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P20974

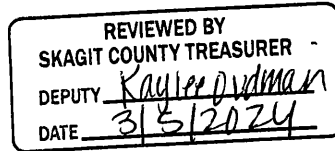
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Signed

Kate Atkinson

Dated

3/12/24



**Permanent Stormwater Control Facilities
Operation and Maintenance (O&M) Manual**

for:

Bay Heights Plat

Located at:

16850 Peterson Road – Bay Heights Place , Burlington WA

Prepared for:

KSA Investments, LLC

Prepared by:

Sound Development Group, LLC

Inspection and maintenance requirements may change in the future, and this manual does not exempt this facility from any future changes in inspection and maintenance requirements.

Parcel Number – P20974

Sec/Twp/Rng - Section 2, Township 34 North, Range 3 East

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1.0 Introduction

The intent of this stormwater maintenance manual is to provide the lot owners/HOA of Bay Heights Plat assistance in performing proper maintenance of their stormwater facilities.

Private property owners are responsible for maintaining their own stormwater management structures. The Department of Ecology and Skagit County suggests regular, routine inspections and maintenance of the systems to ensure the facilities perform properly.

On-site stormwater management facilities consist of collection, conveyance and treatment systems. The roof drain collection and conveyance system will convey the roof runoff from the building rooftops directly to the existing storm system within Bay Heights Road. The driveway and street runoff sheet flows and is collected and conveyed through a bioretention cell/gravel trench bed and catch basin and pipe network to the onsite detention pond.

Record construction drawings should be consulted for pipe size, material, and locational information.

Record Construction drawings should be consulted during maintenance, inspection and repair activities; a copy of the record drawings will be kept at the Skagit County Planning and Development Services office.

2.0 Stormwater Management Facilities

It is useful to have a general knowledge of how the stormwater management facilities on site function, to better understand the facility's maintenance requirements. There is one component to the existing system: collection and conveyance control.

2.1 Collection and Conveyance Systems

Collection and conveyance systems intercept and transport stormwater, and consist of catch basin inlets, sheet flow, ditches, French drains and pipes (solid and perforated) that convey the water. Stormwater conveyance systems are designed to provide adequate capacity for the site's stormwater. Typical failures include reduced capacity due to clogged catch basin grates or pipes, and erosion within ditches. Plugging commonly occurs due to sediment and large debris washed down from adjacent surfaces. Reduced conveyance system capacity can result in localized flooding.

2.2 Stormwater Quality Control

Stormwater treatment facilities onsite provide sediment settling and filtration through soils and vegetation or mechanical treatment with a Stormfilter. Stormwater treatment facilities have limited treatment capability, and are not intended to replace proper site management. The most effective technique for reducing pollutant discharge from the site is to provide good housekeeping through source control Best Management Practices, provided in Appendix A.

2.3 Stormwater Quantity Control

Stormwater flow control facilities onsite provide mitigation for the additional runoff that the development creates. Stormwater control facilities are engineered to detain stormwater runoff, discharging stormwater to match the historical conditions and durations of outflow, for certain storm events.

3.0 Facility Descriptions

Each of the following subsections includes a facility description. The required maintenance and checklists can be found in Appendices D through J – Maintenance Checklists.

- 3.1 Catch Basins / Area Drains
- 3.2 Fencing / Shrubbery / Landscaping
- 3.3 Roof Downspouts
- 3.4 Energy Dissipators
- 3.5 Contech Stormfilter
- 3.6 Bioretention Cell
- 3.7 French Drains
- 3.8 Detention Pond
- 3.9 Conveyance Ditches / Swales

3.1 Catch Basins / Culverts

Catch basins are underground concrete structures typically provided with a slotted grate to collect stormwater runoff and route it through underground pipes.

A Concrete Inlet, Type 1 and 1L are rectangular structures, utilized when the connected pipes are less than 18" in diameter and the depth from the grate to the bottom of the lowest pipe is less than 5 feet.

A Type 2 catch basin is a round structure, ranging in diameter of 4 to 8 feet, and is utilized when the connecting pipes are 18" or greater in diameter, or the depth from grate to bottom of the lowest pipe exceeds 5 feet. They will typically have a ladder mounted on the inside of the structure to allow for access and maintenance.

A Burlington basin, yard drain or other localized area drain is a small rectangular or circular structure, utilized at intersections or directional changes for roofdrains, yard drains, or other small diameter pipes.

A PVC overflow structure (OFS) is constructed with a pvc pipe, vertical, with a grate in the top, to allow bioretention cells to overflow into the conveyance system/underground infiltration trench, when the bioretention cell has ponded to its maximum depth.

A PVC cleanout structure (CO) is constructed with pvc material, vertical, and allows maintenance access through the top of the pipe through a cap or plug.

All catch basin types typically provide a storage volume below the outlet pipe, called a sump, to allow sediments and debris to settle out of the stormwater runoff.

The most common cleaning method for basin sumps is to utilize a truck with a tank and vacuum hose (vactor truck) to remove sediment and debris buildup from the sump. Catch basins are an enclosed space, where vapors can accumulate. If the inspection or cleaning requires entering the catch basin, it should be conducted by an individual with training and certification in working in hazardous, confined spaces.

There are seven (7) Type I, two (2) Type II, and five (5) Overflow Structures on-site, and a minimum of six (6) cleanouts. See Appendix C for a direct list of catch basin ID's. There is one (1) Stormfilter on site, see section 3.5 for description.

See Record Drawings attached, for pipe sizes and slopes.

3.2 Fencing / Shrubbery / Landscaping

Landscaping is an essential component of stormwater management. Bare soil areas generate higher levels of stormwater runoff and sedimentation in stormwater facilities. There are small and large landscaped areas on site, as well as some steeper areas along the property lines that are especially prone to erosion if not maintained.

Landscaping and vegetation should be maintained, deleterious plants and materials removed. Erosion or other types of soil disturbance should be remedied on a regular basis, and new mulch applied bi-yearly.

See Appendix D for maintenance items and schedule.

3.3 Roof Downspouts

Building downspouts connect the building's roof gutters to a storm conveyance system. The roof water is, under normal circumstances, considered "clean" and un-polluted. The buildings onsite are tightlined to a roof drain, and discharged to the existing street storm system directly or through several different ditches.

Downspout systems need to be inspected each year and jetted if a build-up of deleterious material is found. Jetting shall occur from the cleanout to a downstream CB or ditch.

Gutters must be maintained and kept clean and free of silt and deleterious organics. See Appendix E for maintenance items and schedule.

3.4 Energy Dissipator

An energy dissipator is designed to reduce the velocity of stormwater inflow, to protect downstream areas from erosion. The energy dissipators utilized on site include quarry spall rock pads and protection. The water is dispersed across and through the rock as it enters the dissipator, slowing the water considerably. The quarry spalls may be underlain by a geotextile fabric, to minimize erosion and scouring underneath the rocks.

All pipe outlets on site are protected with quarry spall pads/outlet protection.

Typical maintenance of energy dissipators includes removal of trash, debris, deleterious plants/weeds, removal of silt buildup, rock replacement.

See Appendix F for maintenance items and schedule.

3.5 Contech Stormfilter

A Stormfilter will remove fine particles and sediments as well as treat the water for hydrocarbons, metals and other unwanted contaminants.

There is one Stormfilter onsite.

Typical maintenance of Stormfilters includes removal of trash, debris, removal of silt buildup, and importantly, the replacement of the filter cartridge within the unit.

See Appendix G for maintenance items and schedule.

3.6 Bioretention Cells

Bioretention cells are localized depressions within the landscaped areas, that can collect runoff from the adjoining impervious areas. These shallow ponding areas are constructed with an engineered soil mix and plants, that treat the stormwater as the stormwater infiltrates through the system, into an underlying rock reservoir and pipe underdrain.

The bioretention cells both treat the stormwater they catch, and provide a small amount of detention within the cell and underlying rock reservoir, while infiltration into the underlying soils occurs.

Typical maintenance of bioretention cells includes removal of trash, debris, deleterious plants/weeds, soil maintenance, and renewal of plants and mulch/organic soils within the bottom.

See Appendix H for maintenance items and schedule.

3.7 French Drain

A french drain captures sheet flow runoff and conveys or retains the water utilizing a perforated pipe.

There will only be one French drain on site after development of Lot 11, at the southwest corner of said lot. Typical maintenance of a French drain will include the maintenance of all other stormwater appurtenances (yard drains). The failure of one part of the system can expedite the failure of the underground french drain. To prevent the failure and necessary removal and replacement of these underground systems, good housekeeping, preventative maintenance, spill prevention and cleanup, inspections of pollutant sources upstream of the trenches, are the best measures to keep silt and pollutants from entering the and prevent/prolong the need for expensive maintenance.

See Appendix I for maintenance items and schedule.

3.8 Detention Pond

A detention pond retains the stormwater while it discharges at historical rates, providing flow control, prevent flooding and downstream erosion, and reduces stormwater pollutant loading to local surface waters.

There is one regional detention pond, at the northwest corner of the parent property.

Typical maintenance of a detention pond will include removal of trash, debris, deleterious/hazardous plants/weeds, removal of silt/sediment buildup, berm management, fence repair, access road maintenance. Good housekeeping, preventative maintenance, spill prevention and cleanup, inspections of pollutant sources upstream of the pond, are the best measures to keep silt and pollutants from entering the pond, and prevent/prolong the need for expensive maintenance.

See Appendix J for maintenance items and schedule.

3.9 Conveyance Ditches / Swales

A conveyance ditch or swale, will intercept/capture sheet flow or convey a point discharge of stormwater, down a slope. The channel is either lined with quarry spall rock, or vegetated with grasses or other low growing, mowable, native type vegetation. There is one conveyance ditches/swales onsite at the northwest corner of the road, providing conveyance from the street outlet, to the most northernmost bioretention cell.

Typical maintenance of a conveyance ditch will include the removal of trash, debris, deleterious/hazardous plants/weeds, removal of silt/sediment buildup, maintaining cross section, and berm management. See Appendix K for maintenance items and schedule.

4.0 Source Control Best Management Practices

Source control Best Management Practices address multiple situations that may occur at the proposed development. Source control of pollution can prevent damage to the onsite stormwater system and its components. Source control Best Management Practices can be found in Appendix A, and are listed below:

- Landscaping and Lawn/Vegetation Management (S411 BMP)
- Maintenance of Stormwater Drainage and Treatment Systems (S417 BMP)
- Roof / Building Drains (S424 BMP)
- Spills of Oil and Hazardous Substances (S426 BMP)

Appendix A – Source Control Best Management Practices

S417 BMPs for Maintenance of Stormwater Drainage and Treatment Systems

Description of Pollutant Sources: Facilities include roadside catch basins on arterials and within residential areas, conveyance systems, detention facilities such as ponds and vaults, oil/water separators, biofilters, settling basins, infiltration systems, and all other types of stormwater treatment systems presented in Volume V. Oil and grease, hydrocarbons, debris, heavy metals, sediments and contaminated water are found in catch basins, oil and water separators, settling basins, etc.

Pollutant Control Approach: Provide maintenance and cleaning of debris, sediments, and other pollutants from stormwater collection, conveyance, and treatment systems to maintain proper operation.

Applicable Operational BMPs:

Maintain stormwater treatment facilities per the operations and maintenance (O&M) procedures presented in Appendix V-A: BMP Maintenance Tables in addition to the following BMPs:

- Inspect and clean treatment BMPs, conveyance systems, and catch basins as needed, and determine necessary O&M improvements.
- Promptly repair any deterioration threatening the structural integrity of stormwater facilities. These include replacement of clean-out gates, catch basin lids, and rock in emergency spill-ways.
- Ensure adequacy of storm sewer capacities and prevent heavy sediment discharges to the sewer system.
- Regularly remove debris and sludge from BMPs used for peak-rate control, treatment, etc. and discharge to a sanitary sewer if approved by the sewer authority, or truck to an appropriate local or state government approved disposal site.
- Clean catch basins when the depth of deposits reaches 60 percent of the sump depth as measured from the bottom of basin to the invert of the lowest pipe into or out of the basin. However, in no case should there be less than six inches clearance from the debris surface to the invert of the lowest pipe. Some catch basins (for example, WSDOT's *Catch Basin Type 1L* (WSDOT, 2011)) may have as little as 12 inches sediment storage below the invert. These catch basins need frequent inspection and cleaning to prevent scouring. Where these catch basins are part of a stormwater collection and treatment system, the system owner/operator may choose to concentrate maintenance efforts on downstream control devices as part of a systems approach.
- Properly dispose of all solids, polluted material, and stagnant water collected through system cleaning. Do not decant water back into the drainage system from eductor trucks or vacuum equipment since there may be residual contaminants in the cleaning equipment. Do not jet material downstream into the public drainage system.
- Clean woody debris in a catch basin as frequently as needed to ensure proper operation of the catch basin.
- Post warning signs; "Dump No Waste - Drains to Ground Water," "Streams," "Lakes," or emboss on or adjacent to all storm drain inlets where possible.
- Disposal of sediments and liquids from the catch basins must comply with Appendix IV-B: Management of Street Waste Solids and Liquids

S411 BMPs for Landscaping and Lawn / Vegetation Management

Description of Pollutant Sources: Landscaping can include grading, soil transfer, vegetation planting, and vegetation removal. Examples include weed control on golf course lawns, access roads, and utility corridors and during landscaping; and residential lawn/plant care. Proper management of vegetation can minimize excess nutrients and pesticides.

Pollutant Control Approach:

Maintain appropriate vegetation to control erosion and the discharge of stormwater pollutants. Prevent debris contamination of stormwater. Where practicable, grow plant species appropriate for the site, or adjust the soil properties of the site to grow desired plant species.

Applicable BMPs:

- Install engineered soil/landscape systems to improve the infiltration and regulation of storm-water in landscaped areas.
 - Select the right plants for the planting location based on proposed use, available maintenance, soil conditions, sun exposure, water availability, height, sight factors, and space available.
 - Ensure that plants selected for planting are not on the noxious weed list. For example, butterfly bush often gets planted as an ornamental but is actually on the noxious weed list.
- The Washington State Noxious Weed List can be found at the following webpage:
<https://www.nwcb.wa.gov/printable-noxious-weed-list>
- Do not dispose of collected vegetation into waterways or storm sewer systems.
 - Do not blow vegetation or other debris into the drainage system.
 - Dispose of collected vegetation such as grass clippings, leaves, sticks by composting or recycling.
 - Remove, bag, and dispose of class A & B noxious weeds in the garbage immediately.
 - Do not compost noxious weeds as it may lead to spreading through seed or fragment if the composting process is not hot enough.
 - Use manual and/or mechanical methods of vegetation removal (pincer-type weeding tools, flame weeders, or hot water weeders as appropriate) rather than applying herbicides, where practical.
 - Use at least an eight-inch "topsoil" layer with at least 8 percent organic matter to provide a sufficient vegetation-growing medium.
 - Organic matter is the least water-soluble form of nutrients that can be added to the soil. Composted organic matter generally releases only between 2 and 10 percent of its total nitrogen annually, and this release corresponds closely to the plant growth cycle. Return natural plant debris and mulch to the soil, to continue recycling nutrients indefinitely.
 - Select the appropriate turfgrass mixture for the climate and soil type.
 - Certain tall fescues and rye grasses resist insect attack because the symbiotic endophytic fungi found naturally in their tissues repel or kill common leaf and stem-eating lawn insects.
 - The fungus causes no known adverse effects to the host plant or to humans.
 - Tall fescues and rye grasses do not repel root-feeding lawn pests such as Crane Fly larvae.
 - Tall fescues and rye grasses are toxic to ruminants such as cattle and sheep
 - Endophytic grasses are commercially available; use them in areas such as parks or golf courses where grazing does not occur.
 - Local agricultural or gardening resources such as Washington State University Extension office can offer advice on which types of grass are best suited to the area and soil type.
 - Use the following seeding and planting BMPs, or equivalent BMPs, to obtain information on grass mixtures, temporary and permanent seeding procedures, maintenance of a recently planted area, and fertilizer application rates: BMP C120: Temporary and Permanent Seeding, BMP C121: Mulching, BMP C123: Plastic Covering, and BMP C124: Sodding.
 - Adjusting the soil properties of the subject site can assist in selection of desired plant species. Consult a soil restoration specialist for site-specific conditions.

Recommended Additional BMPs:

- Conduct mulch-mowing whenever practicable.
- Use native plants in landscaping. Native plants do not require extensive fertilizer or pesticide applications. Native plants may also require less watering.

- Use mulch or other erosion control measures on soils exposed for more than one week during the dry season (May 1 to September 30) or two days during the rainy season (October 1 to April 30).
- Till a topsoil mix or composted organic material into the soil to create a well-mixed transition layer that encourages deeper root systems and drought-resistant plants.
- Apply an annual topdressing application of 3/8" compost. Amending existing landscapes and turf systems by increasing the percent organic matter and depth of topsoil can:
 - Substantially improve the permeability of the soil.
 - Increase the disease and drought resistance of the vegetation.
 - Reduces the demand for fertilizers and pesticides.
- Disinfect gardening tools after pruning diseased plants to prevent the spread of disease.
- Prune trees and shrubs in a manner appropriate for each species.
- If specific plants have a high mortality rate, assess the cause and replace with another more appropriate species.
- When working around and below mature trees, follow the most current American National Standards Institute (ANSI) ANSI A300 standards (see http://www.tcia.org/TCIA/BUSINESS/ANSI_A300_Standards_/TCIA/BUSINESS/A300_Standards/A300_Standards.aspx?hkey=202ff566-4364-4686-b7c1-2a365af59669) and International Society of Arboriculture BMPs to the extent practicable (e.g., take care to minimize any damage to tree roots and avoid compaction of soil).
- Monitor tree support systems (stakes, guys, etc.).
 - Repair and adjust as needed to provide support and prevent tree damage.
 - Remove tree supports after one growing season or maximum of 1 year.
 - Backfill stake holes after removal.
- When continued, regular pruning (more than one time during the 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.
- Make reasonable attempts to remove and dispose of class C noxious weeds.
- Re-seed bare turf areas until the vegetation fully covers the ground surface.
- 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.
- Plant and protect trees per BMP T5.16: Tree Retention and Tree Planting
- Aerate lawns regularly in areas of heavy use where the soil tends to become compacted. Conduct aeration while the grasses in the lawn are growing most vigorously. Remove layers of thatch greater than 1/4-inch deep.
- Set the mowing height at the highest acceptable level and mow at times and intervals designed to minimize stress on the turf. Generally mowing only 1/3 of the grass blade height will prevent stressing the turf.
 - Mowing is a stress-creating activity for turfgrass.
 - Grass decreases its productivity when mowed too short and there is less growth of roots and rhizomes. The turf becomes less tolerant of environmental stresses, more disease prone and more reliant on outside means such as pesticides, fertilizers, and irrigation to remain healthy.

Additional BMP Information:

- King County's *Best Management Practices for Golf Course Development and Operation* (King County, 1993) has additional BMPs for Turfgrass Maintenance and Operation.
- King County, Seattle Public Utilities, and the Saving Water Partnership have created the following natural lawn and garden care resources that include guidance on building healthy soil with compost and mulch, selecting appropriate plants, watering, using alternatives to pesticides, and implementing natural lawn care techniques.
 - *Natural Yard Care - Five steps to make your piece of the planet a healthier place to live* (King County and SPU, 2008)
 - *The Natural Lawn & Garden Series: Smart Watering* (Saving Water Partnership, 2006)
 - *Natural Lawn Care for Western Washington* (Saving Water Partnership, 2007)
 - *The Natural Lawn & Garden Series: Growing Healthy Soil; Choosing the Right Plants; and Natural Pest, Weed and Disease Control* (Saving Water Partnership, 2012)

- 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

- Washington State University's *Gardening in Washington State* website at <http://garden-ing.wsu.edu> contains Washington State specific information about vegetation management based on the type of landscape.

- See the *Pacific Northwest Plant Disease Management Handbook* (Pscheidt and Ocamb, 2016) for information on disease recognition and for additional resources.

S435 BMPs for Pesticides and an Integrated Pest Management Program

Description of Pollutant Sources: Pesticides include herbicides, rodenticides, insecticides, fungicides, etc. Examples of pesticide uses include:

- Weed control on golf course lawns, access roads, utility corridors and landscaping.
- Sap stain and insect control on lumber and logs.
- Rooftop moss removal.
- Killing nuisance rodents.
- Fungicide application to patio decks.

It is possible to release toxic pesticides such as pentachlorophenol, carbamates, and organo-metallics to the environment by leaching and dripping from treated parts, container leaks, product misuse, and outside storage of pesticide contaminated materials and equipment. Poor management of pesticides can cause appreciable stormwater contamination and unintended impacts to non-targeted organisms.

Pollutant Control Approach: Control of pesticide applications to prevent contamination of stormwater. Develop and implement an Integrated Pest Management (IPM) Plan. Carefully apply pesticides, in accordance with label requirements.

Applicable Operational BMPs:

- Train employees on proper application of pesticides and disposal practices.
- Follow manufacturers' application guidelines and label requirements.
- Do not apply pesticides in quantities that exceed the limits on the product the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) label. Avoid excessive application of chemical.
- Conduct spray applications during weather conditions as specified in the label requirements and applicable local and state regulations. Do not apply during rain or immediately before expected rain (unless the label directs such timing).
- Clean up any spilled pesticides immediately. Do not hose down to a storm drain, conveyance ditch, or water body.
- Remove weeds/vegetation in stormwater ditches, stormwater facilities, and drainage systems by hand or other mechanical means and only use pesticides as a last resort.

- Flag all sensitive areas including wells, creeks, and wetlands prior to spraying.
- Post notices and delineate the spray area prior to the application, as required by the local jurisdiction, or by Ecology.
- Refer to S411 BMPs for Landscaping and Lawn / Vegetation Management and use pesticides only as a last resort.
- Conduct any pest control activity at the life stage when the pest is most vulnerable. For example, if it is necessary to use a *Bacillus thuringiensis* application to control tent caterpillars, apply it to the material before the caterpillars cocoon or it will be ineffective. Any method used should be site-specific and not used wholesale over a wide area.
- Mix pesticides and clean the application equipment under cover in an area where accidental spills will not enter surface or ground waters, and will not contaminate the soil.
- The pesticide application equipment must be capable of immediate shutoff in the event of an emergency.
- Implement a pesticide-use plan and include at a minimum:
 - A list of selected pesticides and their specific uses.
 - Brands and formulations of the pesticides.
 - Application methods and quantities to be used.
 - Equipment use and maintenance procedures.
 - Safety, storage, and disposal methods.

Monitoring, record keeping, and public notice procedures. All procedures shall conform to the requirements of Chapter 17.21 RCW and Chapter 16-228 WAC

- Develop and implement an Integrated Pest Management (IPM) program if pests are present.

The following steps are adapted from (Daar, 1992)

Step One: Correctly identify problem pests and understand their life cycle.

- Learn more about the pest.
- Observe it and pay attention to any damage that may be occurring.
- Learn about the life cycle.
- Many pests are only a problem during certain seasons, or can only be treated effectively in certain phases of the life cycle.

Step Two: Establish tolerance thresholds for pests.

- Decide on the level of infestation that must be exceeded before treatment needs to be considered. Pest populations under this threshold should be monitored but don't need treatment.

Step Three: Monitor to detect and prevent pest problems.

- Monitor regularly to anticipate and prevent major pest outbreaks.
- Conduct a visual evaluation of the lawn or landscape's condition. Take a few minutes before mowing to walk around and look for problems.

- Keep a notebook, record when and where a problem occurs, then monitor for it at about the same time in future years.
- Specific monitoring techniques can be used in the appropriate season for some potential problem pests, such as European crane fly.

Step Four: Modify the maintenance program to promote healthy plants and discourage pests.

- Review your landscape maintenance practices to see if they can be modified to prevent or reduce the problem.
- A healthy landscape is resistant to most pest problems. Lawn aeration and over-seeding along with proper mowing height, fertilization, and irrigation will help the grass out-compete weeds.
- Correcting drainage problems and letting soil dry out between waterings in the summer may reduce the number of crane-fly larvae that survive.

Step Five: If pests exceed the tolerance thresholds:

- Consider the most effective management options concurrent with reducing impacts to the environment. This may mean chemical pesticides are the best option in some circumstances.
- Consider the use of physical, mechanical, or biological controls.
- Study to determine what products are available and choose a product that is the least toxic and has the least non-target impact.

Step Six: Evaluate and record the effectiveness of the control, and modify maintenance practices to support lawn or landscape recovery and prevent recurrence.

- Keep records!
- Note when, where, and what symptoms occurred, or when monitoring revealed a potential pest problem.
- Note what controls were applied and when, and the effectiveness of the control. Monitor next year for the same problems.

Recommended Additional Operational BMPs:

- Choose the least toxic pesticide available that is capable of reducing the infestation to acceptable levels. The pesticide should readily degrade in the environment and/or have properties that strongly bind it to the soil.
- Choose pesticides categorized by EPA as reduced risk. For example, the herbicide imazamox.
- When possible, apply pesticides during the dry season so that the pesticide residue is degraded prior to the next rain event.
- If possible, do not spray pesticides within 100 feet of water bodies. Spraying pesticides within 100 feet of water bodies including any drainage ditch or channel that leads to open water may have additional regulatory requirements beyond just following the pesticide product label. Additional requirements may include:
 - o Obtaining a discharge permit from Ecology.
 - o Obtaining a permit from the local jurisdiction.
 - o Using an aquatic labeled pesticide and adjuvant.
- Use manual pest control strategies such as physically scraping moss from rooftops, high-pressure sprayers to remove moss, and rodent traps.
- Consider alternatives to the use of pesticides such as covering or harvesting weeds, substitute vegetative growth, and manual weed control/moss removal.

- Consider the use of soil amendments, such as compost, that are known to control some common diseases in plants, such as Pythium root rot, ashy stem blight, and parasitic nematodes.
- Once a pesticide is applied, evaluate its effectiveness for possible improvement. Records should be kept showing the effectiveness of the pesticides applied.
- Follow the FIFRA label requirements for disposal. If the FIFRA label does not have disposal requirements the rinseate from equipment cleaning and/or triple-rinsing of pesticide containers should be used as product or recycled into product.
- Develop an and adaptive management plan and annual evaluation procedure including: (adapted from (Daar, 1992))
 - o A review of the effectiveness of pesticide applications.
 - o Impact on buffers and sensitive areas, including potable wells. If individual or public potable wells are located in the proximity of commercial pesticide applications, contact the regional Ecology hydrogeologist to determine if additional pesticide application control measures are necessary.
 - o Public concerns.
 - o Recent toxicological information on pesticides used/proposed for use.

Additional Information

For more information, refer to the Pesticide Information Center Online (PICOL) Databases at <http://cru66.cahe.wsu.edu/LabelTolerance.html>. Washington pesticide law requires most businesses that commercially apply pesticides to the property of another to be licensed as a Commercial Applicator from the Washington State Department of Agriculture.

Appendix B – Inspector Form

Catch Basin / Structure / Item	Inspector's Initials	Inspection notes and actions taken
CB1		
CB2		
CB3		
CB4		
CB5		
CB6		
CB8		
CB9		
OFS 1		
OFS 2		
OFS 3		
OFS 4		
OFS 5		
Landscaping		
Stormfilter		
Ditch/Swale		
French Drain		
Downspouts		
Energy Dissipators		
Detention Pond		
BRC 1		
BRC 2		
BRC 3		
BRC 4		
BRC 5		
BRC 6		

Appendix C – Inspection Checklists - Catch Basins

Maintenance of Catch Basins

Date Inspected: _____

Frequency	Maintenance Component	Defect	Condition When Maintenance is needed	Results Expected When Maintenance is Performed
M S	General	Trash and Debris (Includes Sediment)	Material exceeds 25% of sump depth or 1 foot below orifice plate	Control structure orifice is not blocked. All trash and debris removed
		Structural Damage	Structure is not securely attached to manhole wall	Structure securely attached to wall and outlet pipe
			Structure is not in upright position (allow up to 10% from plumb)	Structure in correct position
			Connections to outlet pipe are not watertight and show signs of rust.	Connections to outlet pipe are water tight; structure repaired or replaced and works as designed.
			Any holes—other than designed holes—in the structure	Structure has no holes other than designed holes.
	Clean out Gate	Damaged or missing	Clean out gate is not watertight or is missing.	Gate is watertight and works as designed.
			Gate cannot be moved up and down by one maintenance person.	Gate moves up and down easily and is watertight
			Chain/rod leading to gate is missing or damaged.	Chain is in place and works as designed
			Gate is rusted over 50% of its surface area	Gate is repaired or replaced to meet design standards.
	Orifice Plate	Damaged or missing	Control device is not working properly due to missing out of place, or bent orifice plate	Plate is in place and works as designed.
		Obstructions	Any trash, debris, sediment, or vegetation blocking the plate	Plate is free of all obstructions and works as designed.
	Overflow pipe	Obstruction	Any trash or debris blocking (or having the potential of blocking) the overflow pipe	Pipe is free of all obstruction and works as designed.
A	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
			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 catch basin
			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.
			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.
		Sediment	Sediment (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 6 inches clearance from the sediment surface to the invert of the lowest pipe	No sediment in the catch basin
			Measured from the bottom of basin to invert of the lowest pipe into or out of the basin	
		Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than ¼ inch (Intent is to make sure no material is running into basin) Frame not sitting flush on top slab, i.e., separation of more than ¼ inch of the frame from the top slab. Frame not securely attached	Top slab is free of holes and cracks Frame is sitting flush on the riser rings or top slab and firmly attached
		Fractures or Cracks in Basin Walls/Bottom	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.

Maintenance of Catch Basins

Date Inspected: _____

			Grout fillet has separated or cracked wider than ½ inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Pipe is regouted and secure at basin wall.
		Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
		Vegetation	Vegetation growing across and blocking more than 10% of the basin opening.	No vegetation blocking opening to basin.
			Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation or root growth present.
		Contamination and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants.	No pollution present.
A	Catch Basin Cover	Cover not in place.	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed.
		Locking Mechanism not working.	Mechanism cannot be opened by one maintenance person with proper tools. bolts into frame have less than ½ inch of thread.	Mechanism opens with proper tools.
		Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure (intent is keep cover from sealing off access to maintenance.)	Cover can be removed by one maintenance person.
A	Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
M	Outlet Pipe	Trash, Debris, Beaver dam	Trash, debris or any signs of beaver dam activity shall be removed upon inspection.	Outlet is free of trash, debris, or beaver dam blockage.
A	Metal Grates (If Applicable)	Grate Opening unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
M		Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
S		Damaged or Missing	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.

A - Annually - preferably in September

M - Monthly - from November through April

S - After any major storm (1 inch in a 24 hour period)

Appendix D – Inspection Checklists – Fencing / Shrubby / Landscaping

Shrubbery Screen/ Landscaping Date of Inspection:

Frequency	Drainage System Feature	Problem	Conditions to Check For	Conditions That Should Exist
M	General	Dead shrubbery	Dead or dying plants	Plants should be removed and a native non-invasive type of vegetation replanted.
M	General	Unruly vegetation	Shrubbery is growing out of control or is infested with weeds.	Shrubbery is trimmed and weeded to provide appealing aesthetics. Do not use chemicals to control weeds.
A	General	Soil aeration	Soil vegetation should be kept from compaction, and well aerated.	If evidence of compaction, vehicle compaction, or other, soils should be re-aerated.
A	General	Mulch/Fertilizer	Organic soil levels (mulch) should be renewed each year.	Vegetation should be mulched yearly, with an approved mulch and organic content. Chemical fertilizers should not be used.

A - Annually - preferably in September

M - Monthly - from November through April

S - After any major storm (1 inch in a 24 hour period)

Appendix E – Inspection Checklists – Roof Downspouts

Downspout Checklist

Date Inspected: _____

Frequen cy	Mainien ance Compon ent	Defect	Condition When Maintenance is needed	Results Expected When Maintenance is Performed
A, S	General	General	Gutters, downspouts and their connection points should be inspected for leakage, failure, blockage.	Free-flowing roof water being conveyed.
A	Catch basin/Structure connection	Blockage between downspout and downstream structure connection.	Water is not freely flowing from downspout to downstream connection point/structure. See CB inspection checklist. Do NOT force with air or water the blockage downstream into the infiltration facility, unless the inlet pipe to the infiltration facility has been completely blocked, and the CB or structure is then vacuumed	Outlet to downstream structure is clear, water freely flowing

A - Annually - preferably in September

M - Monthly - from November through April

S - After any major storm (1 inch in a 24 hour period)

BW - Bi-weekly

D - Daily

Appendix F – Inspection Checklists – Energy Dissipator

Maintenance of Pipe End Energy Dissipators

Date Inspected:

Frequency	Maintenance Component	Defect	Condition When Maintenance is needed	Results Expected When Maintenance is Performed
M A	Rock Pad	Missing or moved rock	Only one layer of rock existing above native soil in area five square feet or larger, or any exposure of native soil.	Rock pad replaced or repaired to design standards.
		Erosion	Soil Erosion in or adjacent to rock pad.	Rock pad replaced or repaired to design standards.
	Dispersal Type	Pipe plugged with sediment	Accumulated sediment that exceeds 20% of design depth.	Pipe Cleaned/flushed so that it matches design.
		Not discharging water properly	Visual evidence of water discharging at concentrated points along trench (normal condition is a sheet flow of water along trench. Intent is to prevent erosion.	Trench redesign or rebuilt to standards.
		Perforations plugged	Over ½ of perforations in pipe are plugged with debris.	Perforated pipe cleaned or replaced.
		Water flows out of distributor catch basin	Maintenance person observes or receives credible report of water flowing out during any storm less than the design storm or its causing or appears likely to cause damage.	Facility rebuilt or redesigned to standards.
		Receiving area Over saturated	Water in receiving area is causing or has potential of causing landslide problems.	No danger of landslides.

A - Annually - preferably in September

M - Monthly - from November through April

S - After any major storm (1 inch in a 24 hour period)

Appendix G – Inspection Checklists – Contech Stormfilter



StormFilter Inspection and Maintenance Procedures



Maintenance Guidelines

The primary purpose of the Stormwater Management StormFilter® is to filter and prevent pollutants from entering our waterways. Like any effective filtration system, periodically these pollutants must be removed to restore the StormFilter to its full efficiency and effectiveness.

Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. Maintenance activities may be required in the event of a chemical spill or due to excessive sediment loading from site erosion or extreme storms. It is a good practice to inspect the system after major storm events.

Maintenance Procedures

Although there are many effective maintenance options, we believe the following procedure to be efficient, using common equipment and existing maintenance protocols. The following two-step procedure is recommended::

1. Inspection

- Inspection of the vault interior to determine the need for maintenance.

2. Maintenance

- Cartridge replacement
- Sediment removal

Inspection and Maintenance Timing

At least one scheduled inspection should take place per year with maintenance following as warranted.

First, an inspection should be done before the winter season. During the inspection the need for maintenance should be determined and, if disposal during maintenance will be required, samples of the accumulated sediments and media should be obtained.

Second, if warranted, a maintenance (replacement of the filter cartridges and removal of accumulated sediments) should be performed during periods of dry weather.



In addition to these two activities, it is important to check the condition of the StormFilter unit after major storms for potential damage caused by high flows and for high sediment accumulation that may be caused by localized erosion in the drainage area. It may be necessary to adjust the inspection/maintenance schedule depending on the actual operating conditions encountered by the system. In general, inspection activities can be conducted at any time, and maintenance should occur, if warranted, during dryer months in late summer to early fall.

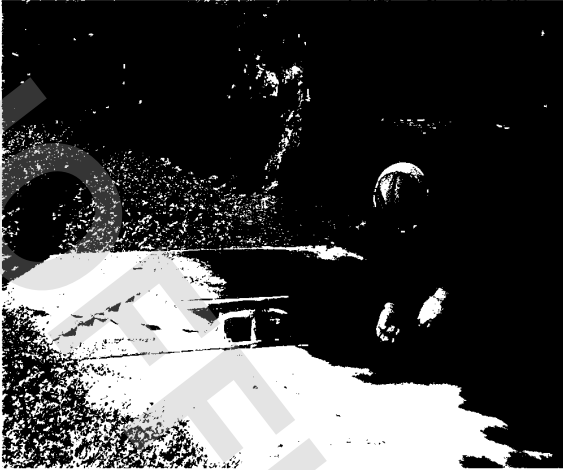
Maintenance Frequency

The primary factor for determining frequency of maintenance for the StormFilter is sediment loading.

A properly functioning system will remove solids from water by trapping particulates in the porous structure of the filter media inside the cartridges. The flow through the system will naturally decrease as more and more particulates are trapped. Eventually the flow through the cartridges will be low enough to require replacement. It may be possible to extend the usable span of the cartridges by removing sediment from upstream trapping devices on a routine as-needed basis, in order to prevent material from being re-suspended and discharged to the StormFilter treatment system.

The average maintenance lifecycle is approximately 1-5 years. Site conditions greatly influence maintenance requirements. StormFilter units located in areas with erosion or active construction may need to be inspected and maintained more often than those with fully stabilized surface conditions.

Regulatory requirements or a chemical spill can shift maintenance timing as well. The maintenance frequency may be adjusted as additional monitoring information becomes available during the inspection program. Areas that develop known problems should be inspected more frequently than areas that demonstrate no problems, particularly after major storms. Ultimately, inspection and maintenance activities should be scheduled based on the historic records and characteristics of an individual StormFilter system or site. It is recommended that the site owner develop a database to properly manage StormFilter inspection and maintenance programs..



Inspection Procedures

The primary goal of an inspection is to assess the condition of the cartridges relative to the level of visual sediment loading as it relates to decreased treatment capacity. It may be desirable to conduct this inspection during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, then typically large amounts of sediments will be present and very little flow will be discharged from the drainage pipes. If this is the case, then maintenance is warranted and the cartridges need to be replaced.

Warning: In the case of a spill, the worker should abort inspection activities until the proper guidance is obtained. Notify the local hazard control agency and Contech Engineered Solutions immediately.

To conduct an inspection:

Important: Inspection should be performed by a person who is familiar with the operation and configuration of the StormFilter treatment unit and the unit's role, relative to detention or retention facilities onsite.

1. If applicable, set up safety equipment to protect and notify surrounding vehicle and pedestrian traffic.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the access portals to the vault and allow the system vent.
4. Without entering the vault, visually inspect the inside of the unit, and note accumulations of liquids and solids.
5. Be sure to record the level of sediment build-up on the floor of the vault, in the forebay, and on top of the cartridges. If flow is occurring, note the flow of water per drainage pipe. Record all observations. Digital pictures are valuable for historical documentation.
6. Close and fasten the access portals.
7. Remove safety equipment.
8. If appropriate, make notes about the local drainage area relative to ongoing construction, erosion problems, or high loading of other materials to the system.
9. Discuss conditions that suggest maintenance and make decision as to whether or not maintenance is needed.

Maintenance Decision Tree

The need for maintenance is typically based on results of the inspection. The following Maintenance Decision Tree should be used as a general guide. (Other factors, such as Regulatory Requirements, may need to be considered).

Please note Stormwater Management StormFilter devices installed downstream of, or integrated within, a stormwater storage facility typically have different operational parameters (i.e. draindown time). In these cases, the inspector must understand the relationship between the retention/detention facility and the treatment system by evaluating site specific civil engineering plans, or contacting the engineer of record, and make adjustments to the below guidance as necessary. Sediment deposition depths and patterns within the StormFilter are likely to be quite different compared to systems without upstream storage and therefore shouldn't be used exclusively to evaluate a need for maintenance.

1. Sediment loading on the vault floor.
 - a. If $>4"$ of accumulated sediment, maintenance is required.
2. Sediment loading on top of the cartridge.
 - a. If $>1/4"$ of accumulation, maintenance is required.
3. Submerged cartridges.
 - a. If $>4"$ of static water above cartridge bottom for more than 24 hours after end of rain event, maintenance is required. (Catch basins have standing water in the cartridge bay.)
4. Plugged media.
 - a. While not required in all cases, inspection of the media within the cartridge may provide valuable additional information.
 - b. If pore space between media granules is absent, maintenance is required.
5. Bypass condition.
 - a. If inspection is conducted during an average rain fall event and StormFilter remains in bypass condition (water over the internal outlet baffle wall or submerged cartridges), maintenance is required.
6. Hazardous material release.
 - a. If hazardous material release (automotive fluids or other) is reported, maintenance is required.
7. Pronounced scum line.
 - a. If pronounced scum line (say $\geq 1/4"$ thick) is present above top cap, maintenance is required.

Maintenance

Depending on the configuration of the particular system, maintenance personnel will be required to enter the vault to perform the maintenance.

Important: If vault entry is required, OSHA rules for confined space entry must be followed.

Filter cartridge replacement should occur during dry weather. It may be necessary to plug the filter inlet pipe if base flows is occurring.

Replacement cartridges can be delivered to the site or customers facility. Information concerning how to obtain the replacement cartridges is available from Contech Engineered Solutions.

Warning: In the case of a spill, the maintenance personnel should abort maintenance activities until the proper guidance is obtained. Notify the local hazard control agency and Contech Engineered Solutions immediately.

To conduct cartridge replacement and sediment removal maintenance:

1. If applicable, set up safety equipment to protect maintenance personnel and pedestrians from site hazards.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the doors (access portals) to the vault and allow the system to vent.
4. Without entering the vault, give the inside of the unit, including components, a general condition inspection.
5. Make notes about the external and internal condition of the vault. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.
6. Using appropriate equipment offload the replacement cartridges (up to 150 lbs. each) and set aside.
7. Remove used cartridges from the vault using one of the following methods:

Method 1:

- A. This activity will require that maintenance personnel enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Disconnect each filter cartridge from the underdrain connector by rotating counterclockwise 1/4 of a turn. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.

Using appropriate hoisting equipment, attach a cable from the boom, crane, or tripod to the loose cartridge. Contact Contech Engineered Solutions for suggested attachment devices.

- B. Remove the used cartridges (up to 250 lbs. each) from the vault.



Important: Care must be used to avoid damaging the cartridges during removal and installation. The cost of repairing components damaged during maintenance will be the responsibility of the owner.

- C. Set the used cartridge aside or load onto the hauling truck.
- D. Continue steps a through c until all cartridges have been removed.

Method 2:

- A. This activity will require that maintenance personnel enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Disconnect each filter cartridge from the underdrain connector by rotating counterclockwise 1/4 of a turn. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.
- B. Unscrew the cartridge cap.
- C. Remove the cartridge hood and float.
- D. At location under structure access, tip the cartridge on its side.
- E. Empty the cartridge onto the vault floor. Reassemble the empty cartridge.
- F. Set the empty, used cartridge aside or load onto the hauling truck.
- G. Continue steps a through e until all cartridges have been removed.

8. Remove accumulated sediment from the floor of the vault and from the forebay. This can most effectively be accomplished by use of a vacuum truck.
9. Once the sediments are removed, assess the condition of the vault and the condition of the connectors.
10. Using the vacuum truck boom, crane, or tripod, lower and install the new cartridges. Once again, take care not to damage connections.
11. Close and fasten the door.
12. Remove safety equipment.
13. Finally, dispose of the accumulated materials in accordance with applicable regulations. Make arrangements to return the used **empty** cartridges to Contech Engineered Solutions.

Related Maintenance Activities - Performed on an as-needed basis

StormFilter units are often just one of many structures in a more comprehensive stormwater drainage and treatment system.

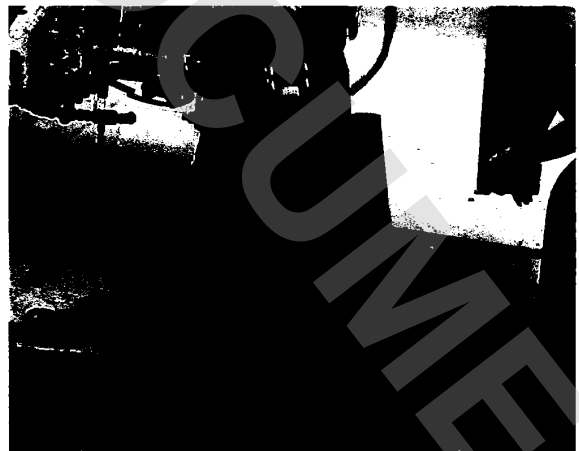
In order for maintenance of the StormFilter to be successful, it is imperative that all other components be properly maintained. The maintenance/repair of upstream facilities should be carried out prior to StormFilter maintenance activities.

In addition to considering upstream facilities, it is also important to correct any problems identified in the drainage area. Drainage area concerns may include: erosion problems, heavy oil loading, and discharges of inappropriate materials.

Material Disposal

The accumulated sediment found in stormwater treatment and conveyance systems must be handled and disposed of in accordance with regulatory protocols. It is possible for sediments to contain measurable concentrations of heavy metals and organic chemicals (such as pesticides and petroleum products). Areas with the greatest potential for high pollutant loading include industrial areas and heavily traveled roads.

Sediments and water must be disposed of in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes. This typically requires coordination with a local landfill for solid waste disposal. For liquid waste disposal a number of options are available including a municipal vacuum truck decant facility, local waste water treatment plant or on-site treatment and discharge.



Inspection Report

Date: _____ Personnel: _____

Location: _____ System Size: _____ Months in Service: _____

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other: _____

Sediment Thickness in Forebay: _____ Date: _____

Sediment Depth on Vault Floor: _____

Sediment Depth on Cartridge Top(s): _____

Structural Damage: _____

Estimated Flow from Drainage Pipes (if available): _____

Cartridges Submerged: Yes ☐ No ☐ Depth of Standing Water: _____

StormFilter Maintenance Activities (check off if done and give description)

☐ Trash and Debris Removal: _____

☐ Minor Structural Repairs: _____

☐ Drainage Area Report _____

Excessive Oil Loading: Yes ☐ No ☐ Source: _____

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: _____

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: _____

Items Needing Further Work: _____

Owners should contact the local public works department and inquire about how the department disposes of their street waste residuals.

Other Comments:

Review the condition reports from the previous inspection visits.

StormFilter Maintenance Report

Date: _____ Personnel: _____

Location: _____ System Size: _____

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other: _____

List Safety Procedures and Equipment Used: _____

System Observations

Months in Service: _____

Oil in Forebay (if present): Yes ☐ No ☐

Sediment Depth in Forebay (if present): _____

Sediment Depth on Vault Floor: _____

Sediment Depth on Cartridge Top(s): _____

Structural Damage: _____

Drainage Area Report

Excessive Oil Loading: Yes ☐ No ☐ Source: _____

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: _____

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: _____

StormFilter Cartridge Replacement Maintenance Activities

Remove Trash and Debris: Yes ☐ No ☐ Details: _____

Replace Cartridges: Yes ☐ No ☐ Details: _____

Sediment Removed: Yes ☐ No ☐ Details: _____

Quantity of Sediment Removed (estimate?): _____

Minor Structural Repairs: Yes ☐ No ☐ Details: _____

Residuals (debris, sediment) Disposal Methods: _____

Notes:



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- Site-specific design support is available from our engineers.

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Appendix H – Inspection Checklists – Bioretention Cells

Table V-A.21: Maintenance Standards - Bioretention Facilities

Maintenance 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	<ul style="list-style-type: none">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	<ul style="list-style-type: none">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	<ul style="list-style-type: none">Repair/ seal cracksReplace 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
	A, S		Accumulated sediment to extent that infiltration rate is reduced (see "Ponded water") or surface storage capacity significantly impacted	<ul style="list-style-type: none">Remove excess sedimentReplace any vegetation damaged or destroyed by sediment accumulation and removalMulch newly planted vegetationIdentify 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
Facility bottom area		Dunnage/after fall leaf drop	Accumulated leaves in facility	Remove leaves if there is a risk to clogging outlet structure or water flow is impeded
	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
Low permeability check dams and weirs	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

Table V-A.21: Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency a		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
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 mix	As needed		Bioretention soil mix protection is needed when performing maintenance requiring entrance into the facility footprint	<ul style="list-style-type: none"> 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)
	A		Pipe is damaged	Repair/replace
Pipe inlet/outlet	W		Pipe is clogged	Remove roots or debris
	A, S		Sediment, debris, trash, or mulch reducing capacity of inlet/outlet	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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

Table V-A.21: Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency ^a		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
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)
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)	<ul style="list-style-type: none"> Plant roots, sediment or debris reducing capacity of underdrain Prolonged surface ponding (see "Ponded water") 	<ul style="list-style-type: none"> 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).	<ul style="list-style-type: none"> 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 <i>LID Technical Guidance Manual for Puget Sound</i>, (Himman and Vulkan, 2012)). Confirm that plant selection is appropriate for site growing conditions Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants 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 the <i>Pacific Northwest Plant Disease Management Handbook</i> (Puschardt and O'Connell, 2016) for information on disease recognition and for additional resources Replant as necessary according to recommendations provided for "facility bottom area and upland slope vegetation".
Vegetation (general)	As needed		Presence of diseased plants and plant material	<ul style="list-style-type: none"> 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
		All pruning seasons (timing varies by species)	Pruning as needed	
	A		Large trees and shrubs interfere with operation of the facility or access for maintenance	<ul style="list-style-type: none"> Prune trees and shrubs using most current ANSI A300 standards and ISA BMPs. Remove trees and shrubs, if necessary.
Trees and shrubs			Standing dead vegetation is present	<ul style="list-style-type: none"> 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

Table V.A.21: Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency ^a		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				<ul style="list-style-type: none"> If specific plants have a high mortality rate, assess the cause and replace with appropriate species. Consultation with a landscape architect is recommended. 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. 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.
	Fall and Spring		Planting beneath mature trees	
	Fall and Spring		Presence of or need for stakes and guys (tree growth, maturation, and support needs)	<ul style="list-style-type: none"> 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
Trees and shrubs adjacent to vehicle travel areas (for areas where visibility needs to be maintained)	A		Vegetation causes some visibility (line of sight) or driver safety issues	
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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> 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")
Weeds		M (March - October,	Weeds are present	<ul style="list-style-type: none"> Remove weeds with their roots manually with pincer-type weeding tools, flame weeders, or hot water weeders as

Table V.A.21: Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
		preceding seed dispersal)		<ul style="list-style-type: none"> appropriate Follow IPM protocols for weed management (see "Additional Maintenance Resources" section for more information on IPM protocols)
		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	<ul style="list-style-type: none"> 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
Excessive vegetation			Excessive vegetation density inhibits stormwater flow beyond design ponding or becomes a hazard for pedestrian and vehicular circulation and safety	<ul style="list-style-type: none"> 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			
	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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> Pulse water to enhance soil absorption, when feasible

Table V.A.21: Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency a		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
				<ul style="list-style-type: none"> 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
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	<ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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. Use of pesticides or <i>Bacillus thuringiensis israelensis</i> (Bti) may be considered only as a temporary measure while addressing the standing water cause. If overflow to a surface water will occur within 2 weeks after pesticide use, apply for coverage under the Aquatic Mosquito Control NPDES General Permit.
Nuisance animals	As needed		Nuisance animals causing erosion, damaging plants, or depositing large volumes of feces	<ul style="list-style-type: none"> 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		Signs of pests, such as wilting leaves, chewed leaves and bark, spotting or other indicators	<ul style="list-style-type: none"> 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

Table V-A.21: Maintenance Standards - Bioretention Facilities (continued)

Maintenance Component	Recommended Frequency ^a		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
	vegetation management			protocols)
<p>Note that the inspection and routine maintenance frequencies listed above are recommended by Ecology. They do not supersede or replace the municipal stormwater permit requirements for inspection frequency required of municipal stormwater permittees for "stormwater treatment and flow control BMP-s/facilities".</p> <p>^a Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; W = Weekly; 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).</p> <p>IPM - Integrated Pest Management</p> <p>ISA - International Society of Arboriculture</p>				

Table V-A.22: Maintenance Standards - 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	<ul style="list-style-type: none"> 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)	<p>Clean surface debris from pavement surface using one or a combination of the following methods:</p> <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> 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 C 1701 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:

Appendix I – Inspection Checklists – French Drain

Maintenance of French Drains

Date Inspected:

Frequency	Maintenance Component	Defect	Condition When Maintenance is needed	Results Expected When Maintenance is Performed
M S A	General	Trash and Debris	Trash and debris accumulated in the bio-swale.	Trash and debris cleared from swale.
		Sediment Accumulation on Grass	Sediment Depth exceeds 2 inches	Remove sediment deposits on grass treatment area of the bio-swale. When finished, swale should be level from side to side and drain freely toward outlet. There should be no areas of standing water once inflow has ceased.
		Standing Water	When water stands in swale between storms and does not drain freely.	Any of the following may apply: remove sediment or trash blockages, improve grade from head to foot of swale, remove clogged check dams, add underdrains or convert to a wet biofiltration swale.
		Flow Spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed through entire swale depth.	Level the spreader and clean so that flows are spread evenly over entire swale width.
		Poor Vegetation Cover	When grass is sparse or bare or eroded patches occur in more than 10% of the swale bottom.	Determine why grass growth is poor and correct that condition. Re-plant with plugs of grass from the upper slope; plant in the swale bottom at 8" intervals, or reseed into loosened fertile soil.
		Vegetation	When the grass becomes excessively tall (greater than 10"); when nuisance weeds and other vegetation starts to take over.	Mow vegetation or remove nuisance vegetation so that flow not impeded. Grass should be mowed to a height of 3 to 4 inches. Remove grass clippings.
		Excessive Shading	Grass growth is poor because sunlight does not reach swale.	If possible, trim back overhanging limbs and remove brushy vegetation on adjacent slopes.
		Inlet/Outlet	Inlet/Outlet clogged with sediment and/or debris	Remove material so that there is no clogging or blockage in the inlet and outlet area.
		Trash & Debris / Sediment in downstream catch basins	Sediment (in the basin) that exceeds 50 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 6 inches clearance from the sediment surface to the invert of the lowest pipe. Measured from the bottom of basin to invert of the lowest pipe into or out of the basin.	No sediment in the catch basins.
		Erosion / Scouring	Eroded or scoured swale bottom due to flow channelization, or higher flows	For ruts or bare areas less than 12" wide, repair the damaged area by filling with crushed gravel. If bare areas are large, generally greater than 12" wide, the swale should be regraded and reseeded. For smaller bare areas, overseed when bare spots are evident, or take plugs of grass from the upper slope and plant in the swale bottom at 8" intervals.

A - Annually - preferably in September

M - Monthly - from November through April

S - After any major storm (1 inch in a 24 hour period)

Appendix J – Inspection Checklists – Detention Pond

Appendix V-A: BMP Maintenance Tables

Ecology intends the facility-specific maintenance standards contained in this section to be conditions for determining if maintenance actions are required as identified through inspection. Recognizing that Permittees have limited maintenance funds and time, Ecology does not require that a Permittee perform all these maintenance activities on all their stormwater BMPs. We leave the determination of importance of each maintenance activity and its priority within the stormwater program to the Permittee. We do expect, however, that sufficient maintenance will occur to ensure that the BMPs continue to operate as designed to protect ground and surface waters.

Ecology doesn't intend that these measures identify the facility's required condition at all times between inspections. In other words, exceedance of these conditions at any time between inspections and/or maintenance does not automatically constitute a violation of these standards. However, based upon inspection observations, the Permittee shall adjust inspection and maintenance schedules to minimize the length of time that a facility is in a condition that requires a maintenance action.

Table V-A.1: Maintenance Standards - Detention Ponds

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	Any trash and debris which exceed 1 cubic foot per 1,000 square feet. In general, there should be no visual evidence of dumping. If less than threshold all trash and debris will be removed as part of next scheduled maintenance.	Trash and debris cleared from site
	Poisonous Vegetation and noxious weeds	Any poisonous or nuisance vegetation which may constitute a hazard to maintenance personnel or the public. Any evidence of noxious weeds as defined by State or local regulations. (Apply requirements of adopted IPM policies for the use of herbicides).	No danger of poisonous vegetation where maintenance personnel or the public might normally be. (Coordinate with local health department) Complete eradication of noxious weeds may not be possible. Compliance with State or local eradication policies required
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants (Coordinate removal/cleanup with local water quality response agency)	No contaminants or pollutants present.
	Rodent Holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Rodents destroyed and dam or berm repaired. (Coordinate with local health department, coordinate with Ecology Dam Safety Office if pond exceeds 10 acre-feet.)
	Beaver Dams	Dam results in change or function of the facility.	Facility is returned to design function. (Coordinate trapping of beavers and removal of dams with appropriate permitting agencies)
	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted IPM policies
	Tree Growth and Hazard Trees	Tree growth does not allow maintenance and inspection access or interferes with maintenance activity (i.e., slope mowing, silt removal, vactoring, or equipment movements). If trees are not interfering with access or maintenance, do not remove If dead, diseased, or dying trees are identified (Use a certified Arborist to determine health of tree or removal requirements)	Trees do not hinder maintenance activities. Harvested trees should be recycled into mulch or other beneficial uses (e.g., alders for firewood). Remove hazard Trees
Side Slopes of Pond	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted berm embankment.	Slopes should be stabilized using appropriate erosion control measure(s), e.g., rock reinforcement, planting of grass, compaction. If erosion is occurring on compacted berms a licensed engineer in the state of Washington should be consulted to resolve source of erosion.
Storage Area	Sediment	Accumulated sediment that exceeds 10% of the designed pond depth unless otherwise specified or affects inletting or outletting condition of the facility.	Sediment cleaned out to designed pond shape and depth, pond reseeded if necessary to control erosion.

Table V-A.1: Maintenance Standards - Detention Ponds (continued)

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
Ponds Berms (Dikes)	Liner (if Applicable)	Liner is visible and has more than three 1/4-inch holes in it.	Liner repaired or replaced. Liner is fully covered.
	Settlements	Any part of berm which has settled 4 inches lower than the design elevation If settlement is apparent, measure berm to determine amount of settlement Settling can be an indication of more severe problems with the berm or outlet works. A licensed engineer in the state of Washington should be consulted to determine the source of the settlement.	Dike is built back to the design elevation.
	Piping	Discernable water flow through pond berm. Ongoing erosion with potential for erosion to continue. (Recommend a Geotechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.)	Piping eliminated. Erosion potential resolved.
	Tree Growth	Tree growth on emergency spillways creates blockage problems and may cause failure of the berm due to uncontrolled overtopping. Tree growth on berms over 4 feet in height may lead to piping through the berm which could lead to failure of the berm.	Trees should be removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. A licensed engineer in the state of Washington should be consulted for proper berm/spillway restoration.
Emergency Overflow/Spillway and Berms over 4 feet in height	Piping	Discernable water flow through pond berm. Ongoing erosion with potential for erosion to continue. (Recommend a Geotechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.)	Piping eliminated. Erosion potential resolved.
Emergency Overflow/Spillway	Emergency Overflow/Spillway	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil at the top of out flow path of spillway. (Rip-rap on inside slopes need not be replaced.)	Rocks and pad depth are restored to design standards.
	Erosion	See "Side Slopes of Pond"	

Table V-A.2: Maintenance Standards - Infiltration

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Poisonous/Noxious Vegetation	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Contaminants and Pollution	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
	Rodent Holes	See Table V-A.1: Maintenance Standards - Detention Ponds	See Table V-A.1: Maintenance Standards - Detention Ponds
Storage Area	Sediment	Water ponding in infiltration pond after rainfall ceases and appropriate time allowed for infiltration. Treatment basins should infiltrate Water Quality Design Storm Volume within 48 hours, and empty within 24 hours after cessation of most rain events.	Sediment is removed and/or facility is cleaned so that infiltration system works according to design.

Appendix K – Inspection Checklists – Conveyance Ditches / Swales

Maintenance of Ditches

Date Inspected:

Frequency	Maintenance Component	Defect	Condition When Maintenance is needed	Results Expected When Maintenance is Performed
Monthly	General	Trash and Debris	Trash and debris accumulated in the bio-swale.	Trash and debris cleared from swale.
		Sediment Accumulation on Grass	Sediment Depth exceeds 2 inches	Remove sediment deposits on grass treatment area of the bio-swale. When finished, swale should be level from side to side and drain freely toward outlet. There should be no areas of standing water once inflow has ceased.
		Standing Water	When water stands in swale between storms and does not drain freely.	Any of the following may apply: remove sediment or trash blockages; improve grade from head to foot of swale; remove clogged check dams; add underdrains or convert to a wet biofiltration swale.
		Constant Baseflow	When small quantities of water continually flow through the swale, even when it has been dry for weeks, and an eroded, muddy channel has formed in the swale bottom.	Add a low flow pea gravel drain the length of the swale or bypass the baseflow around the swale.
		Poor Vegetation Cover	When grass is sparse or bare or eroded patches occur in more than 10% of the swale bottom.	Determine why grass growth is poor and correct that condition. Re-plant with plugs of grass from the upper slope: plant in the swale bottom at 8" intervals, or reseed into loosened fertile soil.
		Vegetation	When the grass becomes excessively tall (greater than 10"); when nuisance weeds and other vegetation starts to take over.	Mow vegetation or remove nuisance vegetation so that flow not impeded. Grass should be mowed to a height of 3 to 4 inches. Remove grass clippings.
		Excessive Shading	Grass growth is poor because sunlight does not reach swale.	If possible, trim back over hanging limbs and remove brushy vegetation on adjacent slopes.
		Inlet/Outlet	Inlet/Outlet clogged with sediment and/or debris	Remove material so that there is no clogging or blockage in the inlet and outlet area.
		Trash & Debris / Sediment in downstream catch basins	Sediment (in the basin) that exceeds 50 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 6 inches clearance from the sediment surface to the invert of the lowest pipe. Measured from the bottom of basin to invert of the lowest pipe into or out of the basin.	No sediment in the catch basins.
		Erosion / Scouring	Eroded or scoured swale bottom due to flow channelization, or higher flows	For ruts or bare areas less than 12" wide, repair the damaged area by filling with crushed gravel. If bare areas are large, generally greater than 12" wide, the swale should be regraded and reseeded. For smaller bare areas, overseed when bare spots are evident, or take plugs of grass from the upper slope and plant in the swale bottom at 8" intervals.

A - Annually - preferably in September

M - Monthly - from November through April

S - After any major storm (1 inch in a 24 hour period)