to phosphorous limited water bodies. The addition of excess fertilizers to the system and/or systems operating in bypass, can increase the potential for export of phosphorous found in bioretention soil or compost and increase nutrient loads to downstream receiving waters.

Key Operations to Preserve Facility Function

For a bioretention system to function properly, stormwater must infiltrate freely through the bioretention soil. The soil infiltration rate can be reduced if the soil is subject to compaction (e.g., foot and vehicle traffic loads). To limit the likelihood of corrective maintenance (e.g., bioretention soil replacement), the facility footprint area should be protected from external loads. Because the risk of compaction is higher when soils are saturated, any type of loading in the bioretention facility (including foot traffic) should be avoided during wet conditions.

Signage can also be used to identify the vegetated area as a stormwater BMP and inform maintenance crews and the general public about protecting the facility's function.

Maintenance Standards and Procedures

Table 3 provides the recommended maintenance frequencies, standards, and procedures for bioretention facility components. The level of routine maintenance required and the frequency of corrective maintenance actions may increase for facilities subject to high sediment loads from the contributing drainage area.

Table 3. Maintenance Standards and Procedures for Bioretention Facilities.

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Facility Footprint				
Earthen side slopes and berms	B, S		Erosion (gullies/ rills) greater than 2 inches deep around inlets, outlet, and alongside slopes	• Eliminate cause of erosion and stabilize damaged area (regrade, rock, vegetation, erosion control matting) • For deep channels or cuts (over 3 inches in ponding depth), temporary erosion control measures should be put in place until permanent repairs can be made. • Properly designed, constructed and established facilities with appropriate flow velocities should not have erosion problems except perhaps in extreme events. If erosion problems persist, the following should be reassessed: (1) flow volumes from contributing areas and bioretention facility sizing; (2) flow velocities and gradients within the facility; and (3) flow dissipation and erosion protection strategies at the facility inlet.
	A		Erosion of sides causes slope to become a hazard	Take actions to eliminate the hazard and stabilize slopes
	A, S		Settlement greater than 3 inches (relative to undisturbed sections of berm)	Restore to design height
	A, S		Downstream face of berm wet, seeps or leaks evident	Plug any holes and compact berm (may require consultation with engineer, particularly for larger berms)
	A		Any evidence of rodent holes or water piping in berm	• Eradicate rodents (see "Pest control") • Fill holes and compact (may require consultation with engineer, particularly for larger berms)
Concrete sidewalls	A		Cracks or failure of concrete sidewalls	• Repair/ seal cracks • Replace if repair is insufficient
Rockery sidewalls	A		Rockery side walls are insecure	Stabilize rockery sidewalls (may require consultation with engineer, particularly for walls 4 feet or greater in height)
Facility area		All maintenance visits (at least biannually)	Trash and debris present	Clean out trash and debris
Facility bottom area	A, S		Accumulated sediment to extent that infiltration rate is reduced (see “Ponded water”) or surface storage capacity significantly impacted	• Remove excess sediment • Replace any vegetation damaged or destroyed by sediment accumulation and removal • Mulch newly planted vegetation • Identify and control the sediment source (if feasible) • If accumulated sediment is recurrent, consider adding presettlement or installing berms to create a forebay at the inlet
		During/after fall leaf drop	Accumulated leaves in facility	Remove leaves if there is a risk to clogging outlet structure or water flow is impeded
Low permeability check dams and weirs	A, S		Sediment, vegetation, or debris accumulated at or blocking (or having the potential to block) check dam, flow control weir or orifice	Clear the blockage
	A, S		Erosion and/or undercutting present	Repair and take preventative measures to prevent future erosion and/or undercutting
	A		Grade board or top of weir damaged or not level	Restore to level position

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; W = At least one visit should occur during the wet season (for debris/clog related maintenance, this inspection/maintenance visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

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Table 3 (continued). Maintenance Standards and Procedures for Bioretention Facilities.

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Facility Footprint (cont'd)				
Ponded water	B, S		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.	Determine cause and resolve in the following order: 1) Confirm leaf or debris buildup in the bottom of the facility is not impeding infiltration. If necessary, remove leaf litter/debris. 2) Ensure that underdrain (if present) is not clogged. If necessary, clear underdrain. 3) Check for other water inputs (e.g., groundwater, illicit connections). 4) Verify that the facility is sized appropriately for the contributing area. Confirm that the contributing area has not increased. If steps #1-4 do not solve the problem, the bioretention soil is likely clogged by sediment accumulation at the surface or has become overly compacted. Dig a small hole to observe soil profile and identify compaction depth or clogging front to help determine the soil depth to be removed or otherwise rehabilitated (e.g., tilled). Consultation with an engineer is recommended.
Bioretention soil media	As needed		Bioretention soil media protection is needed when performing maintenance requiring entrance into the facility footprint	• Minimize all loading in the facility footprint (foot traffic and other loads) to the degree feasible in order to prevent compaction of bioretention soils. • Never drive equipment or apply heavy loads in facility footprint. • Because the risk of compaction is higher during saturated soil conditions, any type of loading in the cell (including foot traffic) should be minimized during wet conditions. • Consider measures to distribute loading if heavy foot traffic is required or equipment must be placed in facility. As an example, boards may be placed across soil to distribute loads and minimize compaction. • If compaction occurs, soil must be loosened or otherwise rehabilitated to original design state.
Inlets/Outlets/Pipes				
Splash block inlet	A		Water is not being directed properly to the facility and away from the inlet structure	Reconfigure/ repair blocks to direct water to facility and away from structure
Curb cut inlet/outlet	M during the wet season and before severe storm is forecasted	Weekly during fall leaf drop	Accumulated leaves at curb cuts	Clear leaves (particularly important for key inlets and low points along long, linear facilities)
Pipe inlet/outlet	A		Pipe is damaged	Repair/ replace
	W		Pipe is clogged	Remove roots or debris
	A, S		Sediment, debris, trash, or mulch reducing capacity of inlet/outlet	• Clear the blockage • Identify the source of the blockage and take actions to prevent future blockages
		Weekly during fall leaf drop	Accumulated leaves at inlets/outlets	Clear leaves (particularly important for key inlets and low points along long, linear facilities)
		A	Maintain access for inspections	• Clear vegetation (transplant vegetation when possible) within 1 foot of inlets and outlets, maintain access pathways • Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants
Erosion control at inlet	A		Concentrated flows are causing erosion	Maintain a cover of rock or cobbles or other erosion protection measure (e.g., matting) to protect the ground where concentrated water enters the facility (e.g., a pipe, curb cut or swale)

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; W = At least one visit should occur during the wet season (for debris/clog related maintenance, this inspection/maintenance visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

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Table 3 (continued). Maintenance Standards and Procedures for Bioretention Facilities.

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Inlets/Outlets/Pipes (cont'd)				
Trash rack	S		Trash or other debris present on trash rack	Remove/dispose
	A		Bar screen damaged or missing	Repair/replace
Overflow	A, S		Capacity reduced by sediment or debris	Remove sediment or debris/dispose
Underdrain pipe	Clean pipe as needed	Clean orifice at least biannually (may need more frequent cleaning during wet season)	• Plant roots, sediment or debris reducing capacity of underdrain • Prolonged surface ponding (see "Ponded water")	• 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.
Vegetation				
Facility bottom area and upland slope vegetation	Fall and Spring		Vegetation survival rate falls below 75% within first two years of establishment (unless project O&M manual or record drawing stipulates more or less than 75% survival rate).	• Determine cause of poor vegetation growth and correct condition • Replant as necessary to obtain 75% survival rate or greater. Refer to original planting plan, or approved jurisdictional species list for appropriate plant replacements (See Appendix 3 - Bioretention Plant List, in the LID Technical Guidance Manual for Puget Sound). • Confirm that plant selection is appropriate for site growing conditions • Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants
Vegetation (general)	As needed		Presence of diseased plants and plant material	• Remove any diseased plants or plant parts and dispose of in an approved location (e.g., commercial landfill) to avoid risk of spreading the disease to other plants • Disinfect gardening tools after pruning to prevent the spread of disease • See Pacific Northwest Plant Disease Management Handbook for information on disease recognition and for additional resources • Replant as necessary according to recommendations provided for "facility bottom area and upland slope vegetation".
Trees and shrubs		All pruning seasons (timing varies by species)	Pruning as needed	• Prune trees and shrubs in a manner appropriate for each species. Pruning should be performed by landscape professionals familiar with proper pruning techniques • All pruning of mature trees should be performed by or under the direct guidance of an ISA certified arborist
	A		Large trees and shrubs interfere with operation of the facility or access for maintenance	• Prune trees and shrubs using most current ANSI A300 standards and ISA BMPs. • Remove trees and shrubs, if necessary.
	Fall and Spring		Standing dead vegetation is present	• Remove standing dead vegetation • Replace dead vegetation within 30 days of reported dead and dying plants (as practical depending on weather/planting season) • If vegetation replacement is not feasible within 30 days, and absence of vegetation may result in erosion problems, temporary erosion control measures should be put in place immediately. • Determine cause of dead vegetation and address issue, if possible • If specific plants have a high mortality rate, assess the cause and replace with appropriate species. Consultation with a landscape architect is recommended.
	Fall and Spring		Planting beneath mature trees	• When working around and below mature trees, follow the most current ANSI A300 standards and ISA BMPs to the extent practicable (e.g., take care to minimize any damage to tree roots and avoid compaction of soil). • Planting of small shrubs or groundcovers beneath mature trees may be desirable in some cases; such plantings should use mainly plants that come as bulbs, bare root or in 4-inch pots; plants should be in no larger than 1-gallon containers.

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; W = At least one visit should occur during the wet season (for debris/clog related maintenance, this inspection/maintenance visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

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Table 3 (continued). Maintenance Standards and Procedures for Bioretention Facilities.

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Vegetation (cont'd)				
Trees and shrubs (cont'd)	Fall and Spring		Planting beneath mature trees	• When working around and below mature trees, follow the most current ANSI A300 standards and ISA BMPs to the extent practicable (e.g., take care to minimize any damage to tree roots and avoid compaction of soil). • Planting of small shrubs or groundcovers beneath mature trees may be desirable in some cases; such plantings should use mainly plants that come as bulbs, bare root or in 4-inch pots; plants should be in no larger than 1-gallon containers.
	Fall and Spring		Presence of or need for stakes and guys (tree growth, maturation, and support needs)	• Verify location of facility liners and underdrain (if any) prior to stake installation in order to prevent liner puncture or pipe damage • Monitor tree support systems: Repair and adjust as needed to provide support and prevent damage to tree. • Remove tree supports (stakes, guys, etc.) after one growing season or maximum of 1 year. • Backfill stake holes after removal.
Trees and shrubs adjacent to vehicle travel areas (or areas where visibility needs to be maintained)	A		Vegetation causes some visibility (line of sight) or driver safety issues	• Maintain appropriate height for sight clearance • When continued, regular pruning (more than one time/ growing season) is required to maintain visual sight lines for safety or clearance along a walk or drive, consider relocating the plant to a more appropriate location. • Remove or transplant if continual safety hazard • Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants
Flowering plants		A	Dead or spent flowers present	Remove spent flowers (deadhead)
Perennials		Fall	Spent plants	Cut back dying or dead and fallen foliage and stems
Emergent vegetation		Spring	Vegetation compromises conveyance	• Hand rake sedges and rushes with a small rake or fingers to remove dead foliage before new growth emerges in spring or earlier only if the foliage is blocking water flow (sedges and rushes do not respond well to pruning)
Ornamental grasses (perennial)		Winter and Spring	Dead material from previous year's growing cycle or dead collapsed foliage	• Leave dry foliage for winter interest • Hand rake with a small rake or fingers to remove dead foliage back to within several inches from the soil before new growth emerges in spring or earlier if the foliage collapses and is blocking water flow
Ornamental grasses (evergreen)		Fall and Spring	Dead growth present in spring	• Hand rake with a small rake or fingers to remove dead growth before new growth emerges in spring • Clean, rake, and comb grasses when they become too tall • Cut back to ground or thin every 2-3 years as needed
Noxious weeds		M (March – October, preceding seed dispersal)	Listed noxious vegetation is present (refer to current county noxious weed list)	• By law, class A & B noxious weeds must be removed, bagged and disposed as garbage immediately • Reasonable attempts must be made to remove and dispose of class C noxious weeds • It is strongly encouraged that herbicides and pesticides not be used in order to protect water quality; use of herbicides and pesticides may be prohibited in some jurisdictions • Apply mulch after weed removal (see "Mulch")

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; W = At least one visit should occur during the wet season (for debris/clog related maintenance, this inspection/maintenance visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

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Table 3 (continued). Maintenance Standards and Procedures for Bioretention Facilities.

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Vegetation (cont'd)				
Weeds		M (March – October, preceding seed dispersal)	Weeds are present	• Remove weeds with their roots manually with pincer-type weeding tools, flame weeders, or hot water weeders as appropriate • Follow IPM protocols for weed management (see "Additional Maintenance Resources" section for more information on IPM protocols)
Excessive vegetation		Once in early to mid- May and once in early- to mid-September	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	• Edge or trim groundcovers and shrubs at facility edge • Avoid mechanical blade-type edger and do not use edger or trimmer within 2 feet of tree trunks • While some clippings can be left in the facility to replenish organic material in the soil, excessive leaf litter can cause surface soil clogging
	As needed		Excessive vegetation density inhibits stormwater flow beyond design ponding or becomes a hazard for pedestrian and vehicular circulation and safety	• Determine whether pruning or other routine maintenance is adequate to maintain proper plant density and aesthetics • Determine if planting type should be replaced to avoid ongoing maintenance issues (an aggressive grower under perfect growing conditions should be transplanted to a location where it will not impact flow) • Remove plants that are weak, broken or not true to form; replace in-kind • Thin grass or plants impacting facility function without leaving visual holes or bare soil areas • Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants
	As needed		Vegetation blocking curb cuts, causing excessive sediment buildup and flow bypass	• Remove vegetation and sediment buildup
Mulch				
Mulch		Following weeding	Bare spots (without mulch cover) are present or mulch depth less than 2 inches	• Supplement mulch with hand tools to a depth of 2 to 3 inches • Replenish mulch per O&M manual. Often coarse compost is used in the bottom of the facility and arborist wood chips are used on side slopes and rim (above typical water levels) • Keep all mulch away from woody stems
Watering				
Irrigation system (if any)		Based on manufacturer's instructions	Irrigation system present	• Follow manufacturer's instructions for O&M
	A		Sprinklers or drip irrigation not directed/located to properly water plants	• Redirect sprinklers or move drip irrigation to desired areas

Summer watering (first year)		Once every 1-2 weeks or as needed during prolonged dry periods	Trees, shrubs and groundcovers in first year of establishment period	• 10 to 15 gallons per tree
				• 3 to 5 gallons per shrub
				• 2 gallons water per square foot for groundcover areas
				• Water 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 is not present
				  ○ Pulse water to enhance soil absorption, when feasible
				  ○ Pre-moisten soil to break surface tension of dry or hydrophobic soils/mulch, followed by several more passes. With this method , each pass increases soil absorption and allows more water to infiltrate prior to runoff
				• Add a tree bag or slow-release watering device (e.g., bucket with a perforated bottom) for watering newly installed trees when irrigation system is not present

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; W = At least one visit should occur during the wet season (for debris/clog related maintenance, this inspection/maintenance visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

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Table 3 (continued). Maintenance Standards and Procedures for Bioretention Facilities.

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Watering (cont'd)				

Summer watering (second and third years)		Once every 2-4 weeks or as needed during prolonged dry periods	Trees, shrubs and groundcovers in second or third year of establishment period	• 10 to 15 gallons per tree
				• 3 to 5 gallons per shrub
				• 2 gallons water per square foot for groundcover areas
				• Water 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 is not present
				  ○ Pulse water to enhance soil absorption, when feasible
				  ○ Pre-moisten soil to break surface tension of dry or hydrophobic soils/mulch, followed by several more passes. With this method , each pass increases soil absorption and allows more water to infiltrate prior to runoff

Summer watering (after establishment)		As needed	Established vegetation (after 3 years)	• Plants are typically selected to be drought tolerant and not require regular watering after establishment; however, trees may take up to 5 years of watering to become fully established • Identify trigger mechanisms for drought-stress (e.g., leaf wilt, leaf senescence, etc.) of different species and water immediately after initial signs of stress appear • Water during drought conditions or more often if necessary to maintain plant cover
Pest Control				
Mosquitoes	B, S		Standing water remains for more than 3 days after the end of a storm	• Identify the cause of the standing water and take appropriate actions to address the problem (see "Ponded water") • To facilitate maintenance, manually remove standing water and direct to the storm drainage system (if runoff is from non pollution-generating surfaces) or sanitary sewer system (if runoff is from pollution-generating surfaces) after getting approval from sanitary sewer authority. • Do not use pesticides or *Bacillus thuringiensis israelensis* (Bti)
Nuisance animals	As needed		Nuisance animals causing erosion, damaging plants, or depositing large volumes of feces	• Reduce site conditions that attract nuisance species where possible (e.g., plant shrubs and tall grasses to reduce open areas for geese, etc.) • Place predator decoys • Follow IPM protocols for specific nuisance animal issues (see "Additional Maintenance Resources" section for more information on IPM protocols) • Remove pet waste regularly • For public and right-of-way sites consider adding garbage cans with dog bags for picking up pet waste.
Insect pests	Every site visit associated with vegetation management		Signs of pests, such as wilting leaves, chewed leaves and bark, spotting or other indicators	• Reduce hiding places for pests by removing diseased and dead plants • For infestations, follow IPM protocols (see "Additional Maintenance Resources" section for more information on IPM protocols)

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; W = At least one visit should occur during the wet season (for debris/clog related maintenance, this inspection/maintenance visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

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Additional Maintenance Resources

Useful related guidance documents include the following:

- LID Technical Guidance Manual for Puget Sound: http://www.wastormwatercenter.org/files/library/lid-manual-2012-final-secure.pdf.
- Natural Lawn and Garden Care resources (King County and SPU 2008; Saving Water Partnership 2006, 2007, and 2012) include guidance on building healthy soil with compost and mulch, selecting appropriate plants, watering, using alternatives to pesticides, and implementing natural lawn care techniques.
- Integrated Pest Management (IPM) protocols (the term "pest" covers a broad range of species including harmful insects, plant pathogens, rodents, and weedy vegetation) provide an approach to pest control that uses regular monitoring to determine if and when treatments are needed, and employs physical, mechanical, cultural, and biological tactics to keep pest numbers low enough to prevent intolerable damage or annoyance (Ecology 2012c) while avoiding or minimizing the use of pesticides and fertilizers herbicides as a management strategy.
- See EPA's website for general information on IPM: www.epa.gov/pesticides/factsheets/ipm.htm
- See the City of Seattle's website for IPM Fact Sheets and Washington specific resources: www.seattle.gov/util/forbusinesses/landscapes/integrated_pest_management
- The International Society of Arboriculture (ISA) is a group that promotes the professional practice of arboriculture and fosters a greater worldwide awareness of the benefits of trees through research, technology, and education. ISA standards used for managing trees, shrubs, and other woody plants are the American National Standards Institute (ANSI) A300 standards. The ANSI A300 standards are voluntary industry consensus standards developed by the Tree Care Industry Association (TCIA) and written by the Accredited Standards Committee (ASC). The ANSI standards can be found on the ISA website: www.isa-arbor.com/education/publications/index.aspx.
- Volume IV (Source Control) of Ecology's 2012 SWMMWW provides guidance on herbicide and pesticide application and alternative management strategies for controlling weeds and pests.
- WSU Weeding Guidelines: http://gardening.wsu.edu
- Pacific Northwest Plant Disease Management Handbook for information on disease recognition and for additional resources: http://pnwhandbooks.org/plantdisease/diagnosis-and-testing/disease-diagnosis-and-control

These resources are supplemental and do not supersede guidance provided in the S*tandards and Procedures* tables.

Equipment and Materials

Table 4 includes recommendations for equipment and materials commonly used to maintain bioretention facilities. Some of the equipment and materials will be used for routine maintenance activities, while other equipment and materials will be necessary for specialized maintenance.

Table 4. Bioretention Equipment and Materials List.

Landscaping equipment	*Landscaping materials**
☐ Gloves	☐ Plants
☐ Weeding tool	☐ Stakes and ties
☐ Soil knife	*Erosion control material**
☐ Pruners	☐ Rock or cobbles for rock pad
☐ Loppers	☐ Erosion control matting
☐ Stakes and guys	*Mulch*
☐ Manual edger	☐ Arborist wood chip mulch
☐ Line trimmer (also known as a string trimmer, weed eater, or weed whacker)	☐ Coarse compost mulch
☐ Rototiller	☐ Rock mulch
☐ Hoe	*Pipe/structure inspection and maintenance equipment*
☐ Rake	☐ Hand tools
☐ Wheelbarrow	☐ Wrench or manhole lifter (for opening manhole lids, grates, etc.)
☐ Shovel	☐ Flashlight
☐ Push broom	☐ Mirror (for viewing pipes without entering structure)
☐ Hand tamper	☐ Garden hose
☐ Blade sharpeners	☐ Plumbing snake
☐ Tarp/ Buckets (to remove leaf litter/debris)	☐ Measuring tape or ruler
☐ Garbage bags (for disposal of trash/noxious weeds)	*Specialized equipment**
☐ Bark and mulch blower	☐ Mini excavator
☐ Boards to stand on during maintenance to prevent soil compaction (if maintenance is necessary during periods when Bioretention media is wet)	☐ Vactor truck
Watering equipment	☐ Manual seed broadcaster
☐ Soaker hose	☐ Soil monitoring equipment (T handle core sampler, soil auger, soil nutrient test kit)
☐ Hose/shower-type wand	☐ Flame weeder or hot water weeder
☐ Sprinklers	☐ Water jet or root saw (Vactor truck tools) for clearing roots from underdrains
☐ Tree watering bags	☐ Equipment for infiltration testing
☐ Buckets	*Bioretention soil**
☐ Keys for irrigation boxes	☐ Bioretention soil per design specifications
☐ Water source (e.g., watering truck), if necessary	

* Items not required for routine maintenance

Skills and Staffing

The skills required for maintenance of bioretention facilities are listed in the text box to the right. Additional specialized skills may also be required for corrective maintenance such as: horticulturalists, arborists, erosion control specialists, engineers, landscape architects, and soil scientists.

The staff effort required for maintenance varies. Table 5 provides some examples of staffing estimates from Washington jurisdictions, the City of Portland, a study conducted among Minnesota jurisdictions (Wilson et al. 2008), and the BMP and LID Whole Life Cost Models (WERF 2009). Annual staff hours are listed for an individual facility (i.e., a "typical" facility of undefined area), 1,000 square feet of facility, or 1,000 linear feet of facility.

Skills Needed for Maintenance of Bioretention Facilities

- Landscaping skills (e.g., general plant care)
- Plant identification skills (weeds vs. planted species, invasive vs. common weeds, how to dispose of invasive weeds, timing of weed seed dispersal)
- Erosion control knowledge
- General drainage system maintenance skills (e.g., inlet/pipe/underdrain cleaning experience, inlet/ pipe maintenance or repair experience)
- Operation of specialized equipment
- Engineer and/or landscape architect for major maintenance
- Certified arborist (or equivalently trained staff) for pruning of mature trees

Table 5. Maintenance Frequency and Staffing for Bioretention Facilities.

Routine Maintenance Activity	Frequency [a]	Annual Staff Hours	Source
General (no activity specified)	A or B	1 to 16 hours (per facility)	Maintenance of Stormwater BMPs: Frequency, Effort, and Cost (Wilson et al. 2008)
Vegetation management	A	0 to 2 hours (per facility)	BMP and LID Whole Life Cost Models (WERF 2009)
General (no activity specified)	M	24 hours (per 1,000 sf)	City of Bellevue
General (no activity specified)	M	16 hours (per facility)	Kitsap County
Weeding	M (May-Sept)	7 hours (per 1,000 lf)	Thurston County
Replanting and mulching	A		
Typical facility maintenance	Q	10 to 30 hours [b] (per 1,000 sf)	City of Portland
More complex site maintenance [c]	> Q	14 to 38 hours [b] (per 1,000 sf)	
General (no activity specified)	Unspecified	10 hours (per 1,000 sf)	City of Olympia

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; Q = Quarterly (four times per year)
[b] Low end of range pertains to City staff and high end of range pertains to Contractor staff
[c] Deciduous canopy, poor soils, adjacent weed vectors, unmaintained commercial right-of-way
lf = linear feet
sf = square feet

Staffing estimates averaged approximately 16 to 22 hours per bioretention facility on an annual basis. The City of Portland estimated that bioretention facilities with more complex maintenance requirements could require up to 38 hours of staff time when using less seasoned maintenance crews.

Rain Gardens

Rain gardens are non-engineered, shallow, landscaped depressions with compost-amended soils and adapted plants. The depression temporarily stores stormwater runoff from adjacent areas. Some or all of the influent stormwater passes through the amended soil profile and into the underlying native soil. Stormwater that exceeds the storage capacity is designed to overflow to an adjacent drainage system.

Key Maintenance Considerations

The main components of rain gardens (and the associated maintenance considerations) are very similar to those listed for bioretention facilities. However, rain gardens do not require an engineered soil mix (native soils may be amended) and usually do not have underdrains or other control structures.

Fertilizer use should be avoided in rain gardens, particularly those located in watersheds draining to phosphorous limited water bodies.

Key Operations to Preserve Facility Function

As explained for bioretention facilities, rain gardens must be protected from foot traffic, vehicles and other loads, particularly during wet conditions, to prevent compaction of the amended soil and preserve infiltration capacity.

Signage can also be used to identify the vegetated area as a stormwater BMP and inform maintenance crews and the general public about protecting the rain garden's function (e.g., no walking in the garden).

Maintenance Standards and Procedures

Table 6 provides the recommended maintenance frequencies, standards, and procedures for rain garden components. For guidance on underdrains, check dams and other control structures, see "Bioretention Facilities".

Table 6. Maintenance Standards and Procedures for Rain Gardens.

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Rain Garden Footprint				
Earthen side slopes	B (during the wet season)		Persistent soil erosion on slopes	If erosion persists, water may be flowing into the garden too rapidly. In this case, the slope of the pipe or swale directing water to the garden, or the amount of water may need to be reduced (see "Erosion control at inlet")
Rockery sidewalls	A		Rockery side walls are insecure	Stabilize rockery sidewalls (may require consultation with engineer, particularly for walls 4 feet or greater in height)
Rain garden footprint		B	Trash and debris present	Clean out trash and debris
Rain garden bottom area	A		Visible sediment deposition in the rain garden that reduces drawdown time of water in the rain garden	• Remove sediment accumulation • If sediment is deposited from water entering the rain garden, determine the source and stabilize the area
		During/after fall leaf drop	Accumulated leaves in rain garden (may reduce infiltration capacity of rain garden or clog overflow)	Remove leaves
Ponded water	B, S		Excessive ponding water: Ponded water remains in the basin more than 3 days after the end of a storm	Confirm leaf, debris or sediment buildup in the bottom of the rain garden is not impeding infiltration. If necessary, remove leaf litter/debris/sediment. If this does not solve the problem, consultation with a professional with rain garden expertise is recommended to evaluate the following: • Check for other water inputs (e.g., groundwater, illicit connections) • Verify that the facility is sized appropriately for the contributing area. Confirm that the contributing area has not increased • Determine if the soil is clogged by sediment accumulation at the surface or if the soil has become overly compacted

[a] Frequency: A = Annually; B = Biannually (twice per year); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

Table 6 (continued). Maintenance Standards and Procedures for Rain Gardens.				
Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Inlets/Outlets/Pipes				
Splash block inlet	A		Water is not being directed properly to the rain garden and away from the building	Reconfigure/ repair blocks to direct water to the rain garden and away from building
Pipe inlet/ outlet	A		Pipe capacity is reduced by sediment or debris (can cause backups and flooding)	Clear pipes of sediment and debris
	A		Damaged/cracked drain pipes	• Repair/seal cracks • Replace when repair is insufficient
Erosion control at inlet	A		Rock or cobble is removed or missing and concentrated flows are contacting soil	Maintain a cover of rock or cobbles to protect the ground where concentrated water flows into the rain garden from a pipe or swale
Vegetation				
Vegetation		As needed	Dying, dead, or unhealthy plants	• Maintain a healthy cover of plants • Remove any diseased plants or plant parts and dispose of in commercial landfill to avoid risk of spreading the disease to other plants • Disinfect gardening tools after pruning to prevent the spread of disease • Re-stake trees if they need more support, but plan to remove stakes and ties after the first year • Cars can damage roots – protect root areas of trees and plants from vehicle traffic
		As needed	Vegetation inhibits sight distances and sidewalks	Keep sidewalks and sight distances on roadways clear
		As needed	Broken, dead, or sucker vegetation is present	Remove broken or dead branches and suckers
		As needed	Vegetation is crowding inlets and outlets	Keep water inlets and outlets in the rain garden clear of vegetation

[a] Frequency: A = Annually; B = Biannually (twice per year); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

Table 6 (continued). Maintenance Standards and Procedures for Rain Gardens.				
Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Vegetation (cont'd)				
Vegetation (cont'd)		As needed	Broken, dead, or sucker vegetation is present	Remove broken or dead branches and suckers
		As needed	Vegetation is crowding inlets and outlets	Keep water inlets and outlets in the rain garden clear of vegetation
	One time March through June		• 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	• Test soil to identify specific nutrient deficiencies • Consult with a professional knowledgeable in the area of natural amendments or refer to Natural Lawn and Garden Care resources and avoid synthetic fertilizers • Consider selecting different plants for soil conditions
Weeds		As needed, preceding seed dispersal	Problem weeds are present	• Remove weeds by hand, especially in spring when the soil is moist and the weeds are small • Dig or pull weeds out by the roots before they go to seed • Apply mulch after weeding (see "Mulch")
Mulch				
Mulch		Following weeding	Bare spots (without mulch cover) are present or mulch depth less than 2 inches	• Supplement mulch with hand tools to a depth of 2 to 3 inches • Use coarse compost in the bottom of the rain garden and arborist wood chips on side slopes and rim (above typical water levels) • Keep all mulch from being in contact with woody stems.

[a] Frequency: A = Annually; B = Biannually (twice per year); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

Table 6 (continued). Maintenance Standards and Procedures for Rain Gardens.

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Watering				
Summer watering (first year)		Once every 1-2 weeks or as needed during prolonged dry periods	Tree, shrubs and groundcovers in first year of establishment period	• 10 to 15 gallons per tree • 3 to 5 gallons per shrub • 2 gallons water per square foot for groundcover areas • Water 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 is not present • Add a tree bag or slow-release watering device (e.g., bucket with a perforated bottom) for watering newly installed trees when irrigation system is not present
Summer watering (second and third years)		Once every 2-4 weeks or as needed during prolonged dry periods	Tree, shrubs and groundcovers in second or third year of establishment period	• 10 to 15 gallons per tree • 3 to 5 gallons per shrub • 2 gallons water per square foot for groundcover areas • Water 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 is not present
Summer watering (after establishment)		As needed	Established vegetation (after 3 years)	• Water during drought conditions or more often if necessary to maintain plant cover • Identify trigger mechanisms for drought-stress (e.g., leaf wilt, leaf senescence, etc.) of different rain garden species and water immediately after initial signs of stress appear

[a] Frequency: A = Annually; B = Biannually (twice per year); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

Table 6 (continued). Maintenance Standards and Procedures for Rain Gardens.				
Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Pest Control				
Mosquitoes	B, S		Standing water remains for more than 3 days after the end of a storm	• Identify the cause of the standing water and take appropriate actions to address the problem (see "Ponded water") • Do not use pesticides or *Bacillus thuringiensis israelensis* (Bti)

[a] Frequency: A = Annually; B = Biannually (twice per year); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

Additional Maintenance Resources

In addition to the resources listed for bioretention, useful guidance for rain gardens can be found in the Rain Garden Handbook for Western Washington Homeowners (http://www.wastormwatercenter.org/low-impact/). These resources are supplemental and do not supersede guidance provided in the Standards and Procedures tables.

Equipment and Materials

Table 7 includes recommendations for equipment and materials commonly used to maintain rain gardens. Some of the equipment and materials will be used for routine maintenance activities, while other equipment and materials will be necessary for specialized maintenance.

Table 7. Rain Garden Equipment and Materials List.

Landscaping equipment	*Watering equipment*
☐ Gloves	☐ Soaker hose
☐ Weeding tool	☐ Hose/shower-type wand
☐ Soil knife	☐ Sprinklers
☐ Pruners	☐ Tree watering bags
☐ Loppers	☐ Buckets
☐ Stakes and guys	*Mulch*
☐ Manual edger	☐ Arborist wood chip mulch
☐ Line trimmer (also known as a string trimmer, weed eater, or weed whacker)	☐ Coarse compost mulch
☐ Rototiller	☐ Rock mulch
☐ Hoe	*Landscaping materials**
☐ Rake	☐ Plants
☐ Wheelbarrow	*Erosion control materials**
☐ Shovel	☐ Rock or cobbles for rock pad
☐ Push broom	☐ Erosion control matting
☐ Hand tamper	*Soil**
☐ Blade sharpeners	☐ Compost (for soil amendment)
☐ Tarp/Buckets (to remove leaf litter/debris)	☐ Bioretention soil mix
☐ Garbage bags (for disposal of trash/noxious weeds)	

* Items not required for routine maintenance

Permeable Pavement

Permeable pavement is a paving system which allows rainfall to percolate through the surface into the underlying soil or an aggregate bed, where stormwater is stored and infiltrated to underlying subgrade, or removed by an overflow drainage system. Permeable pavement facilities are considered Stormwater Treatment and Flow Control BMPs and can be used to meet Minimum Requirements #6 (treatment), #7 (flow control), or both. To satisfy Minimum Requirement #6, stormwater must be infiltrated into underlying soils that meet Ecology's soil treatment requirements or filtered through an engineered treatment layer included in the pavement section.

Key Maintenance Considerations

The main components of permeable pavement facilities are listed below with descriptions of their function and key maintenance considerations.

- **Wearing course**: The surface layer of any permeable pavement system is the wearing course. Categories of wearing courses include:
    - Porous asphalt**:** A flexible pavement similar to standard asphalt that uses a bituminous binder to adhere aggregate. However, the fine material (sand and finer) is reduced or eliminated, resulting in the formation of voids between the aggregate in the pavement surface that allows water to infiltrate to the underlying aggregate base.
    - Pervious concrete**:** A rigid pavement similar to conventional concrete that uses a cementitious material to bind aggregate together. However, the fine aggregate (sand) component is reduced or eliminated in the gradation, resulting in the formation of voids between the aggregate in the pavement surface that allows water to infiltrate to the underlying aggregate base.
    - Interlocking concrete paver blocks: Solid, precast, manufactured modular units. Pavements constructed with these units create joints that are filled with permeable aggregate and installed on an open-graded aggregate base.
    - Aggregate Pavers (or Pervious Pavers): Modular precast paving units made with uniformly sized aggregates and bound with Portland cement concrete using a high strength adhesive. Unlike concrete paver blocks, these pavers are permeable. Pavements constructed with these units create joints that are filled with permeable aggregate and installed on an open-graded aggregate base.
    - Open-celled paving grid with gravel**:** Concrete or plastic grids that are filled with permeable aggregate. The system can be installed on an open-graded aggregate base.
    - Open-celled paving grid with grass**:** Concrete or plastic grids that are filled with a mix of sand, gravel, and topsoil for planting vegetation. The cells can be planted with a variety of non-turf forming grasses or low-growing groundcovers. The system can be installed on an open-graded aggregate base.

A critical component of a successful maintenance program is regular removal of sediment and debris, excessive moss from the facility surface to prevent clogging of the permeable wearing course.

- **Inlet (optional):** While permeable pavement facilities often manage only the rain falling directly on the pavement surface, they may also be designed to accept stormwater runoff from additional areas (e.g., adjacent impervious areas, nearby rooftops). Runoff can be directed to the facility by two main methods:
    - Sheet flow to the surface: Surface areas of the facility receiving runoff contributions will likely be prone to clogging due to sediment inputs, particularly in areas of concentrated inflow. These areas should be carefully inspected and corrective maintenance should be performed as necessary to maintain the function of the pavement at these sites. In addition, the source of the sediment loads should be evaluated to determine if modifications to features in the drainage area landscape (e.g., stabilization of adjacent planted areas) would help to prevent clogging.
    - Piped flow into the aggregate base: Pipes dispersing water into the aggregate bed should be designed with cleanout access to allow pipe maintenance. Runoff that is piped into the aggregate base should be pretreated for sediment removal (e.g., screens, sumps) to protect the subbase from sedimentation and clogging. The pretreatment system must be maintained to remove accumulated sediment.
- **Aggregate Base / Storage Reservoir:** Stormwater passes through the wearing course to an underlying aggregate storage reservoir where it is stored prior to infiltration into the underlying soil. This aggregate bed also provides the structural function of supporting design loads (e.g., vehicle loading) for flexible pavement systems. To allow inspection of the aggregate course, some facilities have an observation port (typically installed during construction) that allows monitoring of the water levels in the aggregate bed to determine if the facility is draining properly.
- **Overflow:** Unless designed to provide full infiltration of stormwater, permeable pavement facilities have an overflow. Facility overflow can be provided by subsurface slotted drain pipe(s) (elevated in the aggregate bed) routed to an inlet or catch basin structure or by lateral flow through the storage reservoir to a daylighted drainage system.
- **Underdrain with flow restrictor (optional):** A slotted drain pipe with flow restrictor assembly may be installed at the bottom of or elevated within the aggregate storage reservoir. Permeable pavement facilities with underdrains and flow restrictors operate as underground detention systems with some infiltration.

Key Operations to Preserve Facility Function

There are several permeable pavement operational actions that can limit the likelihood of corrective maintenance actions or replacement including the following:

- Prohibiting use of sealant on porous asphalt
- Protecting from construction site runoff with proper temporary erosion and sediment controls and flow diversion measures
- Modifying utility cut procedures for permeable pavements. Protocols should *recommend* restoring permeable pavement section in-kind, where feasible, and *require* restoring permeable pavement section in-kind where replacement with conventional pavement would impact overall facility function. Replacing permeable pavement with conventional pavement is acceptable if it is a small percentage of the total facility area and does not impact the overall facility function.
- Modifying snow removal procedures such as:
    - Using a snow plow with skids or rollers to slightly raise the blade above permeable pavers or open-celled paving grid systems to prevent loss of top course aggregate and damage to paver blocks or grids
    - Avoiding stockpiling plowed snow (i.e., dirty snow) directly on top of permeable pavement
    - Avoiding application of sand to pervious pavement and adjacent streets where vehicles may track it onto the pervious pavement. If sand is applied, on an emergency basis during snowy conditions, vacuum sweep surface as soon as possible after the sand is no longer needed.
    - Use alternative deicers in moderation (e.g., salt, molasses-based and chemical deicers).
- Protecting the surface from stockpiles of landscaping materials (e.g., mulch, soil, compost) being used for adjacent pervious areas
- Stabilizing adjacent landscaped areas to avoid eroding soil and clogging surfaces or sloping adjacent landscaped areas away from permeable pavement , if possible

Signage or pavement marking can also be used to identify permeable pavement as a stormwater BMP and inform maintenance crews and the general public about protecting the facility's function (e.g., no stockpiling of soils or mulch on pavement surface).

Maintenance Standards and Procedures

Table 8 provides the recommended maintenance frequencies, standards, and procedures for permeable pavement components. The level of routine maintenance required and the frequency of corrective maintenance actions may increase for facilities receiving high sediment loads (e.g., sanding) or facilities subject to extended wet, shady conditions where moss may accumulate.

Table 8. Maintenance Standards and Procedures for Permeable Pavement.

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Surface/Wearing Course				
Permeable Pavements, all	A, S		Runoff from adjacent pervious areas deposits soil, mulch or sediment on paving	• Clean deposited soil or other materials from permeable pavement or other adjacent surfacing • Check if surface elevation of planted area is too high, or slopes towards pavement, and can be regraded (prior to regrading, protect permeable pavement by covering with temporary plastic and secure covering in place) • Mulch and/or plant all exposed soils that may erode to pavement surface
Porous asphalt or pervious concrete		A or B	None (routine maintenance)	Clean surface debris from pavement surface using one or a combination of the following methods: • Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves) • Vacuum/sweep permeable paving installation using: ○ Walk-behind vacuum (sidewalks) ○ High efficiency regenerative air or vacuum sweeper (roadways, parking lots) ○ ShopVac or brush brooms (small areas) • Hand held pressure washer or power washer with rotating brushes Follow equipment manufacturer guidelines for when equipment is most effective for cleaning permeable pavement. Dry weather is more effective for some equipment.
	A[b]		Surface is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)	• Review the overall performance of the facility (note that small clogged areas may not reduce overall performance of facility) • Test the surface infiltration rate using ASTM C1701 as a corrective maintenance indicator. Perform one test per installation, up to 2,500 square feet. Perform an additional test for each additional 2,500 square feet up to 15,000 square feet total. Above 15,000 square feet, add one test for every 10,000 square feet. • If the results indicate an infiltration rate of 10 inches per hour or less, then perform corrective maintenance to restore permeability. To clean clogged pavement surfaces, use one or combination of the following methods: • Combined pressure wash and vacuum system calibrated to not dislodge wearing course aggregate. • Hand held pressure washer or power washer with rotating brushes • Pure vacuum sweepers Note: If the annual/biannual routine maintenance standard to clean the pavement surface is conducted using equipment from the list above, corrective maintenance may not be needed.
	A		Sediment present at the surface of the pavement	• Assess the overall performance of the pavement system during a rain event. If water runs off the pavement and/or there is ponding then see above. • Determine source of sediment loading and evaluate whether or not the source can be reduced/eliminated. If the source cannot be addressed, consider increasing frequency of routine cleaning (e.g., twice per year instead of once per year).
	Summer		Moss growth inhibits infiltration or poses slip safety hazard	• Sidewalks: Use a stiff broom to remove moss in the summer when it is dry • Parking lots and roadways: Pressure wash, vacuum sweep, or use a combination of the two for cleaning moss from pavement surface. May require stiff broom or power brush in areas of heavy moss.
	A		Major cracks or trip hazards and concrete spalling and raveling	• Fill potholes or small cracks with patching mixes • Large cracks and settlement may require cutting and replacing the pavement section. Replace in-kind where feasible. Replacing porous asphalt with conventional asphalt is acceptable if it is a small percentage of the total facility area and does not impact the overall facility function. • Take appropriate precautions during pavement repair and replacement efforts to prevent clogging of adjacent porous materials

[a] Frequency: A= Annually; B= Biannually (twice per year); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).
[b] Inspection should occur during storm event.

Table 8 (continued). Maintenance Standards and Procedures for Permeable Pavement.

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Surface/Wearing Course (cont'd)				
Interlocking concrete paver blocks and aggregate pavers		A or B	None (routine maintenance)	Clean pavement surface using one or a combination of the following methods: • Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves) • Vacuum/sweep permeable paving installation using: ○ Walk-behind vacuum (sidewalks) ○ High efficiency regenerative air or vacuum sweeper (roadways, parking lots) ○ ShopVac or brush brooms (small areas) • Note: Vacuum settings may have to be adjusted to prevent excess uptake of aggregate from paver openings or joints. Vacuum surface openings in dry weather to remove dry, encrusted sediment.
	A [b]		Surface is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)]	• Review the overall performance of the facility (note that small clogged areas may not reduce overall performance of facility) • Test the surface infiltration rate using ASTM C1701 as a corrective maintenance indicator. Perform one test per installation, up to 2,500 square feet. Perform an additional test for each additional 2,500 square feet up to 15,000 square feet total. Above 15,000 square feet, add one test for every 10,000 square feet. • If the results indicate an infiltration rate of 10 inches per hour or less, then perform corrective maintenance to restore permeability. • Clogging is usually an issue in the upper 2 to 3 centimeters of aggregate. Remove the upper layer of encrusted sediment, and fines, and/or vegetation from openings and joints between the pavers by mechanical means and/or suction equipment (e.g., pure vacuum sweeper). • Replace aggregate in paver cells, joints, or openings per manufacturer's recommendations
	A		Sediment present at the surface of the pavement	• Assess the overall performance of the pavement system during a rain event. If water runs off the pavement and/or there is ponding, then see above. • Determine source of sediment loading and evaluate whether or not the source can be reduced/eliminated. If the source cannot be addressed, consider increasing frequency of routine cleaning (e.g., twice per year instead of once per year).
	Summer		Moss growth inhibits infiltration or poses slip safety hazard	• Sidewalks: Use a stiff broom to remove moss in the summer when it is dry • Parking lots and roadways: Vacuum sweep or stiff broom/power brush for cleaning moss from pavement surface
	A		Paver block missing or damaged	Remove individual damaged paver blocks by hand and replace or repair per manufacturer's recommendations
	A		Loss of aggregate material between paver blocks	Refill per manufacturer's recommendations for interlocking paver sections
	A		Settlement of surface	May require resetting
Open-celled paving grid with gravel		A or B	None (routine maintenance)	• Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves) • Follow equipment manufacturer guidelines for cleaning surface.
	A [b]		Aggregate is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)]	• Use vacuum truck to remove and replace top course aggregate • Replace aggregate in paving grid per manufacturer's recommendations
	A		Paving grid missing or damaged	• Remove pins, pry up grid segments, and replace gravel • Replace grid segments where three or more adjacent rings are broken or damaged • Follow manufacturer guidelines for repairing surface.
	A		Settlement of surface	May require resetting
	A		Loss of aggregate material in paving grid	Replenish aggregate material by spreading gravel with a rake (gravel level should be maintained at the same level as the plastic rings or no more than 1/4 inch above the top of rings). See manufacturer's recommendations.
		A	Weeds present	• Manually remove weeds • Presence of weeds may indicate that too many fines are present (refer to Actions Needed under "Aggregate is clogged" to address this issue)

[a] Frequency: A= Annually; B= Biannually (twice per year); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).
[b] Inspection should occur during storm event.

Table 8 (continued). Maintenance Standards and Procedures for Permeable Pavement.

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Surface/Wearing Course (cont'd)				
Open-celled paving grid with grass		A or B	None (routine maintenance)	• Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves) • Follow equipment manufacturer guidelines for cleaning surface.
	A [b]		Aggregate is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)]	• Rehabilitate per manufacturer's recommendations.
	A		Paving grid missing or damaged	• Remove pins, pry up grid segments, and replace grass • Replace grid segments where three or more adjacent rings are broken or damaged • Follow manufacturer guidelines for repairing surface.
	A		Settlement of surface	• May require resetting
	A		Poor grass coverage in paving grid	• Restore growing medium, reseed or plant, aerate, and/or amend vegetated area as needed • Traffic loading may be inhibiting grass growth; reconsider traffic loading if feasible
		As needed	None (routine maintenance)	• Use a mulch mower to mow grass
		A	None (routine maintenance)	• Sprinkle a thin layer of compost on top of grass surface (1/2" top dressing) and sweep it in • Do not use fertilizer
		A	Weeds present	• Manually remove weeds • Mow, torch, or inoculate and replace with preferred vegetation
Inlets/Outlets/Pipes				
Inlet/outlet pipe	A		Pipe is damaged	Repair/replace
	A		Pipe is clogged	Remove roots or debris
Underdrain pipe	Clean pipe as needed	Clean orifice at least biannually (may need more frequent cleaning during wet season)	Plant roots, sediment or debris reducing capacity of underdrain (may cause prolonged drawdown period)	• 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
Raised subsurface overflow pipe	Clean pipe as needed	Clean orifice at least biannually (may need more frequent cleaning during wet season)	Plant roots, sediment or debris reducing capacity of underdrain	• Jet clean or rotary cut debris/roots from under-drain(s) • If underdrains are equipped with a flow restrictor (e.g., orifice) to attenuate flows, the orifice must be cleaned regularly
Outlet structure	A, S		Sediment, vegetation, or debris reducing capacity of outlet structure	• Clear the blockage • Identify the source of the blockage and take actions to prevent future blockages

[a] Frequency: A= Annually; B= Biannually (twice per year); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).
[b] Inspection should occur during storm event.

Table 8 (continued). Maintenance Standards and Procedures for Permeable Pavement.

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Inlets/Outlets/Pipes (cont'd)				
Overflow	B		Native soil is exposed or other signs of erosion damage are present at discharge point	Repair erosion and stabilize surface
Aggregate Storage Reservoir				
Observation port	A, S		Water remains in the storage aggregate longer than anticipated by design after the end of a storm	If immediate cause of extended ponding is not identified, schedule investigation of subsurface materials or other potential causes of system failure.
Vegetation				
Adjacent large shrubs or trees		As needed	Vegetation related fallout clogs or will potentially clog voids	• Sweep leaf litter and sediment to prevent surface clogging and ponding • Prevent large root systems from damaging subsurface structural components
		Once in May and Once in September	Vegetation growing beyond facility edge onto sidewalks, paths, and street edge	Edging and trimming of planted areas to control groundcovers and shrubs from overreaching the sidewalks, paths and street edge improves appearance and reduces clogging of permeable pavements by leaf litter, mulch and soil.
Leaves, needles, and organic debris		In fall (October to December) after leaf drop (1-3 times, depending on canopy cover)	Accumulation of organic debris and leaf litter	Use leaf blower or vacuum to blow or remove leaves, evergreen needles, and debris (i.e., flowers, blossoms) off of and away from permeable pavement

[a] Frequency: A= Annually; B= Biannually (twice per year); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).
[b] Inspection should occur during storm event.

Equipment and Materials

Table 9 includes recommendations for equipment and materials commonly used to maintain permeable pavement. Some of the equipment and materials will be used for routine maintenance activities, while other equipment and materials will be necessary for specialized maintenance.

Table 9. Permeable Pavement Equipment and Materials List.

Equipment to address clogging of wearing course, such as:	***Weed / vegetation removal equipment, such as:***
☐ Hand held pressure washer or power washer with rotating brushes (not recommended for open-celled aggregate-filled systems) ☐ Walk-behind vacuum (sidewalks) ☐ Pure vacuum sweeper ☐ ShopVac (small areas) ☐ Combined higher pressure wash and vacuum system	☐ Weeding tools ☐ Weed burner ☐ Edging and trimming equipment to control groundcover and other vegetation from extending onto pavement surface
Equipment to remove sediment, debris, and leaf litter, such as:	***Additional equipment for grass-filled open-celled grid systems***
☐ High efficiency regenerative air or vacuum sweeper (roadways, parking lots) ☐ Push broom (can also be used to spread and clean aggregate in gravel-filled open-celled grid and permeable paver systems) ☐ Brush broom (course bristled broom) to remove moss ☐ Leaf blower	☐ Mower or mulch mower ☐ Topdress grass seed ☐ Compost ☐ Replacement grid segments
Erosion control equipment (to stabilize adjacent landscaped areas and protect pavement from sediment inputs)*	***Additional equipment for gravel-filled open-celled grid systems***
☐ Erosion control matting ☐ Rocks ☐ Mulch ☐ Plants ☐ Landscaping tools ☐ Tarps (to protect pavement in area of landscaping from clogging, e.g., mulch stockpiles)	☐ Rakes and shovels ☐ Aggregate to replace material after vacuuming or to replenish material in high use areas ☐ Replacement grid segments ☐ Wheelbarrow (for transporting replacement aggregate)
Pipe/structure inspection and maintenance equipment	***Additional equipment for permeable paver systems***
☐ Hand tools ☐ Wrench or manhole opener (for opening manhole lids, grates, etc.) ☐ Flashlight ☐ Mirror (for viewing pipes without entering structure) ☐ Garden hose ☐ Plumbing snake ☐ Measuring tape or ruler	☐ Rakes and shovels ☐ Extra pavers and bedding material ☐ Aggregate to replace materials between pavers after vacuuming ☐ Wheelbarrow (for transporting replacement aggregate)
	Snow removal equipment, such as:
	☐ Plow with skids to prevent damage to permeable pavement ☐ Snow blower

* Items not required for routine maintenance

Skills and Staffing

The skills required for the maintenance of permeable pavement facilities are listed in the text box to the right.

Skills Needed for Maintenance of Permeable Pavement

- Sweeper and equipment operation
- Commercial driver's license (CDL)
- Landscaping skills (e.g., general plant care) for grass-filled open-celled grid systems
- Engineer and/or landscape architect for major maintenance

The staff effort required for maintenance varies based on the type of facility, sediment loading, and site conditions. Table 10 provides some examples of staffing estimates from Washington jurisdictions, Washington contractors/vendors, a study conducted among Minnesota jurisdictions (Wilson et al. 2008), and the BMP and LID Whole Life Cost Models (WERF 2009). Staff estimates are listed as the number of hours to maintain an individual facility (i.e., a "typical" facility of undefined area) per year or as the area of facility maintained per hour of staff time. Staffing estimates ranged from 1 to 24 hours per facility on an annual basis, with an average of approximately 4 to 6 hours per permeable pavement facility on an annual basis. Cleaning estimates in sf/hr ranged from 1,000 to 87,000 sf/hr depending on the type of maintenance activity.

Table 10. Maintenance Frequency and Staffing for Permeable Pavement.				
Type of Pavement	**Routine Maintenance Activity**	**Frequency** [a]	**Annual Staff Hours**	**Source**
Permeable Pavement (all)	NG	A or B	1 to 4 hours (per facility)	Maintenance of Stormwater BMPs: Frequency, Effort, and Cost (Wilson et al. 2008)
Permeable Pavement (all)	Permeable Pavement Sweeping; Litter and Minor Debris Removal; and Recordkeeping	A	4 to 6 hours (per facility)	BMP and LID Whole Life Cost Models (WERF 2009)
Permeable Pavement (all)	Cleaning	A	4,000 sf/hour	City of Olympia
Permeable Pavement (all)	NG	B	4 hours (per facility)	Kitsap County
Permeable Pavement (all)	NG	3 times/year	24 hours (per facility)	Pierce County
Pervious Concrete	Parking lot (dry)	Q	6,000-9,000 sf/hr	Backstrom Curb & Sidewalk
	Sidewalk (dry)	B	1,000 sf/hr	
GrassPave2	Mowing	Weekly to M	22,000-33,000 sf/hr	Northwest Linings & Geotextile
	Fertilizing and liming		65,000-87,000 sf/hr	
GravelPave2	Gravel raking / re-distribution		11,000-22,000 sf/hr	
	Weed control		65,000-87,000 sf/hr	

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; Q = Quarterly (four times per year); NG = no guidance provided

sf/hr = square feet per hour

Vegetated Roofs

Vegetated roofs (also known as ecoroofs and green roofs) are thin layers of engineered soil and vegetation constructed on top of a conventional roof. Vegetated roofs consist of four basic components: a waterproof membrane, drainage layer, lightweight growth medium, and vegetation. Deeper installations, referred to as "intensive" roofs, are comprised of at least 6 inches of growth media and are planted with groundcovers, grasses, shrubs and sometimes trees. These intensive systems require regular landscape maintenance. Shallower installations, referred to as "extensive" roofs, are comprised of less than 6 inches of growth media and use a planting palette of drought-tolerant, low maintenance groundcovers. The procedures outlined below focus on extensive roof systems, and different procedures for intensive roofs are noted.

Key Maintenance Considerations

The main components of vegetated roof facilities are listed below with descriptions of their function and key maintenance considerations. Components are listed in the order of installation from the roof deck upwards.

- **Waterproof membrane**: Waterproof membranes are installed on the roof deck below the vegetated roof system. Systems also include a protection layer and root barrier to preserve the integrity of the waterproof membrane. These components are not visible, so inspection is typically not possible unless a leak detection system is installed. During maintenance, sharp tools, lawn staples, and stakes should be avoided to prevent damage to membrane.

- **Drainage layer**: All vegetated roofs have a drainage component that routes excess water to the roof drain system. Usually this takes the form of a manufactured drain mat or granular drainage media. A separation layer (e.g., filter fabric) is typically installed above the drainage mat or granular drainage media to prevent fine components of the growth media from being washed into the roof drain system. This component is also not visible, so inspection is difficult. During maintenance, sharp tools, lawn staples, and stakes should be avoided to prevent damage to the drainage layer.

- **Growth media**: Vegetated roofs use a light-weight growth medium with adequate fertility and drainage capacity to support plant growth and allow infiltration and storage of water. In general the media is composed of porous and lightweight mineral aggregates such as pumice, lave rock, expanded shale and expanded slate. The growth media may be covered by a mat (or other erosion control measure) to prevent surface erosion due to rain and wind scour before plants are established.

- **Vegetation**: The plants on vegetated roofs are typically succulents, grass, herbs, and/or wildflowers adapted to the harsh conditions (minimal soils, seasonal drought, high winds, and strong sun exposure) prevalent on rooftops. A wider variety of vegetation types may be used on intensive roofs, but these typically require additional maintenance. Regular maintenance activities associated with vegetation include

weeding and pruning. Plants also require watering during establishment and extended dry periods.

- **Structural drainage elements**: The roof drainage system routes water from the vegetated roof drainage layer to a nearby drainage system. It is important to maintain unobstructed outlet pipes and structures to ensure that stormwater is safely conveyed from the roof to a discharge point. There are also other structural components of a roof that may interface with the vegetated roof (e.g., flashing, roof ventilation points, utilities).
- **Border zone:** This zone forms an area, composed of gravel and devoid of vegetation, around the perimeter of the vegetated roof, typically used as a fire prevention method and to prevent water damage.
- **Gravel stops:** These are sheet metal edges, typically installed outside of the border zone, along the perimeter of the roof to prevent growth medium from blowing or washing off of the roof.

Key Operations to Preserve Facility Function

For vegetated roofs to function properly, stormwater must filter through several layers. Similar to bioretention facilities, filtration can be reduced if the growth media is subject to compaction (e.g., foot traffic). To limit the likelihood of corrective maintenance (e.g., growth media), the planted area of the vegetated roof should be protected from external loads. The risk of compaction is higher when soils are saturated, therefore any type of loading in the planted areas of the vegetated roof (including foot traffic) should be avoided or minimized during wet conditions.

Signage is recommended to identify the planted areas of the vegetated roof as a stormwater BMP and educate maintenance crews and the general public about protecting the facility's function (e.g., no walking on the facility). Clear walkways or pathways should be present to discourage foot traffic on the planted portions of the vegetated roof.

Maintenance Standards and Procedures

Table 11 provides the recommended maintenance frequencies, standards, and procedures for vegetated roof components.

Each vegetated roof installation will have specific O&M guidelines provided by the manufacturer and installer. The following guidelines provide a general set of standards for prolonged vegetated roof performance. Note that some maintenance recommendations are different for extensive versus intensive vegetated roof systems. The procedures outlined below focus on extensive roof systems, and different procedures for intensive roofs are noted.

Table 11. Maintenance Standards and Procedures for Vegetated Roofs.

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Growth medium area				
Growth medium	A [b]		Water does not permeate growth media (runs off soil surface) or crusting is observed	Aerate (e.g., rake) or replace medium taking care not to damage the waterproof membrane
	A		Growth medium thickness is less than design thickness (due to erosion and plant uptake)	Supplement growth medium to design thickness
	B, W		Fallen leaves or debris are present	Remove/dispose
	A, W, S		Growth media erosion/scour is visible (e.g., gullies)	• Take steps to repair or prevent erosion • Fill, hand tamp, or lightly compact, and stabilize with additional soil substrate/growth medium (similar in nature to the original material) and additional plants
Erosion control measures	B [c]		Mat or other erosion control is damaged or depleted during plant establishment period	• Repair/replace erosion control measures until 90% vegetation coverage attained • Avoid application of mulch on extensive vegetated roofs
System Drainage and Structural Components				
Roof drain	B, S		Sediment, vegetation, or debris reducing capacity of inlet structure	• Clear blockage • Identify and correct any problems that led to blockage
	A		Pipe is clogged	Remove roots or debris
	A		Inlet pipe is in poor condition	Repair/replace

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; W = At least once during the wet season (for debris/clog related maintenance, this visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

[b] Inspection should occur during storm event.

[c] Inspection should occur during plant establishment period (typically first 2 years).

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Table 11 (continued). Maintenance Standards and Procedures for Vegetated Roofs.				
Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
System Drainage and Structural Components (cont'd)				
Border zone	A		Vegetation is encroaching into border zone aggregate	Remove and dispose of weeds and transplant desirable vegetation to growth medium area
Flashing, gravel stops, utilities, or other structures on roof	A		Flashing, utilities or other structures on roof are deteriorating (can serve as source of metal pollution in vegetated roof runoff)	Repair (e.g., recoat) or replace to eliminate potential pollutant source. Note that any work done around flashings and drains should be done with care to protect the waterproof membrane.
Access and safety	B		Insufficient egress/ingress routes and fall protection	• Maintain egress and ingress routes to design standards and fire codes • Ensure appropriate fall protection
Vegetation				
Plant coverage	B		Vegetative coverage falls below 90% (unless design specifications stipulate less than 90% coverage)	• Plant bare areas with vegetation • If necessary, install erosion control measures until percent coverage goal is attained
Sedums		A (first 2 years in Spring); As needed (after first 2 years)	Extensive roof with low density sedum population	• Mulch mow sedums- creating cuttings from existing plants to encourage colonization
Dead plants	Fall and Spring		Dead vegetation is present	Normally dead plant material can be recycled on the roof; however, specific plants or aesthetic considerations may warrant removing and replacing dead material (see manufacturer's recommendations).
Trees and shrubs–intensive vegetated roof		All pruning seasons (timing varies by species)	Pruning as needed	All pruning of mature trees should be performed by or under the direct guidance of an ISA certified arborist

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; W = At least once during the wet season (for debris/clog related maintenance, this visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).
[b] Inspection should occur during storm event.
[c] Inspection should occur during plant establishment period (typically first 2 years).
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Table 11 (continued). Maintenance Standards and Procedures for Vegetated Roofs.				
Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Vegetation (cont'd)				
Fertilization– extensive vegetated roof	A		Poor plant establishment and possible nutrient deficiency in growth medium	• Allow organic debris to replenish and maintain long-term nutrient balance and growth medium structure • Conduct annual soil test 2-3 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. Note that extensive vegetated roofs are designed to require zero to minimal fertilization after establishment (excess fertilization can contribute to nutrient export)
Fertilization– intensive vegetated roof	A		Fertilization may be necessary during establishment period or for plant health and survivability after establishment	• Conduct annual soil test 2-3 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

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; W = At least once during the wet season (for debris/clog related maintenance, this visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).
[b] Inspection should occur during storm event.
[c] Inspection should occur during plant establishment period (typically first 2 years).
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Table 11 (continued). Maintenance Standards and Procedures for Vegetated Roofs.				
Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Vegetation (cont'd)				
Weeds		M (March – October, preceding seed dispersal)	Weeds are present	• Remove weeds with their roots manually with pincer-type weeding tools, flame weeders, or hot water weeders as appropriate • Follow IPM protocols for weed management (see "Additional Maintenance Resources" for more information on IPM protocols)
Noxious weeds		M (March – October, proceeding seed dispersal)	Listed noxious vegetation is present (refer to current county noxious weed list)	• By law, class A & B noxious weeds must be removed, bagged and disposed as garbage immediately • Reasonable attempts must be made to remove and dispose of class C noxious weeds • It is strongly encouraged that herbicides and pesticides not be used in order to protect water quality; use of herbicides and pesticides may be prohibited in some jurisdictions
Irrigation System (or Watering)				
Irrigation system (if any)		Based on manufacturer's instructions	Irrigation system present	Follow manufacturer's instructions for operation and maintenance
Summer watering – extensive vegetated roof		Once every 1-2 weeks as needed during prolonged dry periods	Vegetation in establishment period (1-2 years)	Water weekly during periods of no rain to ensure plant establishment (30 to 50 gallons per 100 square feet)
		As needed	Established vegetation (after 2 years)	Water during drought conditions or more often if necessary to maintain plant cover (30 to 50 gallons per 100 square feet)

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; W = At least once during the wet season (for debris/clog related maintenance, this visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).
[b] Inspection should occur during storm event.
[c] Inspection should occur during plant establishment period (typically first 2 years).
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Table 11 (continued). Maintenance Standards and Procedures for Vegetated Roofs.				
Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Irrigation System (or Watering) (cont'd)				
Summer watering – intensive vegetated roof		Once every 1-2 weeks as needed during prolonged dry periods	Vegetation in establishment period (1-2 years)	• Water 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
		As needed	Established vegetation (after 2 years)	Water during drought conditions or more often if necessary to maintain plant cover
Pest Control				
Mosquitoes	B, S		Standing water remains for more than 3 days after the end of a storm	• Identify the cause of the standing water and take appropriate actions to address the problem (e.g., aerate or replace medium, unplug drainage) • Manually remove standing water and direct to storm drainage system • Do not use pesticides or *Bacillus thuringiensis israelensis* (Bti)
Nuisance animals	As needed		Nuisance animals causing erosion, damaging plants, or depositing large volumes of feces	• Reduce site conditions that attract nuisance species • Place predator decoys • Follow IPM protocols for specific nuisance animal issues (see "Additional Maintenance Resources" in Bioretention Facilities section for more information on IPM protocols)

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; W = At least once during the wet season (for debris/clog related maintenance, this visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

[b] Inspection should occur during storm event.

[c] Inspection should occur during plant establishment period (typically first 2 years).

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Additional Maintenance Resources

Useful related guidance documents include the following:

- Vegetation resources listed for bioretention
- LID Technical Guidance Manual for Puget Sound: http://www.wastormwatercenter.org/files/library/lid-manual-2012-final-secure.pdf
- Green Roof ANSI standards developed in conjunction with Green Roofs for Healthy Cities (GRHC). GRHC is a group working to increase awareness of the economic, social, and environmental benefits of vegetated roofs through education and outreach. GRHC standards used for fire and wind uplift design of vegetated roofs are the ANSI RP-14 and VF-1 standards. These standards cover several key design components of vegetated roofs that, once installed, require upkeep to maintain the functionality of these features.
- Integrated Pest Management (IPM) protocols (the term "pest" covers a broad range of species including harmful insects, plant pathogens, rodents, and weedy vegetation) provide an approach to pest control that uses regular monitoring to determine if and when treatments are needed, and employs physical, mechanical, cultural, and biological tactics to keep pest numbers low enough to prevent intolerable damage or annoyance (Ecology 2012c) while avoiding or minimizing the use of pesticides and fertilizers herbicides as a management strategy.
- See EPA's website for general information on IPM: www.epa.gov/pesticides/factsheets/ipm.htm.
- See the City of Seattle's website for IPM Fact Sheets and Washington specific resources: www.seattle.gov/util/forbusinesses/landscapes/integrated_pest_management
- The International Society of Arboriculture (ISA) is a group that promotes the professional practice of arboriculture and fosters a greater worldwide awareness of the benefits of trees through research, technology, and education. ISA standards used for managing trees, shrubs, and other woody plants are the American National Standards Institute (ANSI) A300 standards. The ANSI A300 standards are voluntary industry consensus standards developed by the Tree Care Industry Association (TCIA) and written by the Accredited Standards Committee (ASC). The ANSI standards can be found on the ISA website: www.isa-arbor.com/education/publications/index.aspx.

These resources are supplemental and do not supersede guidance provided in the S*tandards and Procedures* tables.

Equipment and Materials

Table 12 includes recommendations for equipment and materials commonly used to maintain vegetated roofs. Some of the equipment and materials will be used for routine maintenance activities, while other equipment and materials will be necessary for specialized maintenance.

Table 12. Vegetated Roof Equipment and Materials List.

General gardening and landscaping equipment	*Gardening and landscaping materials*
☐ Gloves	☐ Plants/seeds
☐ Weeding tool	☐ Growing media
☐ Soil knife	☐ Fertilizer (encapsulated, slow release)
☐ Hand tamper	*Erosion control material**
☐ Hoe	☐ Mulch (intensive roofs)
☐ Rake	☐ Erosion control matting
☐ Push broom	*Equipment and materials for subsurface or drip irrigation system repairs*
☐ Buckets	☐ Soaker hose
☐ Garbage bags (for disposal of noxious weeds)	☐ Hose/shower-type wand
Additional equipment for intensive roofs:	☐ Sprinklers
☐ Pruners	☐ Tree watering bags
☐ Loppers	☐ Buckets
☐ Manual edger	☐ Water source, if necessary
☐ Line trimmer (also known as a string trimmer, weed eater, or weed whacker)	*Safety equipment*
☐ Wheelbarrow	☐ Fall protection as applicable
☐ Shovel	
☐ Stakes and guys	

* Items not required for routine maintenance

Skills and Staffing

The skills required for the maintenance of vegetated roofs are listed in the text box to the right. Additional specialized skills may also be required for corrective maintenance of intensive vegetated roofs such as: horticulturalists and arborists.

Skills Needed for Maintenance of Vegetated Roofs

- Landscaping skills (e.g., general plant care)
- Plant identification skills (weeds vs. planted species, invasive vs. common weeds, how to dispose of invasive weeds, timing of weed seed dispersal)
- General drainage system maintenance skills (e.g., subsurface or drip irrigation system repair)
- Roof work safety training
- Engineer and/or landscape architect for major maintenance
- Certified arborist (or equivalently trained staff) for pruning of mature trees (intensive vegetated roofs)

The maintenance associated with vegetated roofs may sometimes pose safety hazards and require controls (e.g., fall protection) currently covered under the Washington State Department of Labor & Industries.

Table 13 provides some examples of staffing estimates from the City of Olympia and the BMP and LID Whole Life Cost Models (WERF 2009). The WERF (2009) study provides annual staffing estimates for a "typical" facility of undefined area, while the City of Olympia provided a staffing estimate as the area of vegetated roof that can be maintained per hour of staff time. Staffing estimates presented below range from 53 to 90 hours per facility from the WERF (2009) study (summing all of the routine maintenance activities) or 2,000 sf/hr for the City of Olympia.

Table 13. Maintenance Frequency and Staffing for Vegetated Roofs.

Routine Maintenance Activity	Frequency [a]	Annual Staff Hours	Source
Vegetation management	Every 2 months	30 to 60 hours (per facility)	BMP and LID Whole Life Cost Models (WERF 2009)
Irrigation repair	A	5 to 10 hours (per facility)	
Corrective maintenance [b]	A	8 hours (per facility)	
Soil replacement	A	8 hours (per facility)	
Recordkeeping	A	2 to 4 hours (per facility)	
General (no activity specified)	M	2,000 sf/hr	City of Olympia

[a] Frequency: A = Annually; M = Monthly

[b] Membrane patching, re-vegetation, component failure

sf/hr = square feet per hour

Downspout Full Infiltration Systems

Downspout full infiltration systems include infiltration trenches or drywells intended only for use in infiltrating runoff from roof downspout drains. Infiltration trenches and drywells are backfilled withwashed 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. These systems are considered On-site Stormwater Management BMPs and can be used to help meet Minimum Requirements #5 (On-site Stormwater Management BMPs), #7 (flow control), or both.

Key Maintenance Considerations

The main components of downspout full infiltration systems are listed below with descriptions of their function and key maintenance considerations.

- **Rock trench/well**: Trenches and drywells are excavated depressions filled with uniformly graded washed drain rock. Non-woven geotextile fabric may be used along the walls, bottom, and top of the drain rock. The surface of the trench can be covered with grating, pavement, and/or consist of stone, gabion, sand, or a grassed covered area with a surface inlet. To allow inspection of the drain rock trench/well, some facilities have an observation port (typically installed during construction) that allows monitoring of the water levels in the drain rock bed to determine if the facility is dewatering properly.

- **Inlet:** Stormwater runoff is typically routed to a trench/well with a solid-wall pipe and then distributed into the drain rock bed using a perforated or slotted subsurface pipe. Some trenches are designed to receive sheet flow that enters the facility by infiltrating through a top course of drain rock or sand. Maintenance must be performed to ensure inlets (e.g., pipes) are unobstructed and that surface sheet flow first passes through a grass buffer strip to remove larger sediment particles.

- **Storage sump:** Trenches and drywells designed to receive concentrated flows (e.g., piped flow) typically include a storage sump to settle particulates from inflow. Concentrated flows must be distributed into the aggregate using a perforated or slotted subsurface pipe. The sump must be maintained to remove accumulated sediment.

Key Operations to Preserve Facility Function

When the rock trench/well is designed to receive inflow from the surface via a grate or by infiltrating through an exposed top course of drain rock or sand, the following operational actions can limit the need for corrective maintenance actions or replacement:

- Protecting the surface inlet from stockpiles of landscaping materials (e.g., mulch, soil, compost)

- Prevent discharge of debris to the infiltration trench from roof cleaning practices (e.g., moss removal)

- Stabilize adjacent landscaped areas to avoid runoff mobilizing soil into the surface inlet

Maintenance Standards and Procedures

Table 14 provides the recommended maintenance frequencies, standards, and procedures for downspout full infiltration system components. The level of routine maintenance required and the frequency of corrective maintenance actions may increase for facilities subject to high sediment loads from the contributing drainage area.

Table 14. Maintenance Standards and Procedures for Downspout Full Infiltration Systems.				
Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Rock Trench/Well				
Surface of trench/well (i.e., water enters through exposed aggregate)	Fall and Spring		Accumulated trash, debris, or sediment on drain rock surface impedes sheet flow into facility	Remove/dispose in accordance with local solid waste requirements
	A, W		Vegetation/moss present on drain rock surface impedes sheet flow into facility	Maintain open, freely draining drain rock surface
Drain rock	Fall and Spring		• 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/sand reservoirs as necessary • Tilling of subgrade below reservoir may be necessary (for trenches) prior to backfill
Inlet/ Outlet Pipe Conveyance				
Pipe(s)	A, W		Accumulation of trash, debris, or sediment in roof drains, gutters, driveway drains, area drains, etc.	Remove/ dispose
	A, W		Pipe from sump to trench or drywell has accumulated sediment or is plugged	Clear sediment from inlet/outlet pipe screen and inlet/outlet pipe
	A, W		Cracked, collapsed, broken, or misaligned drain pipes	• Repair/seal cracks • Replace when repair is insufficient
Roof downspout	B, W		Splash pad missing or damaged	Repair/ replace
	A, W		Leaves or other debris plugging downspout	Remove/ dispose

[a] Frequency: A= Annually; B= Biannually (twice per year); W= At least one visit should occur during the wet season (for debris/clog related maintenance, this inspection/maintenance visit should occur in the early fall, after deciduous trees have lost their leaves).

Table 14 (continued). Maintenance Standards and Procedures for Downspout Full Infiltration Systems.				
Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Storage Sump				
Sump	A		Sediment in the sump	Remove/ dispose in accordance with local solid waste requirements
Access lid	A		Cannot be easily opened	Repair/ replace
	A		Buried	Refer to record drawings for design intent. If the access lid was designed to be exposed, expose and restore to surface grade
	A		Cover missing	Replace

[a] Frequency: A= Annually; B= Biannually (twice per year); W= At least one visit should occur during the wet season (for debris/clog related maintenance, this inspection/maintenance visit should occur in the early fall, after deciduous trees have lost their leaves).

Equipment and Materials

Table 15 includes recommendations for equipment and materials commonly used to maintain downspout full infiltration systems.

Table 15. Downspout Full Infiltration System Equipment and Materials List.

Pipe/ structure system inspection and maintenance equipment	*Weed / vegetation removal equipment, such as:*
☐ Hand tools ☐ Flashlight ☐ Mirror (for viewing pipes without entering structure) ☐ Garden hose ☐ Plumbing snake	☐ Weeding tools ☐ Weed burner ☐ Buckets
	Equipment to clear accumulated sediment from sump
	☐ Shop-Vac ☐ Shovel

Skills

The skills required for the maintenance of downspout full infiltration systems are listed in the text box to the right.

Skills Needed for Maintenance of Downspout Full Infiltration Systems

- General drainage system maintenance skills (e.g., inlet/pipe cleaning experience, inlet/pipe maintenance or repair experience)
- Landscape or drainage contractor for major maintenance

Downspout, Sheet Flow, and Concentrated Dispersion Systems

Dispersion attenuates peak flows by slowing the runoff entering into the conveyance system, allowing some infiltration, and providing some water quality benefits. The following three types of dispersion systems are covered in this section:

- **Downspout dispersion systems**: Splash blocks or gravel-filled trenches, which serve to spread roof runoff over vegetated pervious areas.
- **Sheet flow dispersion systems**: Sheet flow dispersion is the simplest method of runoff control. This BMP can be used for any impervious or pervious surface that is graded to avoid concentrating flows. Because flows are already dispersed as they leave the surface, they need only traverse a narrow band of adjacent vegetation for effective attenuation and treatment.
- **Concentrated dispersion systems**: Dispersion of concentrated flows from driveways or other pavement through a vegetated pervious area.

Key Maintenance Considerations

The main components of dispersion systems are listed below with descriptions of their function and key maintenance considerations.

- **Splash block (downspout dispersion):** Splash blocks are used to spread stormwater runoff from a downspout drain over vegetated pervious area. A downspout extension may be included if the ground is fairly level, if the structure includes a basement, or if foundation drains are proposed.
- **Dispersion trench (downspout dispersion):** Gravel-filled trenches are also used to spread stormwater runoff from a downspout drain over a vegetated pervious area. Downspout drains are routed to a trench via a perforated or slotted pipe. The trench typically includes a notched grade board or other device to distribute flow equally along the length of the trench. This board must be maintained at a level grade to prevent concentrated flow. Downspout drains are directed to the trench via a storage sump that must be maintained to remove accumulated sediment.
- **Transition zone (sheet flow dispersion):** A 2-foot-wide transition zone is typically included to discourage channeling between the edge of the impervious surface (or building eaves) and the downslope vegetation. This transition zone may consist of an extension of subgrade material (crushed rock), modular pavement, drain rock, or other material.
- **Rock pad at discharge point (concentrated flow dispersion):** A rock pad must be maintained at any point that a concentrated flow enters a dispersion area.
- **Dispersal area:** Stormwater is dispersed to an area vegetated with well-established lawn or pasture, landscaping with well-established groundcover, or native vegetation with natural groundcover. The required vegetated flow path is 50 feet for splash

blocks and concentrated dispersion, 25 feet when using a dispersion trench and varies for sheet flow dispersion. The groundcover for the extent of the flow must be maintained to be dense enough to help disperse and infiltrate flows and to prevent erosion.

Key Operations to Preserve Facility Function

For dispersion practices to be effective, the dispersion area must remain covered with dense, well-established vegetation. Site uses should protect vegetation and avoid compaction.

Maintenance Standards and Procedures

Table 16 provides the recommended maintenance frequencies, standards, and procedures for dispersion system components.

Table 16. Maintenance Standards and Procedures for Downspout, Sheet Flow, and Concentrated Dispersion Systems.

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Splash Block (Downspout Dispersion)				
Splash block	B		Water is being directed towards building structure	Reconfigure/ repair blocks to direct water away from building structure
	B		Water disrupts soil media	Reconfigure/ repair blocks
Transition Zone (Sheet Flow Dispersion)				
Transition zone	A		Adjacent soil erosion; uneven surface creating concentrated flow discharge; or less than 2 foot of width	Repair/replace transition zone to meet design criteria and eliminate concentrated flows
Dispersion Trench (Downspout Dispersion)				
Dispersion trench	A		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)	• Remove debris from trench surface, if necessary • Realign notched grade board or other distributor type, if possible • Rebuild trench to standards, if necessary
Surface of trench	Fall and Spring		Accumulated trash, debris, or sediment on drain rock surface impedes sheet flow from facility	• Remove/dispose in accordance with local solid waste requirements
	A, W		Vegetation/moss present on drain rock surface impedes sheet flow from facility	• Maintain open, freely draining drain rock surface
Pipe(s) to trench	A, W		Accumulation of trash, debris, or sediment in roof drains, gutters, driveway drains, area drains, etc.	• Remove/ dispose
	A, W		Pipe from sump to trench or drywell has accumulated sediment or is plugged	• Clear sediment from inlet/outlet pipe screen and inlet/outlet pipe
	A, W		Cracked, collapsed, broken, or misaligned drain pipes	• Repair/seal cracks • Replace when repair is insufficient
Sump	A		Sediment in the sump	• Remove/ dispose in accordance with local solid waste requirements • Clear sediment from inlet/outlet pipe screen and/or inlet/outlet pipe
Access lid	A		Cannot be easily opened	• Repair/ replace
	A		Buried	• Refer to record drawings for design intent. If the access lid was designed to be exposed, expose and restore to surface grade
	A		Cover missing	• Replace
Rock Pad (Concentrated Flow Dispersion)				
Rock pad	A		Only one layer of rock exists above native soil in area 6 square feet or larger, or any exposure of native soil	• Replace/ repair rock pad to meet design standards • Enlarge pad size or add additional courses of rock, if necessary
	A		Soil erosion in or adjacent to rock pad	Repair/replace rock pad to meet design standards
Dispersal Area				
Dispersal area (general)	B, S		Erosion (gullies/ rills) greater than 2 inches deep in dispersal area	Eliminate cause of erosion and stabilize damaged area (regrade, rock, revegetate)
	B, S		Accumulated sediment or debris to extent that blocks or channelizes flow path	• Remove excess sediment or debris • Identify and control the sediment source (if feasible)
Ponded water	B, S		Standing surface water in dispersion area remains for more than 3 days after the end of a storm event	• Identify the cause of the standing water (e.g., grade depressions, compacted soil) and take appropriate actions to address the problem (e.g., regrade to eliminate depressions or aerate/ amend soils)

[a] Frequency: A= Annually; B= Biannually (twice per year); W = At least once during the wet season (for debris/clog related maintenance, this visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

[b] Inspection should occur during plant establishment period (1-2 years, or additional 3rd year during extreme dry weather). IPM – Integrated Pest Management

Table 16 (continued). Maintenance Standards and Procedures for Downspout, Sheet Flow, and Concentrated Dispersion Systems.

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Dispersal Area (cont'd)				
Plant establishment	B	Once every 1-2 weeks or as needed during prolonged dry periods [b]	Dispersal area vegetation in establishment period (1-2 years, or additional 3rd year during extreme dry weather)	Water weekly during periods of no rain to ensure plant establishment
Vegetation	As needed		Poor vegetation cover such that erosion is occurring	• Ensure proper care (e.g., watering) • Assess for nutrient deficiencies • Replant as needed with appropriate plant species for the soil and moisture conditions • Consider amending soils to promote plant health
	B, S		Vegetation inhibits dispersed flow along flow path	Trim, weed or replant to restore dispersed flow path
Storage Sump				
Sump	A		Accumulated sediment in the sump	• Remove/ dispose in accordance with local solid waste requirements • Clear sediment from inlet/outlet pipe screen and/or inlet/outlet pipe
Access lid	A		Cannot be easily opened	Repair/ replace
	A		Buried	Expose and restore to surface grade
	A		Cover missing	Replace
Pest Control				
General Pests	As needed		Signs of pest infestations (IPM protocol threshold(s) are exceeded)	• Follow IPM protocols for weed and pest management (see "Additional Maintenance Resources" in Bioretention Facilities section for more information on IPM protocols)
Mosquitoes	B, S		Standing surface water in dispersion area remains for more than 3 days after the end of a storm	• Identify the cause of the standing water and take appropriate actions to address the problem (see "Ponded water") • Do not use pesticides or *Bacillus thuringiensis israelensis* (Bti)
Rodents	As needed		Rodent holes or mounds disturb dispersion flow paths	Fill and compact soil around the holes and vegetate to restore flow path

[a] Frequency: A= Annually; B= Biannually (twice per year); W = At least once during the wet season (for debris/clog related maintenance, this visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

[b] Inspection should occur during plant establishment period (1-2 years, or additional 3rd year during extreme dry weather).

Equipment and Materials

Table 17 includes recommendations for equipment and materials commonly used to maintain downspout, sheet flow, and concentrated dispersion systems.

Table 17. Downspout, Sheet Flow, and Concentrated Dispersion Systems Equipment and Materials List.

Pipe/ structure system inspection and maintenance equipment	*General landscaping equipment and materials to maintain dispersal area*
☐ Hand tools	☐ Mower
☐ Flashlight	☐ Gloves
☐ Mirror (for viewing pipe s without entering structure)	☐ Weeding tool
☐ Garden hose	☐ Soil knife
☐ Plumbing snake	☐ Manual edger
☐ Level	☐ Line trimmer (also known as a string trimmer, weed eater, or weed whacker)
Equipment to clear accumulated sediment from sump	☐ Hoe
☐ Shop-Vac	☐ Rake
☐ Shovel	☐ Shovel
Material to replenish rock pad for concentrated dispersion	☐ Push broom
☐ Aggregate	☐ Compost
	☐ Seeds
	☐ Plants
	☐ Watering equipment

* Items not required for routine maintenance

Skills

The skills required for the maintenance of downspout, sheet flow, and concentrated dispersion systems are listed in the text box to the right. Additional specialized skills may also be required for corrective maintenance such as: horticulturalists, arborists, erosion control specialists, and soil scientists.

Skills Needed for Maintenance of Dispersion Systems

- General drainage system maintenance skills (e.g., inlet/pipe cleaning experience, inlet/pipe maintenance or repair experience)
- Landscaping skills (e.g., general plant care)
- Landscape or drainage contractor for major maintenance

Compost-amended Soils

Naturally occurring (undisturbed) soil and vegetation provide important stormwater functions including: water infiltration; nutrient, sediment, and pollutant adsorption; sediment and pollutant biofiltration; water interflow storage and transmission; and pollutant decomposition. Compaction from construction can reduce the soils natural ability to provide these functions. Establishing a minimum soil quality and depth in the post-development landscape can regain some of these stormwater functions including increased treatment of pollutants and sediments that result from development and habitation, and minimizes the need for some landscaping chemicals. Sufficient organic content is a key to soil quality. Soil organic matter can be attained through numerous amendments such as compost, composted woody material, biosolids, and forest product residuals.

Key Maintenance Considerations

Key maintenance considerations for compost-amended soils include the replenishment of soil media as needed (as a result of erosion) and addressing compacted, poorly draining soils. Site uses should protect vegetation and avoid compaction.

Key Operations to Preserve Facility Function

The full benefits of compost-amended soils are realized when desired soil media depths are maintained and soil compaction is minimized. Care should be taken to prevent compaction of soils via vehicular loads and/or excessive foot traffic, especially during wet conditions.

Maintenance Standards and Procedures

Table 18 provides the recommended maintenance frequencies, standards, and procedures for compost-amended soils. The level of routine maintenance required and the frequency of corrective maintenance actions may increase for facilities prone to erosion due to site conditions such as steep slopes or topography tending to concentrate flows.

Table 18. Maintenance Standards and Procedures for Compost-amended Soils.				
Component	Recommended Frequency[a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
General				
Soil media (maintain high organic soil content)	A		Vegetation not fully covering ground surface or vegetation health is poor	• Maintain 2 to 3 inches of mulch over bare areas in landscape beds • Add plants if sufficient space • Re-seed bare turf areas until the vegetation fully covers ground surface
		Ongoing	None (routine maintenance)	Return leaf fall and shredded woody materials from the landscape to the site when possible in order to replenish soil nutrients and structure
		Ongoing	None (routine maintenance)	On turf areas, "grasscycle" (mulch-mow or leave the clippings) to build turf health
		Ongoing	None (routine maintenance)	Avoiding use of pesticides (bug and weed killers), like "weed & feed", which damage the soil
		A	None (routine maintenance)	• Where fertilization is needed (mainly turf and annual flower beds), a moderate fertilization program should be used which relies on compost, natural fertilizers or slow-release synthetic balanced fertilizers • Follow IPM protocols for fertilization procedures (see "Additional Maintenance Resources" in Bioretention Facilities section for more information on IPM protocols)
Soil media (maintain infiltration)	A[b]		Soils become waterlogged, do not appear to be infiltrating	• To remediate compaction, aerate soil, till to at least 8-inch depth, or further amend soil with compost and re-till • If areas are turf, aerate compacted areas and topdress them with 1/4 to 1/2 inch of compost to renovate them • If drainage is still slow, consider investigating alternative causes (e.g., high wet season groundwater levels, low permeability soils) • Also consider site use and protection from compacting activities

[a] Frequency: A= Annually; B= Biannually (twice per year); M = monthly; S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval); W = At least one inspection/maintenance visit should occur during the wet season (for debris/clog related maintenance, this maintenance visit should occur in the early fall, after deciduous trees have lost their leaves).

[b] Inspection should occur during storm event.

IPM – Integrated Pest Management

Table 18 (continued). Maintenance Standards and Procedures for Compost-amended Soils.				
Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
General (cont'd)				
Erosion/ Scouring	A, W, S		Areas of potential erosion are visible	• Identify and address cause of erosion (e.g., concentrate flow entering area, channelization of runoff) and stabilize damaged area (regrade, rock, vegetation, erosion control matting) • For deep channels or cuts (over 3 inches in ponding depth), temporary erosion control measures should be put in place until permanent repairs can be made.
Grass/ Vegetation		A	Less than 75% of planted vegetation is healthy with a generally good appearance.	• Take appropriate maintenance actions (e.g., remove/ replace plants) • If problem persists, evaluate if vegetation is appropriate for the location (e.g., exposure, soil, soil moisture)
Noxious weeds		M (March – October, preceding seed dispersal)	Listed noxious vegetation is present (refer to current county noxious weed list)	• By law, class A & B noxious weeds must be removed, bagged and disposed as garbage immediately • Reasonable attempts must be made to remove and dispose of class C noxious weeds • Watch for and respond to new occurrences of especially aggressive weeds such as Himalayan blackberry, Japanese knotweed, morning glory, English ivy, and reed canary grass to avoid invasions • It is strongly encouraged that herbicides and pesticides not be used in order to protect water quality; use of herbicides and pesticides may be prohibited in some jurisdictions

[a] Frequency: A= Annually; B= Biannually (twice per year); M = monthly; S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).; W = At least one inspection/maintenance visit should occur during the wet season (for debris/clog related maintenance, this maintenance visit should occur in the early fall, after deciduous trees have lost their leaves).

[b] Inspection should occur during storm event.

IPM – Integrated Pest Management

Table 18 (continued). Maintenance Standards and Procedures for Compost-amended Soils.				
Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
General (cont'd)				
Weeds		M (March – October, preceding seed dispersal)	Weeds are present	• Remove weeds with their roots manually with pincer-type weeding tools, flame weeders, or hot water weeders as appropriate • Follow IPM protocols for weed management(see "Additional Maintenance Resources" in Bioretention Facilities section for more information on IPM protocols)

[a] Frequency: A= Annually; B= Biannually (twice per year); M = monthly; S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).; W = At least one inspection/maintenance visit should occur during the wet season (for debris/clog related maintenance, this maintenance visit should occur in the early fall, after deciduous trees have lost their leaves).

[b] Inspection should occur during storm event.

IPM – Integrated Pest Management

Equipment and Materials

Table 19 includes recommendations for equipment and materials commonly used to maintain compost-amended soils. Some of the equipment and materials will be used for routine maintenance activities, while other equipment and materials will be necessary for specialized maintenance.

Table 19. Compost Amended Soils Equipment and Materials List.

General landscaping equipment
☐ **Gloves**
☐ **Pincer-type weeding tool**
☐ **Soil knife**
☐ **Pruners**
☐ **Loppers**
☐ **Hoe**
☐ **Rake**
☐ **Wheelbarrow**
☐ **Shovel**
☐ **Push broom**
☐ **Garbage bags (for disposal of noxious weeds)**
General landscaping materials
☐ **Arborist wood chip mulch (around trees and woody plants)**
☐ **Compost or leaf mulch (around annuals)**
☐ **Fertilizer (natural fertilizers or slow-release synthetic balanced fertilizers)**
Specialized equipment*
☐ **Deep tine aerator and compost (or compost/sand mixture) to fill aeration holes (if necessary to correct overly compacted soil)**
☐ **Flame weeder or hot water weeder**
☐ **Rototiller**
☐ **Soil probe**

* Items not required for routine maintenance

Skills

The skills required for the maintenance of compost-amended soils are listed in the text box to the right. Additional specialized skills may also be required for corrective maintenance of compost-amended soils such as: horticulturalists, arborists, erosion control specialists, and soil scientists.

Skills Needed for Maintenance of Compost-amended Soils

- Landscaping skills (e.g., general plant care)
- Landscaper for major maintenance

PROGRAMMATIC AND ADMINISTRATIVE GUIDANCE

To implement the new Phase I Permit and Phase II Permit requirements for LID BMP maintenance, local governments may face a variety of programmatic and administrative challenges. This section summarizes Ecology's requirements that relate to LID BMP maintenance and provides guidance regarding administrative tools for implementing these requirements.

This section is not intended to identify specific administrative actions for meeting LID BMP maintenance requirements (e.g., specify how jurisdictions administer bonds) but rather to support jurisdictions by providing optional and flexible guidance for administrative procedures and tools related to LID BMP maintenance programs.

Ecology Requirements for LID BMP Maintenance Programs

Phase I and Phase II municipal stormwater Permittees are required to:

- Adopt an ordinance or other enforceable mechanism requiring maintenance of all permanent Stormwater Treatment and Flow Control BMPs/Facilities
- Adopt maintenance standards that are at least as protective of facility function as those in Chapter 4 of Volume V of the 2012 Stormwater Management Manual for Western Washington (2012 SWMMWW)
- Establish legal authority to inspect private stormwater facilities and enforce maintenance standards
- Implement permitting, plan review, inspections, and enforcement programs to meet the Permit standards for both private and public projects

To implement these requirements, Permittees may need to revise their programs and procedures to support plan review, inspection, enforcement, record keeping, and mapping for LID BMPs. Tables 20 and 21 summarize and reference municipal Permit requirements and 2012 SWMMWW guidance in regard to O&M of LID BMPs. Please refer to the Permits and 2012 SWMMWW for more complete and accurate descriptions.

Table 20. Phase I Permit[4] Requirements and 2012 SWMMWW Guidance Related to LID BMP Maintenance Programs.		
	LID BMP Type	
Requirement	On-site Stormwater Management BMPs	Stormwater Treatment and Flow Control BMPs/Facilities (MR #6 and/or MR #7)
Standards		
Implement maintenance standards	S5.C.9.a	S5.C.9.a
Update ordinance or other enforceable documents	N/A	S5.C.9.b.i
Implement practices, policies, & procedures to reduce stormwater impacts associated with runoff	N/A	S5.C.9.e
Plan Review		
Verify that a maintenance plan is completed and responsibility for maintenance is assigned for each Stormwater Treatment and Flow Control BMP	N/A	S5.C.5.a.v.4
Verify submission of maintenance instructions for each On-site Stormwater Management BMP	Vol. I, Section 3.1.5	Vol. 1, Section 3.1.5
Verify that an O&M manual is complete for each Stormwater Treatment and Flow Control BMP	N/A	Appendix 1 (Section 4.9) and Vol. 1, Section 3.1.7
Review and approve declaration of covenant (including design details, figures, and maintenance instructions for each On-site Stormwater Management BMP) and grant of easement	Vol. 1, Section 3.1.7	Vol. 1, Section 3.1.7
Inspections		
Legal authority to inspect private stormwater facilities and enforce maintenance standards for all new and redevelopment	S5.C.5.a.iv	S5.C.5.a.iv
Conduct post-construction inspections to ensure proper installation	S5.C.5.a.v.4	S5.C.5.a.v.4
Conduct inspections during construction for all permanent Stormwater Treatment and Flow Control BMPs/Facilities and catch basins in new residential developments (every 6 months until 90% of the lots are constructed or when construction is stopped and the site is fully stabilized)	N/A	S5.C.9.b.iii
Conduct ongoing annual inspections	N/A	S5.C.9.b.ii and c.i
Perform spot checks of potentially damaged BMPs owned or operated by the Permittee after major storm events	N/A	S5.C.9.c.ii

BMPs = best management practices
N/A = not applicable
Note: Phase I Permit references are from Ecology (2012a) and 2012 SWMMWW references are from Ecology (2012c).

[4] The special conditions listed in this document are for city and county permittees. Secondary permittees should refer Section S6 of the permit for their special conditions that pertain to LID BMP maintenance.

Table 20 (continued). Phase I Permit Requirements and 2012 SWMMWW Guidance Related to LID BMP Maintenance Programs.		
	LID BMP Type	
Requirement	On-site Stormwater Management BMPs	Stormwater Treatment and Flow Control BMPs/Facilities (MR #6 and/or MR #7)
Enforcement		
Enforce compliance with maintenance standards as needed based on inspections	N/A	S5.C.9.b.ii
Training		
Train staff involved in plan review, permitting, construction site inspections, and enforcement.	S5.C.5.a.vii	S5.C.5.a.vii
Implement an ongoing training program for employees who have primary O&M job functions that may impact stormwater quality	S5.C.9.f	S5.C.9.f
Record Keeping		
Keep records of inspections and enforcement actions (e.g., inspection reports, notices of violations)	S5.C.5.a.v.6 and S5.C.9.h	S5.C.5.a.v.6 and S5.C.9.h
Mapping		
Scale drawing of the lot(s), and any public-right-of-way that displays the location of On-site Stormwater Management BMPs	Vol. I, Section 3.1.5	Vol. I, Section 3.1.5
Map Stormwater Treatment and Flow Control BMPs/Facilities owned or operated by the Permittee	N/A	S5.C.2.a.iii
Map connections between Stormwater Treatment and Flow Control BMPs/Facilities and tributary conveyances mapped in accordance with S5.C.2	N/A	S5.C.2.b.iv

BMPs = best management practices
N/A = not applicable
Note: Phase I Permit references are from Ecology (2012a) and 2012 SWMMWW references are from Ecology (2012c).

Table 21. Phase II[5] WWA Permit Requirements and 2012 SWMMWW Guidance Related to LID BMP Maintenance Programs.		
	LID BMP Type	
Requirement	On-site Stormwater Management BMPs	Stormwater Treatment and Flow Control BMPs/Facilities (MR #6 and/or MR #7)
Standards		
Implement maintenance standards	S5.C.5.a	S5.C.4.c.ii and S5.C.5.a
Adopt and make effective ordinance or other enforceable mechanisms	N/A	S5.C.4.a
Implement practices, policies, & procedures to reduce stormwater impacts associated with runoff	N/A	S5.C.5.f
Plan Review		
Verify that maintenance plan is completed and responsibility for maintenance is assigned for each Stormwater Treatment and Flow Control BMP.	N/A	S5.C.4.b.iv
Verify submission of maintenance instructions for each On-site Stormwater Management BMP	Vol. I, Section 3.1.5	Vol. 1, Section 3.1.5
Verify that an O&M manual is complete for each Stormwater Treatment and Flow Control BMP	N/A	Appendix 1 (Section 4.9) and Vol. 1, Section 3.1.7
Review and approve declaration of covenant (including design details, figures and maintenance instructions for each BMP) and grant of easement	Vol. 1, Section 3.1.7	Vol. 1, Section 3.1.7
Inspections		
Legal authority to inspect private stormwater facilities and enforce maintenance standards for all new and redevelopment	S5.C.4.a.iii	S5.C.4.a.iii
Conduct post-construction inspections to ensure proper installation	S5.C.4.a.iv	S5.C.4.a.iv
Conduct inspections during construction for all permanent Stormwater Treatment and Flow Control BMPs/Facilities in new residential developments (every 6 months until 90% of the lots are constructed or when construction is stopped and the site is fully stabilized)	N/A	S5.C.4.c.iv
Conduct ongoing annual inspections	N/A	S5.C.4.c.iii and S5.C.5.b
Perform spot checks of potentially damaged BMPs owned or operated by the Permittee after major storm events	N/A	S5.C.5.c

BMPs = best management practices
N/A = not applicable
Note: Phase II Permit references are from Ecology (2012b) and 2012 SWMMWW references are from Ecology (2012c).

[5] The special conditions listed in this document are for city and county permittees. Secondary permittees should refer Section S6 of the permit for their special conditions that pertain to LID BMP maintenance.

Table 21 (continued). Phase II WWA Permit Requirements and 2012 SWMMWW Guidance Related to LID BMP Maintenance Programs.		
	LID BMP Type	
Requirement	On-site Stormwater Management BMPs	Stormwater Treatment and Flow Control BMPs/Facilities (MR #6 and/or MR #7)
Enforcement		
Enforce compliance with maintenance standards as needed based on inspections	N/A	S5.C.4.b.iii and iv
Training		
Train staff involved in plan review, permitting, construction site inspections, and enforcement.	S5.C.4.e	S5.C.4.e
Implement an ongoing training program for employees who have primary O&M job functions that may impact stormwater quality	S5.C.5.g	S5.C.5.g
Record Keeping		
Keep records of inspections and enforcement actions (e.g., inspection reports, notices of violations)	S5.C.4.c.vii and S5.C.5.i	S5.C.4.c.vii and S5.C.5.i
Mapping		
Scale drawing of the lot(s), and any public-right-of-way that displays the location of On-site Stormwater Management BMPs	Vol. I, Section 3.1.5	Vol. I, Section 3.1.5
Map Stormwater Treatment and Flow Control BMPs/Facilities owned or operated by the Permittee	N/A	S5.C.3.a.iii

BMPs = best management practices

N/A = not applicable

Note: Phase II Permit references are from Ecology (2012b) and 2012 SWMMWW references are from Ecology (2012c).

Tools for Implementing an LID Maintenance Program

This section discusses a range of administrative tools available to assist jurisdictions in implementing the LID BMP maintenance requirements outlined above. The following key tools are discussed in detail below.

- Stormwater code/manual
- Legal agreements (such as declarations of covenant and access easements between a property owner and the City/County)
- Project-specific BMP maintenance requirements
- Financial surety measures
- Record keeping and tracking process
- Inspection programs
- Mapping
- Private property owner education

Table 22 summarizes the utility of these tools for typical elements of a maintenance program (e.g., plan review, inspection program). A local government can select and tailor the tools described in this section to meet Permit requirements in a manner that fits within their existing program.

Table 22. Administrative Tools to Implement O&M Programs.	
Maintenance Program Element	**Administrative Tool**
Maintenance Requirements	
Require maintenance of all permanent Stormwater Treatment and Flow Control BMPs/Facilities	• Stormwater code/manual
Set forth minimum inspection and O&M requirements	• Stormwater code/manual
Plan Review	
Define permitting and plan review process to meet NPDES Permit requirements for both private and public projects	• Stormwater code/manual • Permitting and plan review processes are typically streamlined or modified for public projects
List required development project submittal elements	• Stormwater code/manual
Identify and characterizes stormwater features on site	• Stormwater Site Plan including scale drawing of the lot(s), and any public-right-of-way that displays the location of On-site Stormwater Management BMPs • Legal agreements/documents should include scale drawings, design details, figures, and maintenance instructions as attachments or refer to building permit, plan, or document in public files
Provide project-specific (or BMP-specific) inspection, operation, and maintenance requirements	• Legal agreements (direct responsible party to code and/or project-specific maintenance requirements) • Stormwater code/manual provides general requirements • Project-specific maintenance requirements include maintenance instructions for each On-site Stormwater Management BMP and project O&M manual for each Stormwater Treatment and Flow Control BMP/Facility • Private property owner education
Identify the party responsible for the retention, protection and maintenance of the BMPs	• Stormwater code/manual sets forth requirements for legal agreements • Legal agreements describe maintenance responsibility
Describe how the responsibility for maintenance is transferred when property ownership changes	• Stormwater code/manual sets forth requirements for legal agreements • Legal agreements describe maintenance responsibility
Inspection	
Set forth inspection process to meet NPDES Permit requirements for both private and public projects	• Stormwater code/manual or internal procedures
Establish legal authority of local government to inspect private stormwater facilities	• Stormwater code/manual sets forth requirements for legal agreements • Legal agreements help allow access for inspection
Ensure proper construction of BMPs	• Inspections during construction and immediately after construction • Inspection checklists
Ensure long-term maintenance of BMPs	• Ongoing annual inspections and inspections after large storm events (review record drawings during inspection) • Inspection checklists
Enforcement	
Set forth enforcement process to meet NPDES Permit requirements for both private and public projects	• Stormwater code/manual or internal procedures • Enforcement processes may not be necessary for public projects, but are helpful to include in contractor specifications/contract language
Establish legal authority of local government to enforce BMP maintenance standards	• Stormwater code/manual
Establish enforcement mechanisms, such as fee triggers and schedule for unmaintained facilities	• Stormwater code/manual lists escalating enforcement actions • Stormwater code/manual sets forth requirement for financial surety measures (e.g., bonds) for development plats to guarantee maintenance of BMPs after construction

Table 22 (continued). Administrative Tools to Implement O&M Programs.	
Maintenance Program Element	**Administrative Tool**
Record Keeping and Tracking Process	
Keep records of inspections and enforcement actions (e.g., inspection reports, notices of violations)	• Develop interdepartmental record keeping and tracking process
Mapping	
Implement ongoing program for mapping BMPs	• Update mapping program as needed, including procedures for mapping distributed LID BMPs within a larger development.
Education/Training	
Train inspectors and staff on LID maintenance	• Develop / update internal training program • Develop /update a public outreach and education program for LID maintenance
Train developers and contractors on LID maintenance	• Develop and provide training on LID maintenance requirements in stormwater code/manual or internal procedures

Stormwater Code / Manual

A stormwater code can be used to require maintenance of private LID BMPs, and legally authorize local governments to inspect BMPs and enforce BMP maintenance requirements. While codes can be written to explicitly address all maintenance requirements, they often refer to a stormwater manual for details (i.e., 2012 SWMMWW or equivalent). Stormwater code and manuals can be used to accomplish the following:

- Require maintenance of all permanent stormwater BMPs and facilities
- Set forth minimum inspection, operation, and maintenance requirements
- Define permitting and plan review processes
- List required development project submittal elements (e.g., Stormwater Site Plans, legal agreements, project O&M manual)

Incorporating private facilities into a City/County stormwater maintenance program

Cities and counties generally have a maintenance program in place and have made decisions regarding whether they assume maintenance responsibility for private facilities. The jurisdiction's decision regarding LID BMP maintenance responsibility would be evaluated in the context of its existing program approach. Options include the following:

1) City/County could inspect facilities and require that the property owner hire a qualified contractor to conduct necessary maintenance
2) City/County could require facility owners to contract with a third party inspector and provide an inspection certification letter to the City/County, as well as proof that any required maintenance has been completed
3) City/County could perform maintenance and charge the property owner
4) City/County could assume maintenance responsibilities through a deed or easement.

- Require legal agreements with private property owners that identify the party responsible for retention, protection, and maintenance of BMPs
- Require legal agreements with private property owners that describe how the responsibility for maintenance of BMPs is transferred when property ownership changes
- Define the inspection process
- Establish legal authority of local government to inspect private stormwater facilities
- Define the enforcement process
- Establish legal authority of local government to enforce BMP maintenance standards
- Establish enforcement mechanisms, such as fee triggers and schedule, for unmaintained facilities
- Set forth requirement for financial surety measures (e.g., bonds) for development plats to guarantee maintenance of BMPs after construction

- Establish limited legal authority to conduct maintenance when not conducted in a timely manner and bill the property owner for the costs.

Often the owner of the property on which the BMP is located is responsible for LID BMP maintenance. However, the local government can choose to incorporate private BMPs into a City/County stormwater maintenance program (see the sidebar for tips).

Legal Agreements and Recordable Documents

Legal agreements between a private party, responsible for BMP maintenance, and the local government can be recorded against a property title to help require and ensure long-term facility maintenance. Examples of these agreements include declarations of covenant and grants of access easement. Some type of legal agreements and recordable documents are necessary to accomplish the following:

- Identify and characterize the stormwater features on site (i.e., attach as-built drawing of the lot with the location of the On-site Stormwater Management BMPs and the area served by them, design details, figures, and maintenance instructions)
- Require inspection and O&M activities and direct responsible party to local municipal code, manual, and/or project-specific O&M manual
- Identify the party responsible for retention, protection, and maintenance of BMPs
- Describe how the responsibility for maintenance of BMPs is transferred when property ownership changes
- Help give the local government legal access for inspection of BMPs

What happens when a property is sold?

When a property is sold, it is important that the new owner is informed of their maintenance responsibilities and that the local government tracks the sale to ensure legal agreements are in place. Options include the following:

- Include language in the covenant that the property owner must inform all future purchasers of the existence and maintenance requirements of the stormwater BMPs on their property and transfer possession of the project O&M manual (or in the case of lots without Stormwater Treatment and Flow Control BMPs/Facilities, maintenance instructions) to the new property owner
- Require informational handouts at point-of-sale inspections
- Require escrow companies to fax or e-mail the City/County when they perform the "tap and connection" check at time of sale to help the local government track the responsible party
- If a financial surety is in place, require the new owner to obtain one before releasing the existing bond

Several example covenants and access easements from Washington jurisdictions are included in Appendix A. Note that a covenant to be recorded against the property can be used to identify the LID BMPs on the property and the land owner's obligations to protect, operate, and maintain the BMPs. If the covenant does not cover access for maintenance then a separate legal agreement is necessary.

Permittees should review the local process for recording legal agreements through the recorder's office/county assessor in order to address barriers or time-consuming delays. For example, if an easement requires city/county council approval, solutions could include:

- Using a covenant instead
- Exempting access easements for maintenance from city/county council approval
- Streamlining or simplifying the process in other ways.

An administrative challenge related to legal agreements is establishing procedures to inform new property owners of their maintenance responsibilities for BMPs on their site. See side bar "What Happens When a Property is Sold" for tips.

Some local governments make the legal agreements with homeowners' associations (HOAs). An advantage of this is that it may be easier to work with the HOA than with individual property owners. The HOA can conduct maintenance or arrange for a qualified third party professional to conduct the maintenance. Another advantage of HOAs is as a point of contact for outreach and education. An incentive to encourage ongoing HOA responsibility for stormwater facility maintenance could include a reduced stormwater utility fee. A disadvantage of assigning responsibility to the HOA through a legal agreement is that some HOAs dissolve over time. The legal agreement can be written to transfer the maintenance responsibility for a shared facility to the individual property owners if an HOA goes defunct. For subdivisions, it is important to list the individual homeowners or lots on permit documents to simplify future enforcement actions, if necessary.

Tips for tracking LID BMP information

To establish an efficient inspection and maintenance program, it is critical to track and link pertinent information. Consider the following

- Establish an interdepartmental coordination process between information technology (IT), GIS, and different permitting administrators
- Develop a geodatabase or web-based database with tags to link electronic "as builts" or "record drawings", inspection forms, O&M manuals, and other BMP information to the BMP location. Consider indexing the BMP(s) by an identifier that will not change over time (e.g., parcel numbers can change).
- Tagging a property will alert plan review staff of the existence of a BMP and help to ensure the BMP is protected or replaced during redevelopment activities
- Conduct an end of the year audit to ensure that everything has been tracked and require that information is transferred between departments (e.g., from permitting administrators to department(s) responsible for inspections and enforcement)

Project-Specific BMP Maintenance Requirements

For development projects subject only to Minimum Requirements #1 through #5, Stormwater Site Plans should include maintenance instructions for On-Site Stormwater Management BMPs.

For projects subject to Minimum Requirements #1 through #9, maintenance instructions should also be developed for all On-site Stormwater Management BMPs that are not defined as Stormwater Treatment and Flow Control BMPs/Facilities.

Where projects must meet MR #6 and/or MR #7, O&M manuals must be developed for each Stormwater Treatment and Flow Control BMP. That means a manual for every bioretention, permeable pavement, and vegetated roof built as part of the project. These manuals identify the party responsible for maintenance, specify maintenance activities, and contain maintenance logs and a maintenance schedule.

At private facilities, a copy of each O&M manual must be retained onsite, or within reasonable access to the site, and must be transferred with the property to the new owner. If the LID BMPs are distributed on individual lots, then each property owner should have an O&M manual. For public facilities, a copy of the project O&M manual must be retained in the appropriate department. A log of maintenance activity, indicating actions taken, must be kept and made available for review upon request by the local government.

The project-specific maintenance requirements must be at least as stringent as those in the local maintenance standards. Because maintenance requirements and recommended procedures may evolve over time, consider allowing project proponents to include a reference to a document that can be updated periodically. The agreement can refer to "the current version of" the document. Some jurisdictions have online maintenance manuals that can be referenced in legal agreements, so that the most up-to-date maintenance information is available for property owners.

Financial Surety Measures

One mechanism for ensuring that LID BMPs are protected and maintained after construction is to require a financial surety, such as a bond or an assignment of accounts (also called an assignment of savings). If authorized by the jurisdiction's code, local governments can require that sureties are obtained by developers (surety measures are typically not used for single infill lots). The financial surety allows the government to enforce maintenance requirements (e.g., by pulling the bond) until the plat is fully constructed, or longer. This is particularly important if a jurisdiction assumes responsibility for private facility maintenance once construction has been completed. It is critical to ensure that adequate funds are available in the event of a non-compliant facility. One drawback to sureties is that they are generally only valid for two years before they are released (RCW 58.17.130), and if LID BMPs are on individual lots, they may not all be in place within 2 years.

Record Keeping & Tracking Process

An effective maintenance program requires the collection and tracking of LID BMP and maintenance information, beginning with the plan review process and continuing for the life of the facility. The following information should be included in a City/County record keeping system for BMP maintenance:

- Parcel information
- City/County permit (right-of-way permit for roads and utilities for a subdivision, and/or building permits for individual lots)

- Relevant sections of the Stormwater Site Plan (e.g., Permanent Stormwater Control Plan) and attached documents
- "As-builts" or "record drawings" for individual lots and for public rights-of-way
- Legal agreements (e.g., covenants or easements)
- Location information (e.g., GPS data, digital maps)
- Project O&M manual (where applicable, see Tables 20 and 21)
- Maintenance logs (typically included in a project O&M manual)
- Inspection forms (e.g., during construction, post-construction, ongoing annual)
- Enforcement documents

It is critical for local governments to develop effective interdepartmental recording and record management procedures to support ongoing annual inspections. The information including, but not limited to, the items listed above should be "linked" for individual property and to a related subdivision (if applicable). See the sidebar for some tips on how to approach tracking.

Challenges & tips for larger development sites

Large subdivision development sites pose challenges for LID BMP maintenance programs because:

- Subdivisions may include numerous distributed LID BMPs with a large number of responsible parties
- The developer may not have all BMPs sited and designed at time of plan review
- There is a risk that the plat will be cleared and the project abandoned
- Lots could be sold to multiple builders and construction could occur over a long period of time

Local governments could consider the following:

- Require bonding until full build out and stormwater BMP construction
- Ensure financial surety amount is sufficient
- Require recording of multi-party covenants for BMPs in the right-of-way (e.g., roadside bioretention) for each lot adjacent to the right-of-way
- Prohibiting or limiting wholesale clearing (mass grading) of sites
- Require recording of covenant and access easement agreements prior to final plat or final short plat
- Revise/supplement plan review checklist and procedures to record, track and establish agreements for single lots in addition to full plats

Inspection Programs

Inspections are required for all LID BMPs immediately post-construction. These inspections are critical to check that the BMPs are installed per plan and functioning properly. Inspections are also required for all permanent Stormwater Treatment and Flow Control BMPs/Facilities in new residential developments every 6 months until 90 percent of the lots are constructed (or when construction is stopped and the site is fully stabilized) to identify maintenance needs and enforce compliance with maintenance standards, as needed. These inspections can require interdepartmental coordination because the site/building inspection process may include multiple departments administering different permits.

Ongoing annual inspections are required for all Stormwater Treatment and Flow Control BMPs/Facilities (designed to meet or help meet MR #6 and/or MR #7). While legal agreements authorize some access to the BMP, the local jurisdiction procedures may include requirements to provide written notice and secure consent from the property owner prior to the inspection. Securing consent may help to avoid potential conflict and allows a "contact" and opportunity for education of the private property owner. In addition, educational door hangers or handouts can be distributed prior to and during inspections to inform property owners of the BMPs located on their site, how the BMP functions, and where to find BMP maintenance requirements.

Local governments could consider allowing third party inspection for BMPs in settings that are difficult for a City/County inspector to access (e.g., backyard of a private residence) or if property owners do not want City/County inspectors on their properties. The property owner would be required to provide the City/County with inspection documentation from an approved third party inspector, or inspections and maintenance could be arranged through the HOA. This would reduce the potential liability concerns and reduce staffing needs while still allowing the jurisdiction to meet their annual inspection requirements. Local governments could consider mitigating the cost to the private property owner by crediting the inspection fee on their utility bill.

Inspectors should be trained on the function of LID BMPs and proper procedures for BMP inspection during and after construction. Inspection checklists for LID BMPs are a good tool to support consistent inspection practices and can be used for record keeping. The project specific O&M document and record drawings should be reviewed before and during the inspection.

Mapping

Jurisdictions increasingly rely on Global Positioning System (GPS) data, digital maps, and field-accessible databases to locate and track inspection and maintenance of stormwater facilities. Unlike traditional centralized stormwater facilities, LID BMPs are small, distributed features. Because there are typically many LID BMPs scattered across development sites, mapping can be a challenge. Local governments can consider the following options for mapping LID BMPs:

- Placing single points on stormwater system maps that reference permanent stormwater control plans (also referred to as "as-builts," or "record drawings"). These plans typically contain the information to support inspections, provided they are maintained, to reflect any modifications made to the facilities, and are readily accessible to inspectors in the field. With this approach, single points would be placed on the map near the center of the dispersed LID BMPs.

- Mapping the location of each LID BMP. This may be more time consuming and clutter some stormwater system maps; however, it will provide the location of each known LID BMP and may be easier to track inspections and maintenance.

Private Property Owner Education

Education is a key component to ensuring that private property owners understand LID BMPs and their maintenance requirements. Some suggestions for public education include:

- Door hangers or handouts distributed at maintenance inspections
- Booklet on how to maintain LID features (e.g., rain gardens), provided to the homeowner, along with other property documentation, by the developer
- Homeowner education program(s) that require realtors to inform potential home buyers of the presence of LID features, their maintenance requirements, and recommends inspection prior to purchase (similar to side sewer education model)
- Placard in the house or signage outside of the house that identifies the LID BMP and refers to maintenance information
- Program for homeowner education provided at the permit counter (e.g., scheduled meeting in which the review staff "walk" the homeowner through the property "as builts" and explain how the BMPs function
- Program for HOA education provided in the classroom and as a site visit. Staff meet with the HOA to go through the property "as builts" and explain how the BMPs function. Staff also describe maintenance techniques specific to the HOA's LID BMPs and review Operations & Maintenance manuals or maintenance instructions for the LID BMPs that HOA maintains. Then staff and the HOA visit their LID BMPs so that staff can teach the HOA about inspecting their LID BMPs and additional maintenance techniques.
- Classes for homeowners/private property owners/HOAs through universities or groups such as extension programs, Conservation Districts, or Master Gardeners Associations
- Educational handouts/fact sheets distributed via local partnerships and programs
- Utility bill inserts
- Broader community outreach through media, web resources, or activities at community events.

An excerpt from Pierce County's stormwater maintenance manual for private facilities is included in Appendix B. Note that this document is provided as an example based on format only; the content has not been reviewed for consistency with the 2013-2018 Permit requirements or the material included in this guidance document.

REFERENCES

Ecology. 2012a. Phase I Municipal Stormwater Permit. Washington State Department of Ecology Water Quality Program. August 1, 2012.

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Ecology. 2012c. Stormwater Management Manual for Western Washington. Publication No. 12-10-030. Prepared by the Washington State Department of Ecology, Olympia, Washington. August 2012.

Herrera. 2012. Preliminary LID Maintenance Equipment, Skills and Staffing Recommendations Memorandum. Prepared for Washington State Department of Ecology by Herrera Environmental Consultants, Seattle, Washington. September 25, 2012.

King County and SPU. 2008. Natural Yard Care. Five steps to make your piece of the planet a healthier place to live. King County Solid Waste Division and City of Seattle Public Utilities. December 9, 2008

Saving Water Partnership. 2006. The Natural Lawn & Garden Series: Smart Watering. May 2006.

Saving Water Partnership. 2007. Natural Lawn Care for Western Washington.

Saving Water Partnership. 2012. The Natural Lawn & Garden Series: Growing Healthy Soil; Choosing the Right Plants; and Natural Pest, Weed and Disease Control. January and August 2012.

WERF. 2009. BMP and LID Whole Life Cost Models. Developed by the Water Environment Research Foundation.

Wilson, B.C., J.S. Gulliver, J-H. Kang, and P.T. Weiss. 2008. Maintenance of Stormwater BMPs: Frequency, Effort, and Cost. Stormwater Magazine. November-December 2008.

APPENDIX A

Examples of Covenants and Easements

When Recorded, Return to

Department of Planning and Development
700 5th Ave, Suite 1800
P.O. Box 34019
Seattle, WA 98124-4019

11/08/11

MEMORANDUM OF DRAINAGE CONTROL
(SMC 22.807.020)

GRANTOR: 1) _____

2) _____

3) _____

☐Additional Owners/Grantors on page _____

GRANTEE: The City of Seattle

LEGAL DESCRIPTION (ABBREVIATED):

☐Additional legal description on page 2.

ASSESSOR'S TAX PARCEL ID NO(S). _____

Permit Street Address _____

Application No. (by DPD staff): _____

Date (by DPD staff): _____/_____/_____

Grantor's Address _____

City _____ State _____ Zip _____

MEMORANDUM OF DRAINAGE CONTROL
(SMC 22.807.020)

THIS Agreement is executed in favor of the City of Seattle ("City") by the undersigned owner(s ("Grantor") of the following described real property situated in City of Seattle, King County, State of Washington (the "Property") (insert complete legal description):

In consideration of the City's granting a permit for the drainage control facilities proposed by Grantor, and for the City's allowing the connection thereof to the City's drainage system if applicable, Grantor hereby agrees and covenants, pursuant to SMC 22.807.020, as follows:

On_____, 20_____, Side Sewer Permit #_____and Building Permit #_____were issued for the above described Property.

WHEREAS; the drainage control facilities permitted by said side sewer permit are the following and are key terms of the Property's drainage control plan, which is documented in the drainage control plan drawing(s) as amended by the side sewer construction as-built record drawing(s) on file with the City of Seattle:

1. The following flow control best management practices (BMPs):
   - ☐ Existing Trees
   - ☐ Dispersion (downspout or sheet flow)
   - ☐ Bioretention Cells/Planters
   - ☐ Rainwater Harvesting
   - ☐ Permeable Pavement Surfaces
   - ☐ Permeable Pavement Facilities
   - ☐ Green Roof
   - ☐ Detention Cistern for a Single-Family Project
   - ☐ Infiltration Basins
   - ☐ Infiltration Trenches
   - ☐ Dry wells
   - ☐ Detention Pond
   - ☐ Detention Pipe
   - ☐ Detention Vault
   - ☐ Surface Ponding
   - ☐ Other (describe)_____

MEMORANDUM OF DRAINAGE CONTROL
(SMC 22.807.020)

2. The following stormwater treatment BMPs:
   - ☐ Pretreatment Facilities_____
   - ☐ Biofiltration Swales
   - ☐ Filter Strips
   - ☐ Infiltration Basins, Trenches or Dry Wells
   - ☐ Bioretention System
   - ☐ Permeable Pavement Facilities
   - ☐ Sand Filtration
   - ☐ Wet Pond/Wet Vault
   - ☐ Stormwater Treatment Wetland
   - ☐ Oil Control Facilities: API / Coalescing Plate
   - ☐ StormFilter Units
   - ☐ Filterra Units
   - ☐ Other (describe)_____

3. The following source control structures:
   - ☐ Roof, Awning, Cover
   - ☐ Ground Surface Treatment
   - ☐ Sumps, Tanks
   - ☐ Berms, Dikes
   - ☐ Pavement
   - ☐ Containment
   - ☐ Washpad
   - ☐ Other (describe)_____

   to contain the following activities:
   - ☐ Cleaning and Washing
   - ☐ Material Transfer
   - ☐ Product and Application
   - ☐ Storage and Stockpiling
   - ☐ Dust Control and Soil and Sediment Control
   - ☐ Other: (describe)_____

4. and the following items, terms and/or limitations:
   - ☐ catch basin(s), quantity ___
   - ☐ submersible pump(s), quantity ____
   - ☐ Roof leader connections
   - ☐ Pipes with less than 2% grade
   - ☐ Invert connection less than 12 inches above main sewer or drain
   - ☐ Other (describe)_____

NOW THEREFORE; the Grantor, on behalf of Grantor and Grantor's heirs, successors and assigns, agrees to the following and hereby creates a covenant running with the land that shall be binding upon all parties and their heirs, successors and assigns forever:

The Grantor, on behalf of Grantor and Grantor's heirs, successors and assigns, agrees to and shall (1) inspect and maintain the above described drainage control facilities in accordance with the provisions of Seattle Municipal Code (SMC) Chapters 22.800 – 22.808 and any other provisions applicable to the facilities, as now and hereafter in effect, (2) implement the terms of the drainage control plan required by the SMC and (3) inform all future purchasers, successors and assigns of the existence of the drainage control facilities and other elements of the drainage control plan, the limitations of the drainage control facilities, and of the requirement for the facilities' continued inspection and maintenance; and

The obligations of Grantor and each of Grantor's heirs, successors and assigns under this Memorandum of Drainage Control shall terminate when that person, sells, devises or transfers the Property, or his or her interest therein, unless the obligation arises out of a claim of negligence or intentional act of that person. Further, recording of this Memorandum of Drainage Control as required herein shall satisfy the obligations to inform under subsection (3) above.

The Grantor, on behalf of Grantor and Grantor's heirs, successors and assigns, hereby grants permission for authorized representatives of the City of Seattle to enter onto the Property for inspection, monitoring, correction or abatement of conditions related to the Property's drainage control plan, drainage control facilities, Chapters SMC 22.800 – 22.808 or any other SMC provision applicable to drainage control, as now and hereafter in effect; and

The Grantor, on behalf of Grantor and Grantor's heirs, successors and assigns, (1) agrees and acknowledges that the City is not responsible for the adequacy or performance of the drainage control plan or the drainage control facilities, (2) agrees to accept any and all risks of harm, loss, or damage related to the drainage control plan or the drainage control facilities and (3) hereby waives any right to assert any and all present and future claims against the City, whether known or unknown, for any harm, loss or damage occurring either on or off the Property, related to the drainage control plan, the drainage control facilities, or drainage or erosion on the Property, except only for such harm, damages and losses that directly result from the sole negligence of the City.

This Memorandum of Drainage Control shall be recorded in the real estate records of the Office of Records and Elections of King County, Washington. If any provision of this Memorandum is held invalid, the remainder of the Memorandum is not affected.

SIGNATURES, ACKNOWLEDGEMENTS AND NOTARY
(INDIVIDUAL—attach more pages if needed)

Dated:_____

_____
Owner/Grantor

_____
Printed Name

_____
Address

State of Washington)
) ss
County of _____)

I certify that I know or have satisfactory evidence that_____
is the person who appeared before me, and said person acknowledged that he/she signed this instrument and acknowledged it to be his/her free and voluntary act for the uses and purposes mentioned in the instrument.

Date: _____

NOTARY PUBLIC in and for the State of Washington
Residing at_____
My commission expires:_____
PRINT NAME: _____

Use this space for Notary Seal

Dated:_____

_____
Owner/Grantor

_____
Printed Name

_____
Address

) ss
County of _____)

I certify that I know or have satisfactory evidence that_____
is the person who appeared before me, and said person acknowledged that he/she signed this instrument and acknowledged it to be his/her free and voluntary act for the uses and purposes mentioned in the instrument.

Date: _____

NOTARY PUBLIC in and for the State of Washington
Residing at_____
My commission expires:_____
PRINT NAME: _____

Use this space for Notary Seal

State of Washington)

(**CORPORATE OWNER, PARTNERSHIP OWNER, LIMITED LIABILITY COMPANY OWNER/OTHER LEGAL ENTITY OWNER—attach more pages if needed)**

Date:_____

_____
Owner/Grantor

_____
Printed Name

_____
Address

By_____

_____
Printed Name

Its_____

State of Washington)
)ss
County of _____)

I certify that I know or have satisfactory evidence that_____
is the person who appeared before me, and said person acknowledged that he/she signed this instrument, on oath stated that he/she was authorized to execute the instrument and acknowledged it as the_____
(type of authority, e.g., partner, trustee, title of officer, personal representative, guardian, attorney in fact for a principal, etc.) of_____
(name of owner/entity on behalf of whom instrument was executed), to be the free and voluntary act of such party for the uses and purposes mentioned in the instrument.

Date: _____

NOTARY PUBLIC in and for the State of Washington
Residing at_____
My commission expires: _____
PRINT NAME: _____

Use this space for Notary Seal

Date:_____

_____
Owner/Grantor

_____
Printed Name

_____
Address

By_____

_____
Printed Name

Its_____

State of Washington)
)ss
County of _____)

I certify that I know or have satisfactory evidence that_____
is the person who appeared before me, and said person acknowledged that he/she signed this instrument, on oath stated that he/she was authorized to execute the instrument and acknowledged it as the_____
(type of authority, e.g., partner, trustee, title of officer, personal representative, guardian, attorney in fact for a principal, etc.) of_____
(name of owner/entity on behalf of whom instrument was executed), to be the free and voluntary act of such party for the uses and purposes mentioned in the instrument.

Date: _____

NOTARY PUBLIC in and for the State of Washington
Residing at_____
My commission expires: _____
PRINT NAME: _____

Use this space for Notary Seal

Memorandum of Drainage Control—Page No. ____

Appendix I-G3

Maintenance Agreement, Non-Residential Stormwater Facilities

(CORPORATE VERSION)

AGREEMENT TO MAINTAIN
STORMWATER FACILITIES AND TO IMPLEMENT A
POLLUTION SOURCE CONTROL PLAN
BY AND BETWEEN _____
(HEREINAFTER "THE LOCAL GOVERNMENT") AND
_____, AND
ITS HEIRS, SUCCESSORS, OR ASSIGNS
(HEREINAFTER "OWNER")

The upkeep and maintenance of stormwater facilities and the implementation of pollution source control best management practices (BMPs) is essential to the protection of water resources in _____. All property owners are expected to conduct business in a manner that promotes environmental protection. This Agreement contains specific provisions with respect to maintenance of stormwater facilities and use of pollution source control BMPs. The authority to require maintenance and pollution source control is provided by ordinance.

LEGAL DESCRIPTION:

Whereas, Owner has constructed improvements, including but not limited to, buildings, pavement, and stormwater facilities on the property described above. In order to further the goals of the Local Government to ensure the protection and enhancement of Local Government's water resources, the Local Government and Owner hereby enter into this Agreement. The responsibilities of each party to this Agreement are identified below.

OWNER SHALL:

(1) Implement the stormwater facility maintenance program included herein as Attachment "A".

(2) Implement the pollution source control program included herein as Attachment "B".

(3) Maintain a record (in the form of a log book) of steps taken to implement the programs referenced in (1) and (2) above. The log book shall be available for inspection by Local Government staff at Owner's business during normal business hours. The log book shall catalog the action taken, who took it, when it was done, how it was done, and any problems encountered or follow-on actions recommended. Maintenance items ("problems") listed in Attachment "A" shall be inspected on a monthly or more frequent basis as necessary. Owner is encouraged to photocopy the individual checklists in Attachment A and use them to complete its monthly inspections. These completed checklists would then, in combination, comprise the monthly log book.

(4) Submit an annual report to the Local Government regarding implementation of the programs referenced in (1) and (2) above. The report must be submitted on or before May 15 of each calendar year and shall contain, at a minimum, the following:

(a) Name, address, and telephone number of the business, the person, or the firm responsible

for plan implementation, and the person completing the report.

(b) Time period covered by the report.

(c) A chronological summary of activities conducted to implement the programs referenced in (1) and (2) above. A photocopy of the applicable sections of the log book, with any additional explanation needed, shall normally suffice. For any activities conducted by paid parties not affiliated with Owner, include a copy of the invoice for services.

(d) An outline of planned activities for the next year.

THE LOCAL GOVERNMENT WILL, AS RESOURCES ALLOW:

(1) Provide technical assistance to Owner in support of its operation and maintenance activities conducted pursuant to its maintenance and source control programs. Said assistance shall be provided upon request and at no charge to Owner.

(2) Review the annual report and conduct occasional site visits to discuss performance and problems with Owner.

(3) Review this agreement with Owner and modify it as necessary.

REMEDIES:

(1) If the Local Government determines that maintenance or repair work is required to be done to the stormwater facility existing on the Owner property, the Stormwater Manual Administrator shall give Owner within which the drainage facility is located, and the person or agent in control of said property if different, notice of the specific maintenance and/or repair required. The Administrator shall set a reasonable time in which such work is to be completed by the persons who were given notice. If the above required maintenance and/or repair is not completed within the time set, written notice will be sent to the persons who were given notice stating the Local Government's intention to perform such maintenance and bill Owner for all incurred expenses. The Local Government may also adjust stormwater utility charges on the Owner's bill if required maintenance is not performed.

(2) If at any time the Local Government determines that the existing system creates any imminent threat to public health or welfare, the Administrator may take immediate measures to remedy said threat. No notice to the persons listed in (1), above, shall be required under such circumstances.

(3) The Owner grants authority to the Local Government for access to any and all stormwater system features for the purpose of inspection, and performing maintenance or repair as may become necessary under Remedies (1) and/or (2).

(4) The persons listed in (1), above, shall assume all responsibility for the cost of any maintenance and for repairs to the stormwater facility. Such responsibility shall include reimbursement to the Local Government within 30 days of the receipt of the invoice for any such work performed. Overdue payments will require payment of interest at the current legal rate for liquidated judgments. If legal action ensues, any costs or fees incurred by the Local Government will be borne by the parties responsible for said reimbursements.

(5) The owner hereby grants to the Local Government a lien against the above-described property

in an amount equal to the cost incurred by the Local Government to perform the maintenance or repair work described herein.

This Agreement is intended to protect the value and desirability of the real property described above and to benefit all the citizens of the Local Government. It shall run with the land and be binding on all parties having or acquiring from Owner or their successors any right, title, or interest in the property or any part thereof, as well as their title, or interest in the property or any part thereof, as well as their heirs, successors, and assigns. They shall inure to the benefit of each present or future successor in interest of said property or any part thereof, or interest therein, and to the benefit of all citizens of the Local Government.

Dated at _____, Washington, this _____ day of _____, _____.

OWNER

By:_____
Authorized Agent for Owner

_____

STATE OF WASHINGTON)
) **ss**
COUNTY OF THURSTON)

On this day and year above personally appeared before me, a Notary Public in and for the State of Washington duly commissioned and sworn, personally appeared _____, to me known to be the _____ of _____ and acknowledge the said instrument to be the free and voluntary act and deed of said corporation, for the uses and purposes therein mentioned, and on oath stated that _____ is authorized to execute the said instrument and that the seal affixed is the corporate seal of said corporation.

WITNESS my hand and official seal the day and year first above written.

_____

Notary Public in and for the State of
Washington, residing in _____

My Commission Expires: _____

Dated at _____, Washington, this _____ day of _____, _____.

LOCAL GOVERNMENT

By:_____
Authorized Agent for Local Government

STATE OF WASHINGTON)
) **ss**
COUNTY OF THURSTON)

On this day and year above personally appeared before me, _____, to me known to be acting as Authorized Agent for_____, a Municipal Corporation, who executed the foregoing instrument and acknowledged the said instrument to be the free and voluntary act and deed of said Municipal Corporation for the uses and purposes therein mentioned and on oath states he is authorized to execute the said instrument.

Given under my hand and official seal this _____ day of _____, _____.

_____
Notary Public in and for the State of
Washington, residing in _____

My Commission Expires: _____

APPROVED AS TO FORM:

_____
Local Government Attorney

Appendix I-G4

Maintenance Agreement, Residential Stormwater Facilties

(RESIDENTIAL SUBDIVISION VERSION)

AGREEMENT TO MAINTAIN STORMWATER FACILITIES AND TO IMPLEMENT A POLLUTION SOURCE CONTROL PLAN

BY AND BETWEEN_____
(HEREINAFTER "THE LOCAL GOVERNMENT") AND
_____, AND
ITS HEIRS, SUCCESSORS, OR ASSIGNS
(HEREINAFTER "OWNER")

The upkeep and maintenance of stormwater facilities and the implementation of pollution source control best management practices (BMPs) is essential to the protection of water resources in the Local Government's jurisdiction. All property owners are expected to conduct business in a manner that promotes environmental protection. This Agreement contains specific provisions with respect to maintenance of stormwater facilities and use of pollution source control BMPs. The authority to require maintenance and pollution source control is provided in ordinance.

LEGAL DESCRIPTION:

Whereas, Owner has constructed improvements, including but not limited to, buildings, pavement, and stormwater facilities on the property described above. In order to further the goals of the Local Government to ensure the protection and enhancement of Local Government's water resources, the Local Government and Owner hereby enter into this Agreement. The responsibilities of each party to this Agreement are identified below.

OWNER SHALL:

(1) Implement the stormwater facility maintenance program included herein as Attachment "A".

(2) Implement the pollution source control program included herein as Attachment "B".

(3) Maintain a record (in the form of a log book) of steps taken to implement the programs referenced in (1) and (2) above. The log book shall be available for inspection by Local Government staff at Owner's business during normal business hours. The log book shall catalog the action taken, who took it, when it was done, how it was done, and any problems encountered or follow-on actions recommended. Maintenance items ("problems") listed in Attachment "A" shall be inspected on a monthly or more frequent basis as necessary. Owner is encouraged to photocopy the individual checklists in Attachment A and use them to complete its monthly inspections. These completed checklists would then, in combination, comprise the monthly log book.

(4) Submit an annual report to the Local Government regarding implementation of the programs

referenced in (1) and (2) above. The report must be submitted on or before May 15 of each calendar year and shall contain, at a minimum, the following:

(a) Name, address, and telephone number of the business, the person, or the firm responsible for plan implementation, and the person completing the report.

(b) Time period covered by the report.

(c) A chronological summary of activities conducted to implement the programs referenced in (1) and (2) above. A photocopy of the applicable sections of the log book, with any additional explanation needed, shall normally suffice. For any activities conducted by paid parties not affiliated with Owner, include a copy of the invoice for services.

(d) An outline of planned activities for the next year.

THE LOCAL GOVERNMENT WILL, AS RESOURCES ALLOW:

(1) Provide technical assistance to Owner in support of its operation and maintenance activities conducted pursuant to its maintenance and source control programs. Said assistance shall be provided upon request and at no charge to Owner.

(2) Review the annual report and conduct occasional site visits to discuss performance and problems with Owner.

(3) Review this agreement with Owner and modify it as necessary.

REMEDIES:

(1) If the Local Government determines that maintenance or repair work is required to be done to the stormwater facility existing on the Owner property, the Stormwater Manual Administrator shall give Owner, and the person or agent in control of said property if different, notice of the specific maintenance and/or repair required. The Administrator shall set a reasonable time in which such work is to be completed by the persons who were given notice. If the above required maintenance and/or repair is not completed within the time set by the Administrator, written notice will be sent to the persons who were given notice stating the Local Government's intention to perform such maintenance and bill the owner for all incurred expenses. The Local Government may also adjust stormwater utility charges if required maintenance is not performed.

(2) If at any time the Local Government determines that the existing system creates any imminent threat to public health or welfare, the Administrator may take immediate measures to remedy said threat. No notice to the persons listed in (1), above, shall be required under such circumstances.

(3) The Owner grants authority to the Local Government for inspection, and access to any and all stormwater system features for the purpose of performing maintenance or repair as may become necessary under Remedies (1) and/or (2).

(4) The Owner shall assume all responsibility for the cost of any maintenance and for repairs to the stormwater facility. Such responsibility shall include reimbursement to the Local

Government within 30 days of the receipt of the invoice for any such work performed. Overdue payments will require payment of interest at the current legal rate for liquidated judgments. If legal action ensues, any costs or fees incurred by the Local Government will be borne by the parties responsible for said reimbursements.

(5) The Owner hereby grants to the Local Government a lien against the above-described property in an amount equal to the cost incurred by the Local Government to perform the maintenance or repair work described herein.

This Agreement is intended to protect the value and desirability of the real property described above and to benefit all the citizens of the Local Government. It shall run with the land and be binding on all parties having or acquiring from Owner or their successors any right, title, or interest in the property or any part thereof, as well as their title, or interest in the property or any part thereof, as well as their heirs, successors, and assigns. They shall inure to the benefit of each present or future successor in interest of said property or any part thereof, or interest therein, and to the benefit of all citizens of the Local Government.

Dated at _____, Washington, this _____ day of _____, _____.

OWNER

_____
Authorized Agent for Owner

STATE OF WASHINGTON)
) ss
COUNTY OF THURSTON)

On this day and year above personally appeared before me, _____ _____ known to be the individual(s) described, and who executed the foregoing instrument and acknowledge that they signed the same as their free and voluntary act and deed for the uses and purposes therein mentioned.

Given under my hand and official seal this _____ day of _____, _____.

_____

Notary Public in and for the
State of Washington, residing in

_____.

Dated at _____, Washington, this _____ day of _____, _____.

LOCAL GOVERNMENT

_____
Authorized Agent for the Local Government

STATE OF WASHINGTON)
) ss
COUNTY OF THURSTON)

On this day and year above personally appeared before me,_____, to me known to be the Authorized Agent for the Local Government, a Municipal Corporation, who executed the foregoing instrument and acknowledge the said instrument to be the free and voluntary act and deed of said Municipal Corporation for the uses and purposes therein mentioned and on oath states he is authorized to execute the said instrument.

Given under my hand and official seal this _____ day of _____, _____.

_____
Notary Public in and for the
State of Washington, residing in

_____.

APPROVED AS TO FORM:

_____
Local Government Attorney

When Recorded, Return To:

City of Tacoma
Environmental Services / Science and Engineering
747 Market Street Tacoma, WA 98402

DOCUMENT TITLE: COVENANT AND EASEMENT **PROJECT NAME**
Grantor(s): **DEVELOPER**
Grantee: CITY OF TACOMA, a Municipal Corporation
Legal Description (abbreviated): *****EXAMPLE***** <u>See Page 4, Exhibit "A", for Legal Description</u>
Reference Number(s): City of Tacoma Short Plat No. xxxxxxxxx; City of Tacoma Work Order No. xxxxxxxx; City of Tacoma Building Permit No. xxxxxxxx
Assessor's Parcel Number(s): XX-XX-XX-XX

COVENANT AND EASEMENT – PROJECT NAME

WHEREAS DEVELOPER, hereinafter collectively referred to as the Grantor(s), owns the real property known as Project Name, located at ***insert address here*** (the "Subject Property"), which is more fully described herein; and

WHEREAS pursuant to Tacoma Municipal Code 12.08.090(D), as may be hereafter amended, a condition of developing the Subject Property requires that it have adequate stormwater drainage; and

WHEREAS pursuant to _____ approval, private storm drainage collection systems must be provided; and

WHEREAS Grantor(s) have/has chosen to install a private storm drainage system for the Subject Property, the location of which is legally described in Exhibit A, so as to proceed with _____ approval; and

WHEREAS such a private storm drainage system will require ongoing maintenance to ensure it operates as designed;

NOW THEREFORE, in consideration of the mutual benefits herein described, Grantor(s) hereby make the following Covenant which shall be recorded with the Pierce County Auditor encumbering the Subject Property (Assessor's Parcel Number(s) xx-xx-xx-x-xxx).

(1) The Grantor(s) shall construct and maintain at his/her/their/its own cost, a private storm drainage system on the Subject Property, in accordance with the approved construction plans under City of Tacoma Short Plat No. XXXXXXXXXXX. The private storm drainage system shall consist of storm drainage pipes, manholes, catch basins and various drainage facilities throughout the short plat including all drainage facilities located in private easements.

(2) It shall be the sole responsibility of the Grantor(s) and/or his/her/their/its successors-in-interest to maintain the private storm drainage system in its originally designed condition. Any damages caused by the failure of the system shall be the sole responsibility of the Grantor(s), owner(s) and/or his/her/their successor(s)-in-interest.

(3) This Covenant is made to ensure the proper maintenance of the storm drainage system. This Covenant shall run with the Subject Property and be binding upon the Grantor(s) and all successor(s)-in-interest. The Grantor(s) consent(s) to filing this Covenant with the Pierce County Auditor's Office once it is executed.

(4) If the private storm drainage system is not maintained in accordance with the approved or as-built design, approved under City of Tacoma Work Short Plat No. XXXXXXXXXXX incorporated herein by reference, the City may enter the Subject Property, inspect and repair the system, and assess reasonable costs for the work that may be charged against the owner of any beneficiary lot(s).

(5) No permanent structures shall be constructed over or within any private storm sewer easements located within the Subject Property. Permanent structures shall mean any concrete foundation, concrete slab, wall, building, or other site improvement that would unreasonably interfere with the ability to access the utilities in said easement(s). Permanent structures shall not mean normal landscaping, asphalt paving, firewood or chain-link fences, or other similar site improvements.

NOW THEREFORE, to this end, the Grantor(s) hereby grant(s) a perpetual easement to the City of Tacoma to enter the Subject Property, inspect the private storm drainage system, and make necessary repairs at the expense of Grantor or other benefitted owners. Name, company, Address**,** designed the private storm drainage system.

By _____
Name
Company
Address
City, state, zip code

ACKNOWLEDGEMENT

STATE OF WASHINGTON)
) SS.
COUNTY OF PIERCE)

I, the undersigned, a Notary Public, do hereby certify that on this _____ day of _____, 20___, personally appeared before me_____ _____to me known to be the individual(s) described in and who executed the within instrument and acknowledged that he/she/they signed and sealed the same, on oath stated that he/she/they was authorized to execute the instrument and acknowledged it as his/her/their free and voluntary act and deed for the uses and purposes therein mentioned.

Given under my hand and official seal this _____ day of _____, 20___.

_____
Notary Public in and for the State of Washington
residing at _____
My Commission expires _____

DESCRIPTION APPROVED:

_____
City Surveyor

APPROVED AS TO FORM:

_____
Deputy City Attorney

EXHIBIT A

LEGAL DESCRIPTION

****EXAMPLE****

When Recorded Return To:

City of Tacoma
Public Works
Real Property Services
747 Market Street, Room 737
Tacoma WA 98402-3769

DOCUMENT TITLE: COVENANT AND EASEMENT **********
Grantor(s):
Grantee: CITY OF TACOMA, a Municipal Corporation
Legal Description (abbreviated): See pages 5 thru , Exhibit's "A" and "B", for full Legal Description
Reference Number(s): City of Tacoma Work Order
Assessor's Parcel Number(s):

COVENANT AND EASEMENT –Short Plat

WHEREAS**********, hereinafter referred to as the Grantor, owns the properties on **********. hereinafter referred to as **********, which is more fully described in the attached and incorporated Exhibit A; and

WHEREAS in order to satisfy the requirements of TMC 12.08.090 (D), Grantor intends to construct a public bioretention facility located within the planting strip of the Fawcett Avenue right-of-way, for the benefit of the **********; and

WHEREAS in order to satisfy requirements set forth in TMC Chapter 9.17, 9.18, and 9.19, *abutting property owners* are responsible for the maintenance of the planting strip and will be responsible for ongoing maintenance of the proposed bioretention facility to ensure it operates as designed.

WHEREAS Grantor, and all successors in interest, of those certain Lots within the **********, (hereinafter collectively referred to as "Owner"), shall be obligated to maintain the public bioretention facility in accordance with this Covenant and Easement; and

WHEREAS the bioretention facility was designed by **********who also designed the public storm drainage system;

NOW THEREFORE, in consideration of the mutual benefits herein described, Grantor hereby makes the following Covenant which shall be recorded with the Pierce County Auditor under Parcel Number's **********.

.

COVENANT AND EASEMENT – **********

(1) The Grantor shall construct and maintain, at its own cost, a public storm drainage system within the right-of-way adjacent to the property legally described in Exhibit B (which is incorporated herein by this reference), and in accordance with the approved Work Order under City of Tacoma Permit Number **********

(2) The proposed bioretention facility in the right of way will be an asset of the City of Tacoma. However per Tacoma Municipal Code Chapter 9.17, 9.18, and 9.19, *abutting property owners* are responsible for the maintenance of the planting strip and will be responsible for maintenance of the proposed bioretention facility and Grantor hereby agrees to maintain the facility as outlined herein below.

Grantor shall:

- Weed and water the bioretention facility as necessary until the plants have become established,
- Remove leaves and debris blocking storm drains and pipes to prevent local flooding on an on-going basis,

- Keep sidewalks in front of homes clear of impediments to pedestrian access and safety, also on an on-going basis.

The City shall be responsible for:

- Regular monitoring and maintenance of the Natural Drainage System "hardware" – pipes, culverts, outlets, drains, and grates, and
- Providing emergency services and repairs.

(3) This Covenant is made to ensure the proper maintenance of the storm drainage system. It is the Grantor's intent that the terms and conditions of this Covenant shall run with the land and be binding upon the Grantor(s) and all successor(s) in interest. The Grantor consents to the City filing this Covenant with the Pierce County Auditor's Office once it is executed.

_____

****

STATE OF WASHINGTON)
) ss
COUNTY OF _____)

I certify that I know or have satisfactory evidence that **********is the person who appeared before me, and said person acknowledged that he signed this instrument, on oath stated that he was authorized to execute the instrument and acknowledged it, as the owner of the property concerned in this agreement, to be his free and voluntary act for the uses and purposes mentioned in the instrument.

Dated this _____ day of _____, 2009

_____
Notary Public in and for the
State of Washington
My Commission Expires _____

LEGAL DESCRIPTION APPROVED:

_____ _____
********** City Surveyor
****
/Environmental Services

APPROVED AS TO FORM:

_____
Assistant City Attorney

EXHIBIT A-- **********

EXHIBIT B

Legal Description

RECORDING REQUESTED BY AND
WHEN RECORDED MAIL TO:

_____

_____

_____

_____

RECORDING COVER SHEET

DECLARATION OF COVENANT AND GRANT OF EASEMENT

Grantor: _____

Grantee: _____

Legal Description: _____

_____

_____

Additional Legal(s) on: _____

Assessor's Tax Parcel ID#: _____

_____

_____

DECLARATION OF COVENANT AND GRANT OF EASEMENT
For Stormwater Flow Control Best Management Practices

IN CONSIDERATION of the following approved King County (check one of the following) ❑ residential building permit, ❑ commercial building permit, ❑ clearing and grading permit, ❑ subdivision permit, or ❑ short subdivision permit for Application No. _____ relating to real property ("Property") legally described as follows:

_____

_____

_____

_____

The Grantor(s), the owner(s) in fee of the above described parcel of land, hereby covenants with King County, a political subdivision of the state of Washington its successors in interest and assigns ("King County"), that it will observe, consent to, and abide by the conditions and obligations set forth and described in Paragraphs 1 and 2 and 4 through 7 below with regard to the Property, and hereby grants an access easement on and to the Property to King County, for the purposes described in Paragraph 3 below. Grantor(s) hereby grants, covenants, and agrees as follows:

1. Owner(s) of the Property shall retain, uphold, and protect the stormwater management devices, features, pathways, limits, and restrictions, known as flow control best management practices ("Flow Control BMPs"), shown on the approved Flow Control BMP Site Plan for the Property attached hereto and incorporated herein as Exhibit A.

2. Owner(s) of the Property shall at their own cost, operate, maintain, and keep in good repair, the Property's Flow Control BMPs as described in the approved Design and Maintenance Details for each BMP attached hereto and incorporated herein as Exhibit B.

3. King County shall have a nonexclusive perpetual access easement on the Property in order to ingress and egress over the Property for the sole purposes of inspecting and monitoring the Property's Flow Control BMPs, and if applicable in accordance with the terms of Paragraph 4 below, performing any corrective work required to bring the Property's Flow Control BMPs into compliance with Title 9 of the King County Code.

4. If King County determines that maintenance, repair, restoration, and/or mitigation work is required to be done to the Flow Control BMPs and has not been performed by the Property owner(s), the Director of the Water and Land Resources Division of the King County Department of Natural Resources and Parks shall give notice to the Property owner (s) of the specific maintenance, repair, restoration, and/or mitigation work (Work) required pursuant to Title 9 of the King County Code. The Manager shall also set a reasonable time in which the Work is to be completed by the Property owner(s). If the Work is not completed within the time set by the Division Director, King County may perform the required Work. Written notice will be sent to the Property owner(s) stating King County's intention to perform the Work. Performance of the Work by King County will not commence until at least seven (7) days after such notice is mailed. If, within the sole discretion of the Water and Land Resources Division Director, there exists an imminent or present danger, the owner hereby waives the seven (7) day notice period and the Work will begin immediately.

5. The owner(s) of the Property shall assume all responsibility for the cost of any Work required to be done to the Flow Control BMPs. Such responsibility shall include reimbursement to King County within thirty (30) days of the receipt of the invoice for any such Work performed by King County in accordance with the terms of Paragraph 3 above. Overdue payments will require payment of interest at the current legal rate as liquidated damages. In the event that King County does not receive reimbursement within the required time frame, it may elect to place a lien on the

Property and act upon the lien in accordance with the terms and procedures specified in Chapter 23.40 of the King County Code, as amended from time to time. If legal action is taken to enforce the provisions of this Paragraph, the prevailing party is entitled to costs and attorney's fees.

6. Apart from performing routine landscape maintenance, the Property owner(s) is (are) hereby required to obtain written approval from the Water and Land Resources Division Manager of the King County Department of Natural Resources and Parks prior to performing any alterations or modifications to the Flow Control BMPs. Any notice or consent required to be given or otherwise provided for by the provisions of this Declaration of Covenant and Grant of Easement shall be effective upon personal delivery, or three (3) days after mailing by Certified Mail, return receipt requested, whichever occurs sooner.

7. This Declaration of Covenant and Grant of Easement is intended to promote the efficient and effective management of surface water drainage on the Property, and it shall inure to the benefit of all the citizens of King County, its successors and assigns. This Declaration of Covenant and Grant of Easement shall run with the land and be binding upon Grantor(s), and Grantor's (s') successors in interest and assigns.

8. This Declaration of Covenant and Grant of Easement may be terminated by execution of a written agreement by Grantor(s) and King County expressing their mutual agreement to terminate this Declaration of Covenant and Grant of Easement.

IN WITNESS WHEREOF, this Declaration of Covenant and Grant of Easement is executed this _____day of _____, 20___.

By _____

Its _____

By _____

Its _____

STATE OF WASHINGTON)
)SS
COUNTY OF KING)

On this _____ day of _____, 20___, before me, the undersigned, a Notary Public in and for the State of _____, duly commissioned and sworn personally appeared , to me known to be the individual described in and who executed the foregoing instrument, and acknowledged to me that he signed and sealed the said instrument as h free and voluntary act and deed for the uses and purposes therein mentioned.

WITNESS my hand and official seal hereto affixed the day and year in this certificate above written.

_____

_____
Printed name
Notary Public in and for the State of Washington,
residing at _____

My appointment expires _____

RECORDING REQUESTED BY AND
WHEN RECORDED MAIL TO:

_____

_____

_____

_____

DECLARATION OF COVENANT

FOR INSPECTION AND MAINTENANCE OF STORMWATER FACILITIES AND BMPS

Grantor: _____

Grantee: King County

Legal Description: _____

_____

_____

Additional Legal(s) on: _____

Assessor's Tax Parcel ID#: _____

IN CONSIDERATION of the approved King County _____ permit for application No. _____ relating to the real property ("Property") described above, the Grantor(s), the owner(s) in fee of that Property, hereby covenants(covenant) with King County, a political subdivision of the state of Washington and its municipal successors in interest and assigns ("King County" and "the County", or "its municipal successor"), that he/she(they) will observe, consent to, and abide by the conditions and obligations set forth and described in Paragraphs 1 through

10 below with regard to the Property, and hereby grants(grant) an easement as described in Paragraphs 2 and 3. Grantor(s) hereby grants(grant), covenants(covenant), and agrees(agree) as follows:

1. The Grantor(s) or his/her(their) successors in interest and assigns ("Owners") shall at their own cost, operate, maintain, and keep in good repair, the Property's stormwater facilities and best management practices ("BMPs") identified in the plans and specifications submitted to King County for the review and approval of permit(s) #: _____ . Stormwater facilities include pipes, swales, tanks, vaults, ponds, and other engineered structures designed to manage stormwater on the Property. Stormwater BMPs include dispersion and infiltration devices, native vegetated areas, permeable pavements, vegetated roofs, rainwater harvesting systems, reduced impervious surface coverage, and other measures designed to reduce the amount of stormwater runoff on the Property.

2. King County shall have the right to ingress and egress over those portions of the Property necessary to perform inspections of the stormwater facilities and BMPs and conduct other activities specified in this Declaration of Covenant and in accordance with King County Code ("KCC") 9.04.120 or relevant municipal successor's codes as applicable. This right of ingress and egress, right to inspect, and right to perform required maintenance or repair as provided for in Section 3 below, shall not extend over those portions of the Property shown in Exhibit "A."

3. If King County determines that maintenance or repair work is required to be done to any of the stormwater facilities or BMPs, the Director of the Water and Land Resources Division or its municipal successor in interest ("WLR") shall give notice of the specific maintenance and/or repair work required pursuant to KCC 9.04.120 or relevant municipal successor's codes as applicable. The Director shall also set a reasonable time in which such work is to be completed by the Owners. If the above required maintenance or repair is not completed within the time set by the Director, the County may perform the required maintenance or repair, and hereby is given access to the Property, subject to the exclusion in Paragraph 2 above, for such purposes. Written notice will be sent to the Owners stating the

County's intention to perform such work. This work will not commence until at least seven (7) days after such notice is mailed. If, within the sole discretion of the WLR Director, there exists an imminent or present danger, the seven (7) day notice period will be waived and maintenance and/or repair work will begin immediately.

4. If at any time King County reasonably determines that a stormwater facility or BMP on the Property creates any of the hazardous conditions listed in KCC 9.04.130 or relevant municipal successor's codes as applicable and herein incorporated by reference, the WLR Director or equivalent municipal successors official may take measures specified therein.

5. The Owners shall assume all responsibility for the cost of any maintenance or repair work completed by the County as described in Paragraph 3 or any measures taken by the County to address hazardous conditions as described in Paragraph 4. Such responsibility shall include reimbursement to the County within thirty (30) days of the receipt of the invoice for any such work performed. Overdue payments will require payment of interest at the current legal rate as liquidated damages. If legal action ensues, the prevailing party is entitled to costs or fees.

6. The Owners are hereby required to obtain written approval from the King County WLR Director prior to filling, piping, cutting, or removing vegetation (except in routine landscape maintenance) in open vegetated stormwater facilities (such as swales, channels, ditches, ponds, etc.), or performing any alterations or modifications to the stormwater facilities and BMPs referenced in this Declaration of Covenant.

7. Any notice or consent required to be given or otherwise provided for by the provisions of this Agreement shall be effective upon personal delivery, or three (3) days after mailing by Certified Mail, return receipt requested.

8. With regard to the matters addressed herein, this agreement constitutes the entire agreement between the parties, and supersedes all prior discussions, negotiations, and all agreements whatsoever whether oral or written.

9. This Declaration of Covenant is intended to protect the value and desirability of the real property described above, and shall inure to the benefit of all the citizens of King County and its municipal successors and assigns. This Declaration of Covenant shall run with the land and be binding upon Grantor(s), and Grantor's(s') successors in interest, and assigns.

10. This Declaration of Covenant may be terminated by execution of a written agreement by the Owners and King County or the municipal successor that is recorded by King County in its real property records.

IN WITNESS WHEREOF, this Declaration of Covenant for the Inspection and Maintenance of Stormwater Facilities and BMPs is executed this _____ day of _____, 20_____.

_____
GRANTOR, owner of the Property

_____
GRANTOR, owner of the Property

STATE OF WASHINGTON)
COUNTY OF KING)ss.

On this day personally appeared before me:

_____, to me known to be the individual(s) described in and who executed the within and foregoing instrument and acknowledged that they signed the same as their free and voluntary act and deed, for the uses and purposes therein stated.

Given under my hand and official seal this _____ day of _____, 20_____.

_____

_____
Printed name
Notary Public in and for the State of Washington, residing at

_____

My appointment expires _____

Drainage Facility Maintenance Covenant

We, the owners and contract purchasers of the lands herein platted (Grantor), agree that the obligations of Grantor shall inure to the benefit of and be binding upon the heirs, successors, and assigns. Grantor agrees that this covenant touches and concerns the land described herein and shall run with the land.

Grantor by execution of this covenant acknowledges that the benefits of this covenant inure to Grantor, downstream property owners, and the general public, and that Snohomish County (County) as third-party beneficiary of this covenant has the right, but not the obligation, to enforce this covenant on behalf of downstream property owners and the general public. County requires this covenant to protect private and public property, private and public drainage infrastructure, and natural resources of downstream property owners and the general public.

Grantor, in consideration of the approval of this subdivision, hereby covenants to perform regular maintenance upon the drainage facilities installed, or to be installed, upon Grantor's property. Regular maintenance shall include, at a minimum, annual inspection of the stormwater drainage system. As applicable, the system shall include the stormwater conveyance system pipes, ditches, swales, and catch basins; stormwater flow regulation system detention ponds, vaults, pipes, retention ponds, flow regulation and control structures; infiltration systems and water quality control system.

The scope of this covenant and right of entry shall be adequate to provide for the access, inspection, and maintenance of the stormwater drainage system, and shall be subject to the following terms and conditions:

1. County shall have the perpetual right of entry across adjacent lands of the Grantor for purposes of inspecting, auditing, or conducting required maintenance of the drainage facility.

2. If County inspection determines that maintenance is not being performed, County shall endeavor to provide Grantor reasonable advance notification of the need to perform the maintenance and a reasonable opportunity for Grantor to perform it. In the event that Grantor fails to complete the required maintenance within a reasonable time period, County

shall have the right to perform or contract with others to perform it at the sole expense of the Grantor. If County in its sole discretion determines that an imminent or present danger exists, required maintenance and/or repair may begin immediately at Grantor's expense without prior notice to Grantor. In such event, County shall provide Grantor with a written statement and accounting of all work performed and the fees, charges, and expenses incurred in making such repairs. Grantor shall agree to reimburse County or pay County's vendors directly for all reasonable fees, charges, and expenses identified in County's statement.

3. If County is required to act as a result of Grantor's failure to comply with this covenant, County may remove any obstructions and/or interferences that in the sole opinion of County impair the operation of the drainage facility or the maintenance thereof. Grantor agrees to hold County, its officers, employees, and agents harmless from any and all claims, actions, suits, liability, loss, expenses, damages and judgments of any nature whatsoever, including costs and attorney's fees, incurred by the removal of vegetation or physical interference from the drainage facility.

4. When exercising the maintenance provisions of the covenant, in the event of nonpayment, County may bring suit to recover such costs, including attorney's fees, and upon obtaining a judgment, such amount shall become a lien against the property of Grantor as provided in RCW 4.56.190.

5. Grantor covenants that all of the owners, contract purchasers and lien holders of the property described herein have signed the dedication and/or declaration of this subdivision, that they have the right to grant this covenant on the property, and that the title to the property is free and clear of any encumbrances which would interfere with the ability to grant this covenant.

Return Address:
Snohomish County Property Manager
3000 Rockefeller Avenue
Mail Stop 404
Everett, WA 98201-4046
PDS Reference PFN: _____

Drainage Facility Maintenance Covenant

Grantor(s) hereinafter referred to as **Grantor:**

1.
2.
3.

Grantee: Snohomish County, hereinafter referred to as **County,** a Political Subdivision under the Laws of the State of Washington.

Legal Description of property encumbered by covenant**:**
Abbreviated:

(if applicable, insert lot, Block, Plat Name), and/or as described in Exhibit(s) " " *(typically Exhibit A).*

Located in *qtr./ qtr*. Sec. Twp. N., Rge. E., W.M.

Reference Number(s) of documents assigned, released, or modified:

Assessor's Property Tax Parcel/Account Number(s) of property(s) encumbered by the drainage covenant:

 Grantor's Initials_____

Grantor has a record interest in the property encumbered by the covenant and agrees that the obligations of Grantor shall inure to the benefit of and be binding upon the heirs, successors, and assigns. Grantor agrees that this covenant touches and concerns the land described in Exhibit _____ and shall run with the land.

Grantor by execution of this covenant acknowledges that the benefits of this covenant inure to Grantor, downstream property owners, and the general public, and that the County as third-party beneficiary of this covenant has the right, but not the obligation, to enforce this covenant on behalf of downstream property owners and the general public. The County requires this covenant to protect private and public property, private and public drainage infrastructure, and natural resources of downstream property owners and the general public.

Grantor in consideration of the approval of County development permit No. _____, relating to the real property described in Exhibit _____ and in consideration of other valuable consideration, receipt and sufficiency of which is hereby acknowledged, hereby covenants to perform regular maintenance upon the drainage facilities installed, or to be installed, upon Grantor's property. Regular maintenance shall include, at a minimum, annual inspection of the stormwater drainage system. As applicable, the system shall include the stormwater conveyance system pipes, ditches, swales, and catch basins; stormwater flow regulation system detention ponds, vaults, pipes, retention ponds, flow regulation and control structures; infiltration systems and water quality control system.

The scope of this covenant and right of entry shall be adequate to provide for the access, inspection, and maintenance of the stormwater drainage system, and shall be subject to the following terms and conditions:

1. The County shall have the perpetual right of entry across adjacent lands of the Grantor for purposes of inspecting, auditing, or conducting required maintenance of the drainage facility.

2. If County inspection determines that maintenance is not being performed, the County shall endeavor to provide Grantor reasonable advance notification of the need to perform the maintenance and a reasonable opportunity for the Grantor to perform it. In the event that Grantor fails to complete the required maintenance within a reasonable time period, the County shall have the right to perform or contract with others to perform it at the sole expense of the Grantor. If the County in its sole discretion determines that an

imminent or present danger exists, required maintenance and/or repair may begin immediately at Grantor's expense without prior notice to Grantor. In such event, the County shall provide Grantor with a written statement and accounting of all work performed and the fees, charges, and expenses incurred in making such repairs. Grantor shall agree to reimburse the County or pay the County's vendors directly for all reasonable fees, charges, and expenses identified in the County's statement.

3. If the County is required to act as a result of Grantor's failure to comply with this covenant, the County may remove any obstructions and/or interferences that in the sole opinion of the County impair the operation of the drainage facility or the maintenance thereof. Grantor agrees to hold the County, its officers, employees, and agents harmless from any and all claims, actions, suits, liability, loss, expenses, damages and judgments of any nature whatsoever, including costs and attorney's fees, incurred by the removal of vegetation or physical interference from the drainage facility.

4. When exercising the maintenance provisions of the covenant, in the event of nonpayment, the County may bring suit to recover such costs, including attorney's fees, and upon obtaining a judgment, such amount shall become a lien against the property of Grantor as provided in RCW 4.56.190.

5. Grantor covenants that the owners of the property described herein are the person or persons identified on page 1 of this covenant as Grantors, that they have the right to grant this covenant on the property, and that the title to the property is free and clear of any encumbrances which would interfere with the ability to grant this covenant.

Executed this _____ day of _____, _____

Grantors:

Signature(s): _____ _____

Printed
Name(s): _____ _____

Title of Authorized Representative(s):
(if signing on behalf of a corporation)
_____ _____

 Grantor's Initials_____

Drainage Facility Maintenance Covenant

PFN _____

Additional Signatures (if needed):

_____

_____

Note: Signature(s) of Grantor(s) must be acknowledged by appropriate Notary Form.

Accepted and approved
for Snohomish County:

_____ Date: _____
Director
Snohomish County
Department of Planning and
Development Services

Grantor's Initials_____

CONSENT TO AND APPROVAL OF
DRAINAGE MAINTENANCE COVENANT

_____ (*lender)*, the current Beneficiary of a Deed of Trust recorded under AFN _____ , records of Snohomish County, which deed of trust encumbers the real estate described in Exhibit _____ of the attached Drainage Maintenance Covenant, does hereby consent to the establishment of said covenant

Signed: _____

Title: _____

Date: _____

REPRESENTATIVE ACKNOWLEDGMENT

STATE OF WASHINGTON)
) ss
COUNTY OF SNOHOMISH)

I certify that I know or have satisfactory evidence that _____ is the person who appeared before me, and said person acknowledged that (he/she/they) signed this instrument , on oath stated that (he/she/they) was/were authorized to execute the instrument and acknowledged it as the _____ of _____ to be the free and voluntary act of such party for the uses and purposes mentioned in the instrument.

Dated: _____

Signature: _____
(print name) _____

(Seal or stamp)

NOTARY PUBLIC IN AND FOR THE STATE OF WASHINGTON
My appointment expires _____

INDIVIDUAL ACKNOWLEDGMENT

STATE OF WASHINGTON)
) ss
COUNTY OF SNOHOMISH)

I certify that I know or have satisfactory evidence that
_____
is/are the person(s) who appeared before me, and said person(s) acknowledged that (he/she/they) signed this instrument and acknowledged it to be (his/her/their) free and voluntary act for the uses and purposes mentioned in the instrument.

Dated: _____

Signature: _____
(print name) _____

(Seal or stamp)

NOTARY PUBLIC IN AND FOR THE STATE OF WASHINGTON
My appointment expires _____

_____

REPRESENTATIVE ACKNOWLEDGMENT

STATE OF WASHINGTON)
) ss
COUNTY OF SNOHOMISH)

I certify that I know or have satisfactory evidence that
_____ is the person who appeared before me, and said person acknowledged that (he/she/they) signed this instrument , on oath stated that (he/she/they) was/were authorized to execute the instrument and acknowledged it as the
_____ of _____
to be the free and voluntary act of such party for the uses and purposes mentioned in the instrument.

Dated: _____

Signature: _____
(print name) _____

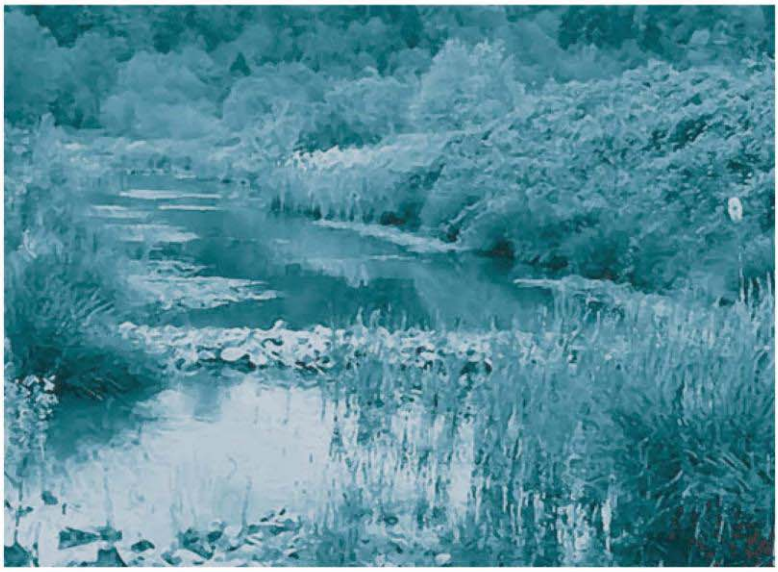
(Seal or stamp)

NOTARY PUBLIC IN AND FOR THE STATE OF WASHINGTON
My appointment expires _____

APPENDIX B

Examples of Private Property Owner Education

Pierce County
Stormwater Maintenance Manual for Private Facilities



Pierce County

DRAFT 6/30/2009

1.0 Introduction: Maintaining Your Stormwater Facilites

The intent of this stormwater maintenance manual is to assist private stormwater management sytem owners in performing proper maintenance of these facilities.

Stormwater management facilities consist of a series of collection and conveyance systems, detention systems, and treatment facilities. They are typically a combination of landscape and structural components that slow, filter, detain, or infiltrate stormwater runoff on-site after a rainfall event. Properly designed, installed and maintained stormwater management facilites protect water quality and reduce flooding.

Pierce County Code Section 17A.40.020 states that private property owners are responsible for maintaining stormwater management structures that they own. Owners should have a maintenance program that addresses every component of the stormwater system, to ensure the system does not lose its intended capability to manage stormwater. Pierce County's "Stormwater Management and Site Development Manual", (Ord. 2008-59s, Ord. 96-47) requires that owners of private stormwater management facilities applying for development after the effective date of the Stormwater Manual conduct routine and non-routine inspection and maintenance of their stormwater system and prepare an annual inspection report to be submitted to Pierce County on or before May 15.

Property owners with private systems constructed prior to the effective date of the *Stormwater Manual* are also required to maintain their stormwater facilities, but are not required to submit the annual inspection and maintenance report to Pierce County.

1.1 How to Apply this Manual

Private owners should review this manual for understanding of the general function of their stormwater management facilities. After determining the type of facilities associated with the owner's site, the owner should download or copy the checklists for each facility and utilize them in facility inspection and maintenance.

It is important to note that there may be more than one facility associated with an individual site. For example, your site may include catch basins, a detention pond, and a control structure/flow restrictor. In this case, all three checklists should be utilized for inspection and maintenance.

1.2 Why Manage Stormwater Runoff?

When it rains or snows in urban areas, the stormwater runs off impervious surfaces (such as roofs and paved areas) instead of soaking into the ground. In the past stormwater runoff has mainly been directed into drains and pipes that carry it off-site for eventual discharge into a river or stream.

The past approach to stormwater management has a number of harmful effects:

- Impervious areas and residential lawns generate large volumes of runoff relatively quickly. The increased volume and rate of runoff can cause flooding and erosion of natural waterways, damage to roads and other manmade structures, and destroy natural wildlife habitat.
- The stormwater runoff picks up oil, pesticides, metals, chemicals, sediment, and other pollutants that harm water quality and fish habitat.
- During warm weather, the runoff absorbs heat from the impervious surfaces. This increases the temperature of the receiving waters, with negative impacts on fish and other aquatic life.
- Less water is able to infiltrate into the ground. This reduces groundwater recharge which reduces summer base flow in streams.

The current approach to stormwater management is for facilities to be designed to help mitigate for these negative effects of stormwater runoff by a combination of reducing or eliminating runoff, treatment of runoff, and/or retention or detention of runoff with a metered release through actions called “Best Management Practices”.

1.3 Frequently Asked Questions

1. **Q.** What are Best Management Practices (BMPs)?

   A. BMPs are a series of actions that are designed to reduce stormwater pollution, prevent discharging contaminants to natural water bodies and reduce stormwater facility maintenance costs. These actions can take several different forms. Examples of these are:

   Behavioral--For example, sweeping a driveway instead of hosing it into the storm drain.

   Procedural--Such as implementing an inventory control program for hydraulic oil or other lubricants to identify changes in consumption. This type of program can be used to identify maintenance problems, and save the business owner money on equipment down-time and lubricant costs.

   Structural--Such as building a roof over a production area, or installing an oil/water separator.

   In general, behavioral and procedural type BMPs will cost the least to implement initially and may save money over time. Structural BMPs typically cost more to construct, operate, and maintain.

   BMPs are separated into two broad categories, namely *source control* and *treatment BMPs*. As the name implies, source control BMPs prevent contaminants from entering stormwater runoff by controlling them at the source. Treatment BMPs are utilized to treat stormwater that is already contaminated. Most treatment BMPs require planning, designing, permitting, and construction, and none can remove 100% of the contaminants in stormwater. These factors, added to the typical expense of treatment BMPs, makes source control BMPs the preferred choice.

2. **Q.** There is a ditch in front of my home. Who is responsible for maintaining it?

   A. If you are in a private development: you and your neighbors will have to maintain the drainage. If you are within a city's limits: contact your city's public works department. If you are not within a city's limits: storm drainage systems in public roads are maintained by the Transportation Division of Public Works and Utilities. The contact number for the Road Maintenance Division is (253)-798-6000. You can also use the online request system at the following URL; http://www.co.pierce.wa.us/cfapps/secure/publicworks/request.cfm

3. **Q**. What methods should we use to control unwanted pests and vegetation?

A. Pierce County encourages the use of an Integrated Pest Management (IPM) approach to control unwanted pests. Pests are any plant or animal life that adversely interferes with the function, safety, and aesthetics of the stormwater facility. IPM is a coordinated decision-making and action process that uses the most appropriate control methods and strategy in an environmentally and economically sound manner.

The IPM approach emphasizes physical, mechanical, cultural, and biological tactics to keep pests and vegetation problems low enough to limit or eliminate the use of chemical control. The major elements of IPM include:

- Preventing pest problems;
- Monitoring for the presence of pests and pest damage;
- Establishing a level of pest population that can be tolerated without being detrimental to the stormwater facilities function or aesthetics of the facility.
- Treating pest problems to reduce populations below those established levels by using the most environmentally sensitive and safe method to control the pest;
- Evaluating the effects and effectiveness of the pest treatment.

Monitoring of pest populations is key to successful IPM implementation. Pest problems are easier to control if the problem is discovered early. With IPM, pesticides are used only as a last resort in order to protect water quality and human health.

More information on IPM is available from the Washington State Department of Agriculture (http://agr.wa.gov) and the Washington State University/Pierce County Extension Service (http://www.pierce.wa.wsu.edu).

4. **Q.** There is tall grass and debris in the pond/creek near my house. Who takes care of this?

A. Publicly owned storm drainage ponds and some creeks are maintained by Surface Water Management. Call the Water Quality/ Flooding and Storm Drainage Line at 253-798-4274 to report your concern. Your call will be routed to a member of our maintenance team for inspection and the scheduling of a work crew if needed. Privately owned storm drain systems must be maintained by the property owner or homeowner's association.

5. **Q.** *t plants should we avoid planting?*

A **.**Non-native, invasive plants should not be planted. Early detection and control of these plants are important to prevent future maintenance problems and increased

maintenance costs. Some native plants, such as red alder (*Alnus rubra*), can increase maintenance costs due to leaf fall into the pond causing clogging problems. Additional plant species to avoid are: English ivy (*Hedera helix*), willow (*Salix* species), black cottonwood (*Populous balsamifera* spp. *trichocarpa*), Himalayan and evergreen blackberry (*Rubas discolor* and *laciniatus*), and cattails (*Typha*).

6. **Q.** *How can we make the stormwater facility more attractive?*

A. The Integrated Pond, a booklet produced by King County, provides information on Integrating stormwater facilities into attractive community spaces. This booklet provides information on planting appropriate vegetation around the facility to make it more attractive or to screen the facility. The booklet can be downloaded from King County's website at (http://www.kingcounty.gov/environment/waterandland/stormwater/documents/integrated-pond.aspx)

Pierce County recommends native plants be used around stormwater facilities. Native plants require less water once they are established, resist pests and diseases better, require less fertilizer and pesticides, and provide wildlife habitat.

Plants differ in their ability to cope with different soils, moisture levels, and sun exposure. When planting next to the stormwater facility, consider future maintenance requirements such as grass mowing and watering requirements. Avoid planting deciduous trees and shrubs adjacent to the facility as their falling leaves may cause blocking problems. Avoid plants with invasive root systems, such as willows, and plants that can blow over easily, such as Red alder and Cottonwood. See *The Integrated Pond* (King County) and the *Low Impact Development Technical Guidance Manual for Puget Sound – Appendices 1 and 3* at (http://www.pierce.wsu.edu/Water_Quality/LID/LID_manual2005.pdf) for a list of native plants appropriate for stormwater facilities. Additional information on native plants can be found on the Washington Native Plant Society website at (http://www.wnps.org/index.html).

To reduce maintenance costs and prevent future water flow problems, it is not recommended to plant shrubs or trees in stormwater ponds below the maximum designed water level. Planting grass or low growing, non-invasive, native plants within the facility may be appropriate but it should be done cautiously so as to not interfere with the functions of the facility. Promptly replant any bare soil areas that could contribute sediments to the stormwater system or cause erosion of the facility.

7. **Q.** *We have a limited maintenance budget. What are the most important vegetation maintenance activities we should do?*

A. The inlets and outlets should be kept clear of vegetation and other potentially blocking material. The pond should not be allowed to become overgrown with noxious or invasive vegetation.

8. **Q.** Where do I find more information on the cost of stormwater maintenance?

A. Unit costs for common maintenance procedures can be found on the Stormwater Managers Resource Center (SMRC) website at:

Stormwater Managers Resource Center (SMRC)

9. **Q.** Can I get credit for maintaining my stormwater facility?

A. A properly maintained storm drainage system can significantly reduce your Surface Water Management Fee.

Credits to the Surface Water Management Fee can be received by meeting the requirements of Pierce County Code Section 11.02.050B.

For more information on receiving stormwater credits call (253) 798-4020.

10. **Q.** Why can't I dump used motor oil and other wastes into the stormwater inlet on my street?

A. Stormwater inlets lead to stormwater management systems that discharge to natural water bodies (e.g. lakes or stream) or to the groundwater. Excessive contaminants, such as motor oils dumped into the storm system, will create the need for more frequent maintenance and higher maintenance costs.

11. **Q.** I wash my own car, how can I be environmentally responsible?

A. The best option is to use a commercial car wash where the wash water is recycled and does not drain to the storm system. Improper disposal of wash water will increase the required maintenance frequency resulting in higher maintenance costs. The Pierce County Stormwater Pollution Prevention Manual provides Best Management Practices (BMPs) for washing vehicles on private property; see additional resources section in Chapter 5.

12. **Q.** Can you make the flooding go away?

A. Not once the flooding has started, but we might be able to help keep it from flooding again. We use input from residents to figure out the best solution to flood problems and to prioritize which projects get constructed first. During a flood, sand bags can be picked up at your local Fire District Headquarters. If a blocked pipe or ditch in the public system is the cause of your flooding, the Road Maintenance Shops may also help with cleaning them out.

County Road Maintenance Hot Line ..... (253) 798-6000
Requests will be acted on within 24 hours or the next business day.

Water Quality/ Flood & Storm Drainage Complaints: ..... (253) 798-4274
Report flooding and private property storm drainage concerns.

13. Q. Where do I find information on the West Nile virus?

A. West Nile virus is a mosquito-borne virus that can cause encephalitis (or meningitis in humans and animals. Preventing mosquito bites and reducing mosquito-breeding habitat around your home are the best ways to protect your family. You should empty containers that hold standing water, such as old tires, buckets, and planters. Also, change the water in your birdbaths, fountains, wading pools and animal troughs weekly, and clean out your rain gutters so that they drain properly.

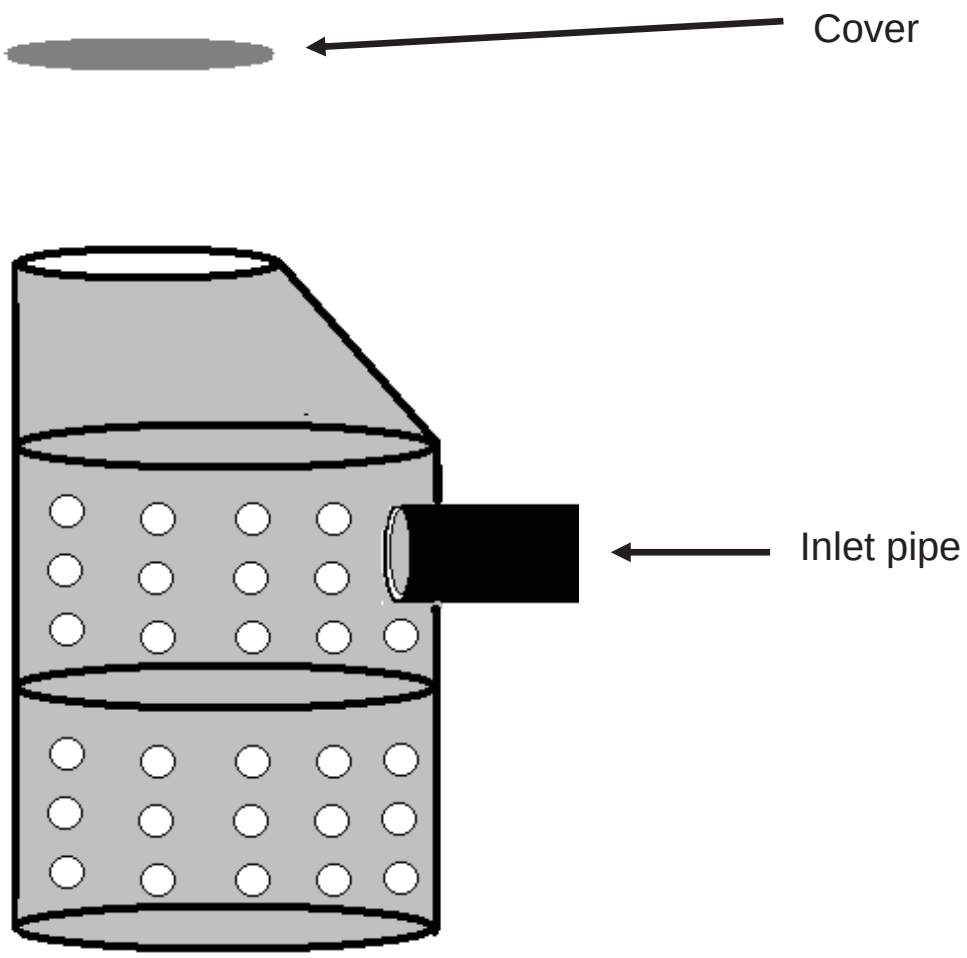
For questions related to West Nile Virus, contact the Tacoma-Pierce County Health Department at (253) 798-6578

Poorly maintained private stormwater drainage facilities can increase breeding sites for mosquitoes in your community or property. Owners of private stormwater drainage facilities can request a courtesy inspection of their system to insure proper operation by contacting Pierce County Surface Water Management at (253) 798-2725.

3.25 Drywell

A drywell is a perforated, open-bottomed manhole used to infiltrate stormwater into the ground. Drywells temporarily store stormwater runoff during rain events. Drywells do not discharge to a downstream conveyance system or nearby surface water. Instead, drywells rely on the ability of the site's soils to absorb the stormwater into the ground.

While not the intended use, drywells trap sediment and some of the oily pollutants in runoff. They are more likely to fill with oily sediment in areas that lack swales or other treatment facilities. Fine oil sediment can clog drywells and lead to localize street flooding. Also, pollutants discharged into drywells can migrate into groundwater. Drywells were often installed in closed topographic depressions, areas with well drained soils, or areas having inadequate storm sewers. Often, drywells contain groundwater. Because drywells can be easily clogged and tend to concentrate pollutants in one place; pollution and sediment control practices should be used to protect them.



3.25 Drywell Checklist

		Date						
Frequency	Drainage System Feature	✓	✓	✓	✓	Problem	Conditions to Check For	Conditions That Should Exist
MONTHLY, STORM	General					Trash & Debris	Trash or debris (in the drywell) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the drywell, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe.	No trash or debris in the drywell.
MONTHLY	General					Contaminants and pollution	Any evidence of oil, gasoline, contaminants or other pollutants in or around facility.	Remove. (Coordinate removal and cleanup with local water quality agency).
MONTHLY	General					Cover damaged or difficult to remove	One maintenance person cannot remove lid after applying normal lifting pressure. Corrosion/deformation of cover. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and installed by one maintenance person.
MONTHLY	General					Cover not in place	Cover is missing or only partially in place. Any open manhole or catch basin requires maintenance.	Manhole or catch basin cover is closed.
MONTHLY	General					Does not dissipate stormwater	Does not dissipate stormwater	Replace or repair.
MONTHLY	General					Ladder damaged	Ladder is unsafe due to missing rungs, misalignment, not securely attached to structure wall, rust, cracks, corrosion, or sharp edges. Confined space warning sign is missing.	Ladder meets design standards. Allows maintenance person safe access. Replace sign warning of confined space entry requirements. Ladder and entry notification complies with OSHA standards.
ANNUAL	Structure					Structure damage	Maintenance/inspection personnel determine that drywell is not structurally sound.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound.

Drywell Checklist (Continued)

		DANNUALte						
Frequency	Drainage System Feature	✓	✓	✓	✓	Problem	Conditions to Check For	Conditions That Should Exist
ANNUAL	Structure					Structure Damage	Cracks wider than ½-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 ¼-inch at the joint of the inlet/outlet pipe.
MONTHLY	General					Opening clogged	Openings are clogged, reducing capacity.	Water-jet clogged openings; or Convert existing, clogged drywell to a sediment trap and install a new drywell or drainage trench. To convert to a sediment trap, required are grouting holes, covering the base with concrete, and adding piping.
MONTHLY	General					Sediment	Sediment is greater than 1/3 of the distance between the base and the inlet pipe.	Remove. Do not allow sediment and water to discharge back into the storm sewer.
MONTHLY	General					Standing water	Standing water indicates the drywell is into the water table.	Rebuild drywell to prevent stormwater from going directly into groundwater.

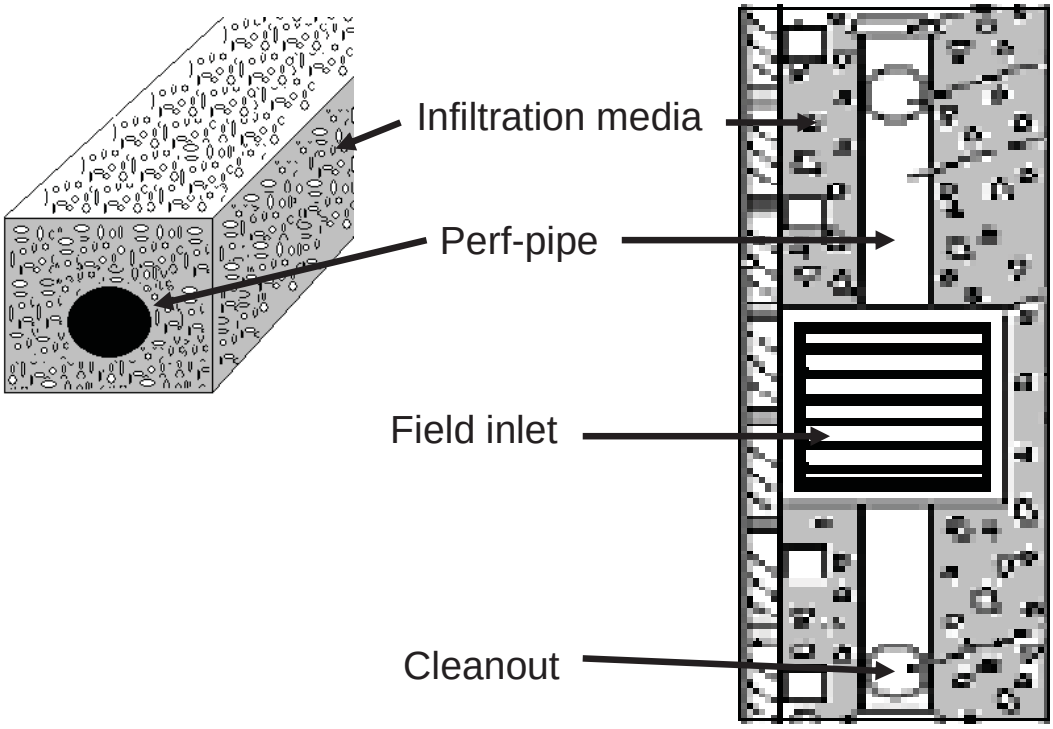
If you are unsure whether a problem exists, please contact a Professional Engineer.

Comments:

Key:
(MONTHLY) Monthly from November through April.
(ANNUAL) Once in late summer (preferable September)
(STORM) After any major storm (use 1-inch in 24 hours as a guideline).

3.28 Infiltration Trench

A stormwater infiltration trench is a closed basin built by excavating below existing ground. Infiltration trenches temporarily store stormwater runoff during rain events. Infiltration trenches do not discharge to a downstream conveyance system or nearby surface water. Instead, infiltration trenches rely on the ability of the site's soils to absorb the stormwater into the ground.



3.28 Infiltration Trench Checklist

		Date						
Frequency	Drainage System Feature	✓	✓	✓	✓	Problem	Conditions to Check For	Conditions That Should Exist
MONTHLY	General					Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants in or around facility.	Remove. (Coordinate removal and cleanup with local water quality response agency).
MONTHLY	General					Drainage Slow	Drainage Trench - decreased capacity that indicates slow drainage.	Verify facility design rate. Clean perforated drain pipe. Do not allow removed sediment and water to discharge back into the storm sewer.
MONTHLY	General					Sediment & Debris	Sediment depth is greater than 20% of pipe diameter.	Clean pipe and remove material.
MONTHLY	General					Trash & Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%.	No Trash or debris located immediately in front of catch basin or on grate opening.
MONTHLY	General					Trash & Debris	Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe.	No trash or debris in the trench.
MONTHLY	General					Trash & Debris	Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height.	Inlet and outlet pipes free of trash or debris.
MONTHLY	General					Trash & Debris	Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within the catch basin.

If you are unsure whether a problem exists, please contact a Professional Engineer.

Comments:

Key:
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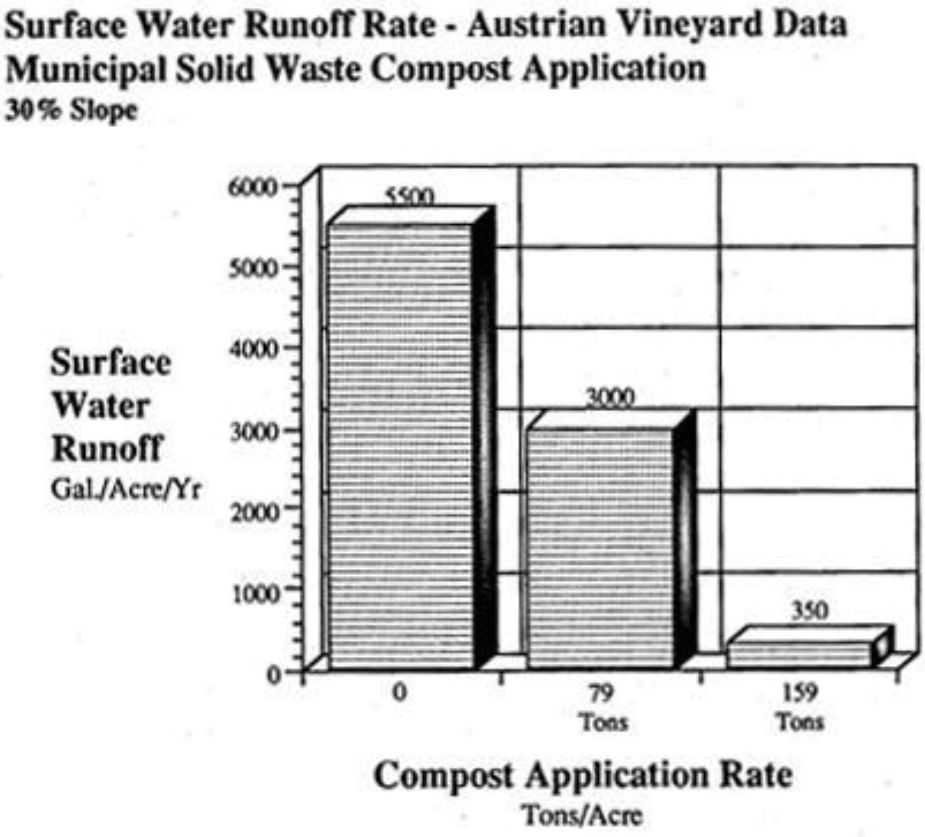
3.31 Compost Amended Soils

Amending a soil with compost increases the soil's permeability and water holding capacity, thereby delaying and often reducing the peak stormwater run-off flow rate, and decreasing irrigation water requirements. Amending soils will also enhance the lawn's long-term aesthetics while reducing fertilizer and pesticide requirements.



3.31 Compost Amended Soil

		Date						
Frequency	Drainage System Feature	✓	✓	✓	✓	Problem	Conditions to Check For	Conditions That Should Exist
ANNUAL	General Facility Requirements					Soil media (maintain high organic soil content	Vegetation not fully covering ground surface.	Re-mulch landscape beds with 2-3 inches of mulch until the vegetation fully closes over the ground surface
Ongoing	General Facility Requirements					Soil media (maintain high organic soil content	None. Preventative maintenance	Return leaf fall and shredded woody materials from the landscape to the site as mulch.
Ongoing	General Facility Requirements					Soil media (maintain high organic soil content	None. Preventative maintenance	On turf areas, “grasscycle” (mulch-mow or leave the clippings) to build turf health
Ongoing	General Facility Requirements					Soil media (maintain high organic soil content	None. Preventative maintenance .	Avoiding broadcast use of pesticides (bug and weed killers) like “weed & feed,” which damage the soil life.
ANNUAL	General Facility Requirements					Soil media (maintain high organic soil content	None. Preventative maintenance	Where fertilization is needed (mainly turf and annual flower beds), a moderate fertilization program which relies on natural organic fertilizers (like compost) or slow release synthetic balanced fertilizers.
ANNUAL	General Facility Requirements					Compaction	Soils become waterlogged, do not appear to be infiltrating.	To remediate, aerate soil, till or further amend soil. If drainage is still slow, consider investigating alternative causes (e.g., high wet-season groundwater levels, low permeability soils). Also consider landuse and protection from compacting activities. If areas are turf, aerate compacted areas and top dress them with ¼-½ inch of compost to renovate them.
ANNUAL	General Facility Requirements					Erosion/scouring	Areas of potential erosion are visible.	Take steps to repair or prevent erosion. Identify and address the causes of erosion.
ANNUAL	General Facility Requirements					Grass/vegetation	Less than 75% of planted vegetation is healthy with a generally good appearance.	Take appropriate maintenance actions (e.g., remove/replace plants)

MONTHLY	General Facility Requirements					Noxious weeds	Listed noxious vegetation is present. See Pierce County noxious weed list.	By law, noxious weeds must be removed and disposed immediately. It is strongly encouraged that herbicides and pesticides not be used in order to protect water quality.
QUARTERLY	General Facility Requirements					Weeds	Weeds are present.	Remove and dispose of weed material. It is strongly encouraged that herbicides and pesticides not be used in order to protect water quality.

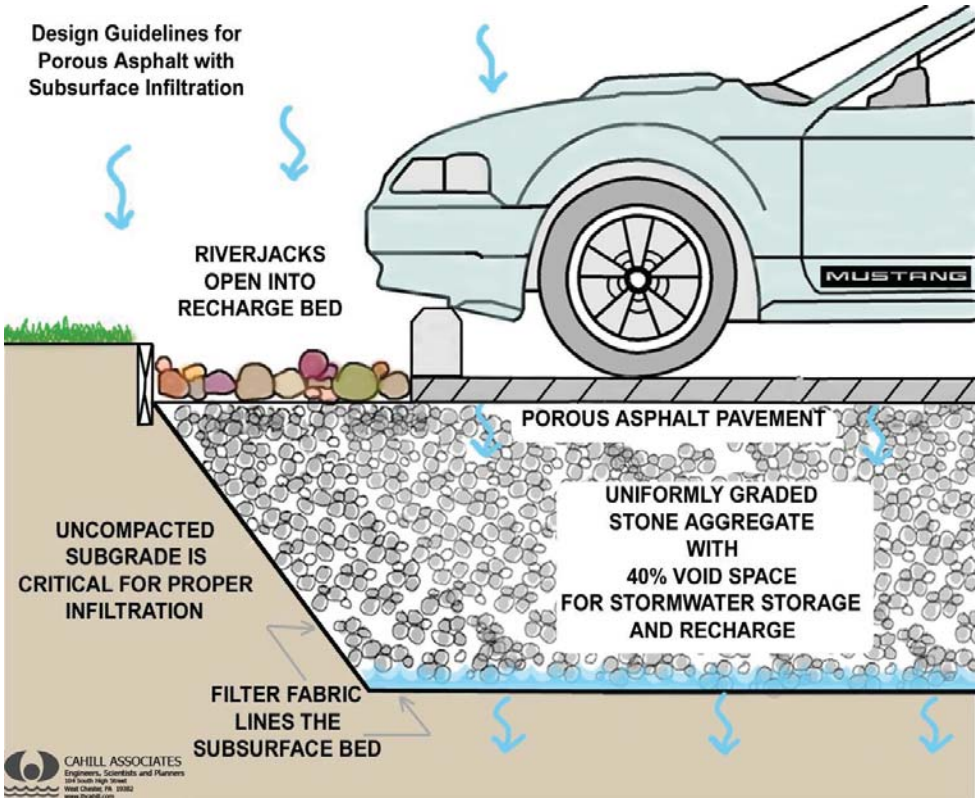
If you are unsure whether a problem exists, please contact a Professional Engineer.

Comments:

Key:
(MONTHLY) Monthly from November through April.
(ANNUAL) Once in late summer (preferable September)
(STORM) After any major storm (use 1-inch in 24 hours as a guideline).
(Biannually) Twice per year in the spring and fall
(Quarterly) 4 times per year

3.32 Pervious Pavement

Pervious paving allows water to infiltrate into layers of gravel placed below the paving and then into soil and groundwater below. By infiltrating most of the storm water on-site, the amount of water and pollution flowing into storm sewers and directly to rivers and streams is greatly reduced. This, in turn, protects water quality, maintains more stable base flows to streams, reduces flood peaks, and reduces stream bank erosion. With infiltration, groundwater is recharged and streams are replenished with cool, clean groundwater in a more natural way. Pervious paving is one component of Low Impact Development (LID).



3.32 Pervious Pavement

		Date						
Frequency	Drainage System Feature	✓	✓	✓	✓	Problem	Conditions to Check For	Conditions That Should Exist
BIANNUAL	Surface					Pervious asphalt or cement concrete	None. Maintenance to prevent clogging with fine sediment.	Use conventional street sweepers equipped with vacuums, water, and brushes or pressure washer to restore permeability. Vacuum or pressure wash the pavement two to three times annually.
Ongoing	Surface					Pervious asphalt or cement concrete	None. Maintenance to prevent clogging with fine sediment.	Prohibit use of sand and sealant application and protect from construction runoff.
ANNUAL	Surface					Pervious asphalt or cement concrete	Major cracks or trip hazards.	Fill with patching mixes. Large cracks and settlement may require cutting and replacing the pavement section.
As needed	Surface					Pervious asphalt or cement concrete	Utility cuts. .	See utility restoration protocol on SPU NDS website.
BIANNUAL	Surface					Fallen leaves / debris	Fallen leaves or debris.	Remove/dispose.
BIANNUAL	Surface					Interlocking concrete paver blocks .	Interlocking paving block missing or damaged.	Replace damaged paver block .
ANNUAL	Surface					Interlocking concrete paver blocks	Settlement of surface. .	May require resetting
BIANNUAL	Surface					Interlocking concrete paver blocks	Sediment or debris accumulation between paver blocks.	Remove/dispose
ANNUAL	Surface					Interlocking concrete paver blocks	Loss of void material between paver blocks.	Refill per manufacturer's recommendations.
Varies	Surface					Interlocking concrete paver blocks	Varied conditions.	Perform O&M per manufacturer's recommendations.
BIANNUAL	Surface					Open-celled paving grid with gravel	Sediment or debris accumulation in grid voids.	Remove/dispose
ANNUAL	Surface					Open-celled paving grid with gravel	Loss of soil and/or grass material in grid.	Refill and/or replant per manufacturer's recommendations.

Varies	Surface					Open-celled paving grid with gravel	Varied conditions.	Perform O&M per manufacturer's recommendations.
BIANNUAL	Surface					Open-celled paving grid with grass	Sediment or debris accumulation in grid voids.	Remove/dispose
ANNUAL	Surface					Open-celled paving grid with grass	Loss of soil and/or grass material in grid.	Refill and/or replant per manufacturer's recommendations.
Varies	Surface					Open-celled paving grid with grass	Varied conditions.	Perform O&M per manufacturer's recommendations.
BIANNUAL	Overflows and Emergency Spillways					Obstructions / debris	Obstructions or debris block 30% or more of outlet structure.	Remove/dispose
BIANNUAL	Overflows and Emergency Spillways					Erosion	Native soil is exposed or other signs of erosion damage are present.	Repair erosion and stabilize surface of spillway
Ongoing	Spill Prevention and Response					Spill prevention	Storage or use of potential contaminants in the vicinity of facility.	Exercise spill prevention measures whenever handling or storing potential contaminants
As needed	Spill Prevention and Response					Spill response	Release of pollutants. Call to report any spill to the the Wa Dept of Emergency Management 1-800-258-5990	Cleanup spills as soon as possible to prevent contamination of stormwater

If you are unsure whether a problem exists, please contact a Professional Engineer

Comments:

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5.0 Developing a Maintenance Program

A stormwater maintenance program is essential to ensure that the facilities continue to function as designed to prevent possible flooding, property damage, water quality problems and expensive future repairs. The maintenance program consists of inspections and repairs as detailed in the maintenance checklists provided in Section 3.0.

Stormwater management facilities are most effective coupled with good housekeeping procedures. Good housekeeping includes educating facility users of proper storage and disposal of chemicals and potential pollutants, procedures for spill cleanup, proper use of fertilizers and other lawn care products, and maintenance of equipment to prevent release of pollutants to the stormwater system. Guidelines for establishing good housekeeping procedures (I.E. Source Control BMPs) and developing a training program to educate facility users can be found in the Pierce County Surface Water Management Webpage at Stormwater Pollution Prevention Manual located at:

http://www.co.pierce.wa.us/swm

5.1 Who Should Perform Maintenance Duties?

Private stormwater facility owners are responsible for ensuring that the facilities are maintained and continue to function as designed. Some activities such as litter removal and mowing can be effectively undertaken by facility owners, however, it is usually worth the cost to have a professional do the more difficult tasks. Filling eroded areas and soil disturbing activities, such as reseeding or re-planting vegetation are tasks that a professional landscaping firm should manage. If these tasks are not performed properly, erosion may occur resulting in accelerated sedimentation of stormwater facilities. Grading and sediment removal are tasks that are best left to professional contractors with the equipment and experience to safely perform the task and who are also able to identify potential problems early when it is most cost effective to make repairs or alterations.

5.2 Working with Maintenance Contractors

The following is a guideline for researching and choosing a qualified contractor to meet your maintenance needs.

Start your search for a contractor the right way - be informed. The information provided below will help you in your search for the right contractor for your job.

- Landscape maintenance contractors are typically capable of providing most routine maintenance for stormwater facilities. Special, non-routine maintenance may require an earthwork contractor or vactor company. Recently, several contractors have started specializing in stormwater facility maintenance. Private owners can choose to hire contractors when individual maintenance needs arise or enter into annual maintenance agreements where the contractor monitors and provides routine maintenance throughout the year as needed.

- Develop a list of potential contractors. Look in the Yellow Pages and/or ask friends, neighbors, relatives, and coworkers who they have used. Find out if their experiences were good or bad and why. Ask if they would use the contractor again.

- Ask contractors for references. Call your potential contractors and ask for a list of their customers or locations of completed jobs. Call references and ask whether they were satisfied with the job done, if the contractor kept to the agreed upon schedule, and whether they would hire the same contractor again.

- Ask to which trade associations the contractor belongs. Membership in a professional association is one sign the contractor recognizes the responsibilities of being a professional.

- Make sure to obtain and evaluate bids. Ask for a free written estimate of the work you want done. Be sure everyone is bidding on the same exact scope of work and including the exact materials you want. Be sure all quotes include everything you want and that there is a clear understanding of work to be performed by owner and work to be performed by contractor.

- Remember *"you get what you pay for."* A higher bid may be worth the price for better workmanship and contractor reliability.

- Make sure you understand the different types of bids you may receive. Be careful about hiring a contractor on an hourly time-and-materials, or cost-plus basis. Although the price may seem high at first, a fixed-price bid may give you the best protection and price. Also beware of "special deals," "demonstration projects," or *"a great deal from a friend of a friend."* Completely review and understand the contract prior to authorizing work.

Questions to Ask Before Hiring a Contractor

- What experience, expertise and/or certification do you have? Do you specialize?
- Who will be doing the actual work: you personally, your employees, or subcontractors?
- Who will oversee the day-to-day job? (You may really like the contractor, but that person may not be the one performing or supervising the work.)
- How many other jobs will you be working on at the same time as mine? (If there are several, yours may not get the attention you want. On the other hand, the contractor's business may be large and he may be able to handle several jobs.)
- How long will the job take? What kind of mess, noise, and inconvenience should I expect? What problems may come up? (Asking questions before the job starts helps prevent surprises later.)
- Where will you dispose of material removed from storm drainage facilities? Is there an extra fee for contaminated materials?
- Does hiring this contractor feel right? (Use intuition - if you do not feel comfortable, find someone else.)
- Do I have rapport with this contractor? Am I confident in his expertise and ideas? Does he care about my concerns? Will he be reliable, keep his appointments, and return my telephone calls?
- Can I communicate with this person? Does he seem honest and forthright? (The contractor may be top-notch at the trade, but if the final product is not what you expected, you will not be happy.)
- Am I willing to be reasonable about unexpected costs that arise and to let my contractor make a profit?
- Am I ready for the unexpected, such as digging into solid rock, major replacement, etc.?
- Can I be flexible when the job takes longer than expected?
- Are my expectations so high that I will never be satisfied with my contractor?

5.3 How much will it Cost to Maintain a Stormwater Management System?

Specific maintenance costs depend on the characteristics of the facility, the site, and the area that contributes runoff to the facility. The general rule of thumb is that annual maintenance costs will be 5 to 10% of the facility's total capital cost. Routine, scheduled maintenance can help keep overall costs down by addressing problems before they require major attention.

Most of the routine maintenance measures recommended in the checklists (excluding major repair and replacement) are estimated to have an annual cost of $200 to $600 per acre of facility, above current landscape maintenance costs. Costs can vary depending on the types and level of maintenance practices used.

The cost and intensity of maintenance activities are usually higher during the two-year plant establishment period than after the facility has "settled in" after those first two years.

You need to determine how you will finance your maintenance needs. A healthy reserve should be put into place for both capital maintenance procedures (e.g., facility replacement and non-routine maintenance such as sediment removal, facility component repair or replacement, major replanting, or safety structure construction) and operating maintenance procedures (routine activities such as facility inspection, debris removal, and vegetation management).

The best recommendation is to establish a facility maintenance fund. For homeowner associations, this could be a portion of homeowner fees or a specific assessment. The fund should include:

- Ten percent of the facility's capital cost for annual routine maintenance per year.

- A percentage of the non-routine maintenance costs per year (i.e. for sediment removal, vegetation replacement) based on the frequency of removal. For example, if the facility needs mechanical sediment removal every 10 years, 10 percent of the total cost should be put aside each year.

- An additional 3 to 5% of the facility's capital cost per year for eventual facility replacement, based on the facility's life expectancy. Most of these facilities have a life expectancy of 25 to 50 years.

6.0 Additional Information/Resources

For more information on operation and maintenance of your stormwater management system contact:

Pierce County Department of Public Works and Utilities, Surface Water Management Division, (253) 798-2725

Or refer to information provided in the following resources:

Pierce County Stormwater Pollution Prevention Manual
http://www.co.pierce.wa.us/PC/services/home/environ/water/swm/sppman/

King County Drainage Maintenance Standards for Commercial and Multifamily Drainage Facilities, 1997.
http://dnr.metrokc.gov/wlr/stormwater/DrainMaint.htm

Puget Sound Shoreline Stewardship Guide Book,
http://dnr.metrokc.gov/wlr/watersheds/puget/puget-sound-guidebook.htm