

# LAND TECHNOLOGIES, INC.

PLANNING • PERMITTING • ENGINEERING



James G. Murphy

3803 & 3821 136th St NE, Marysville, WA 98271

October 2022

## Operations & Maintenance Manual for James G. Murphy

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# Section 1 - Introduction

## 1.1.1 Purpose

This manual provides guidelines and requirements for the maintenance and general upkeep of the stormwater management BMPs and facilities as implemented as required by law.

The inspection, operation, and maintenance of the stormwater management facilities of the project is a legal obligation pursuant to the City of Marysville.

## 1.1.2 Site Description

James G. Murphy

3803 & 3821 136th St NE, Marysville, WA 98271

### Legal Description:

#### PARCEL A:

THE EAST 209 FEET OF THE SOUTH 268 FEET OF GOVERNMENT LOT 4, SECTION 4, TOWNSHIP 30 NORTH, RANGE 5 EAST, W.M., EXCEPT THAT PORTION LYING WITHIN 136TH STREET NORTHEAST. SITUATE IN THE COUNTY OF SNOHOMISH, STATE OF WASHINGTON.

#### PARCEL B:

THAT PORTION OF GOVERNMENT LOT 4, SECTION 4, TOWNSHIP 30 NORTH, RANGE 5 EAST, W.M., IN SNOHOMISH COUNTY, WASHINGTON, DESCRIBED AS FOLLOWS:  
BEGINNING AT THE SOUTHEAST CORNER OF SAID GOVERNMENT LOT 4;  
THENCE WEST 209 FEET TO THE TRUE POINT OF BEGINNING; THENCE NORTH 525 FEET, MORE OR LESS, TO THE NORTH LINE OF TRACT CONVEYED TO MOSES PIKE BY DEED RECORDED MAY 19, 1909 UNDER RECORDING NUMBER 141663; THENCE WEST TO THE EAST LINE OF COUNTY ROAD KNOWN AS HIGHWAY 99, SAID ROAD BEING DESCRIBED IN DEED RECORDED JUNE 17, 1913 UNDER RECORDING NUMBER 190204; THENCE SOUTHERLY ALONG EAST LINE OF SAID HIGHWAY 99 TO THE SOUTH LINE OF SAID GOVERNMENT LOT 4; THENCE EAST TO THE TRUE POINT OF BEGINNING;  
EXCEPT COUNTY ROAD ALONG THE SOUTHERLY LINE OF SAID PREMISES KNOWN AS 136TH STREET CONVEYED TO SNOHOMISH COUNTY BY DEEDS RECORDED UNDER RECORDING NUMBER 2166391 AND RECORDING NUMBER 8301280241;  
AND EXCEPT ADDITIONAL RIGHT OF WAY BORDERING SAID HIGHWAY 99 AND 136TH STREET AS CONVEYED TO THE STATE OF WASHINGTON BY DEED RECORDED JUNE 24, 1952 UNDER RECORDING NUMBER 1030807;  
AND EXCEPT THAT PORTION CONVEYED TO SNOHOMISH COUNTY BY DEED RECORDED UNDER RECORDING NUMBER 9208070367;  
AND EXCEPT THAT PORTION CONVEYED TO THE CITY OF MARYSVILLE BY DEED RECORDED UNDER RECORDING NUMBER 200712110343.

SITUATE IN THE COUNTY OF SNOHOMISH, STATE OF WASHINGTON.

## 1.1.3 Maintenance Agreements

Agreement to maintain facilities in accordance with City of Marysville and the Washington State Department of Ecology's maintenance standards.

### 1.1.4 Obligations

Maintenance and operation of all drainage facilities located within the Site boundaries and outside of the right-of-way is the responsibility of the home-owner's association and of the individual property owner. Drainage facilities must be maintained and operated in accordance with the maintenance standards presented in this document. All privately maintained flow control BMPs must be maintained as specified in the Site's/Lot's declaration of covenant and grant of easement.

The City of Marysville may inspect all privately maintained drainage facilities for compliance with these requirements. If the property owner(s) fails to maintain their facilities to the acceptable standards, the City may issue a written notice specifying the required remedial actions and requiring a schedule for timely completion of the actions. If these actions are not performed in a timely manner, the City may enter the property to perform the actions needed and bill the property owner(s) for the cost of the actions. If a hazard to public safety exists, the City may perform remedial actions without written notice.

**A copy of this manual must be kept by an officer of the homeowner's association as well as any/all persons involved with upkeep and operation and maintenance. This manual and all associated records must be made available for inspection by the City of Marysville or an agent thereof.**

### 1.1.5 Scheduling

The facility-specific maintenance standards contained in this manual are intended to be conditions for determining if maintenance actions are required as identified through inspection. They are not intended to be measures of 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 inspection and maintenance schedules shall be adjusted to minimize the length of time that a facility is in a condition that requires a maintenance action.

In addition to the maintenance schedules, severe events, such as windstorms, flooding rains, construction or vehicular accidents, seismic events, or the like, is cause for inspection. In the event of extensive damage, reconstruction may be required, in which case, refer to the construction plan set in addition to this manual.

Key:

[M] Monthly from November through April.

[A] Annually, once in late summer (preferable September)

[S] After any major storm (use 1-inch in 24 hours as a guideline).

[B] Biannually (spring and fall)

[Q] Quarterly

[F] Observable failure of facility

### 1.1.6 Activity Logs

Reproduce the tables for each facility listed here for a maintenance activity log sheet to document any inspection or maintenance of a facility.

### **1.1.7 Record Keeping**

This section contains the inspection and maintenance sheets for the various stormwater management BMPs and facilities. Copies of these sheets are to be used for every inspection and/or service for each facility. Make enough copies of each sheet for each facility for an annual service cycle. Adhere to the following guidelines:

Provide one copy of sheet for each inspection or service.

All inspections or services must be documented and tracked via these maintenance sheets.

The logged sheets are to be stored and kept with the facilities manager

Inspect the facility(s) at the specified interval.

Use and fill out the inspection/maintenance sheet for each inspection event.

Document and log any maintenance expenses as required.

Make back-up copies for your records.

## 1.1.8 Definitions & Terms

<b>Amended Soils</b>	Engineered soils that are a blend of soils with low to very low silt and clay content (sandy soils) with a minimum of 10% organics materials (vegetative matter) to be used for stormwater management.
<b>BMP</b>	A Best Management Practice, as applied to stormwater management. This can be physical device, such as a Rain Garden, or a procedure, such as placing the grasses and vegetative matter along the downslope side and the underlying soils along the upslope side while excavating a trench to minimize the chance of sediment laden runoff.
<b>CB</b>	Catch basin. Typically a sub-surface concrete structure used in between pipes, often at a bend location, or at the start of pipe.
<b>Conveyance</b>	The process of moving stormwater runoff from one place to another. This is typically achieved by pipes, swales, or ditches.
<b>Rock Bed</b>	A buried bed or 'chamber' of clean angular rocks or stones, typically crushed rocks from a quarry or gravel or aggregates supplier that have been washed or otherwise cleaned to remove the fine particles (silt and clay). This bed is used for a temporary waters storage facility where the water is held within the void spaces (air gaps between the rocks).
<b>Facility</b>	A physical BMP that has been engineered to manage stormwater. This management can be to regulate the rate of water release and/or to provide pollution control.
<b>Impervious Surface</b>	Any hard surface that prevents or severely limits water from infiltrating into the soil. Such examples are roof, concrete or asphalt paved areas, or highly compacted gravels or soils that are high in silt and fines content.
<b>Infiltration</b>	The process of water percolating or draining downward into the soil. This is often measured as a rate with units of inches of standing water per hour.
<b>Runoff</b>	Runoff or Stormwater runoff is the portion of rainwater that does not infiltrate into the ground or is received by a stormwater management facility. This water runs over the top of hard surfaces like roofs and roads, and when uncontrolled, can cause damage or flooding.
<b>Swale</b>	An engineered form of a ditch that is used to convey, treat, or infiltrate stormwater runoff, or any combination of these facets depending on the design of the swale. The swale is considered a facility.
<b>Treatment</b>	The process of eliminating or reducing the pollutant content of stormwater runoff.

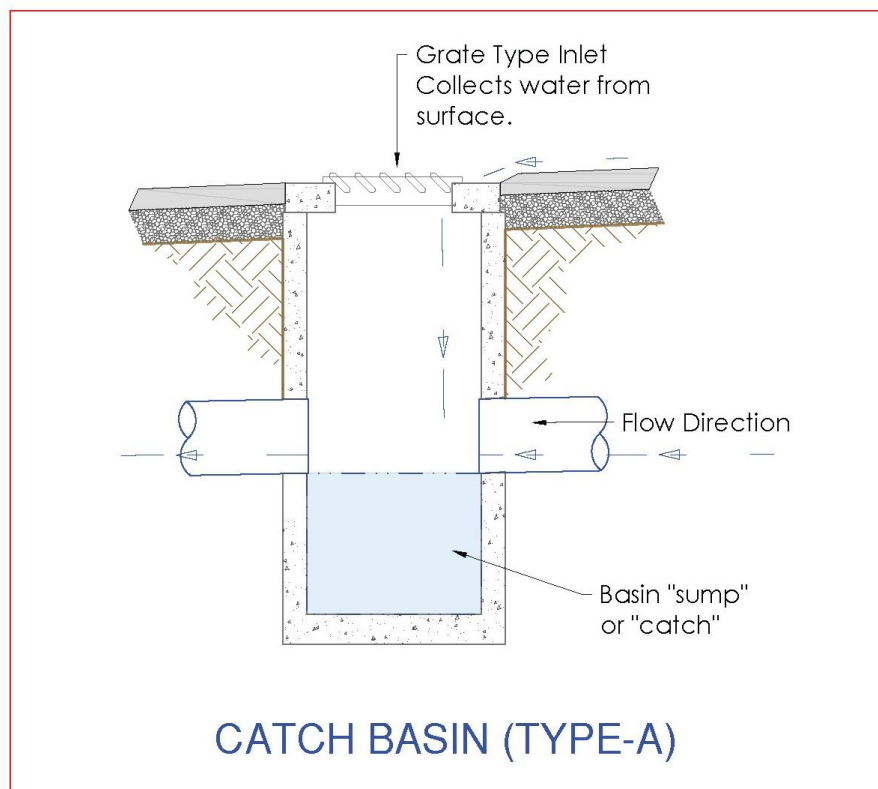
## 1.2 Facility Functions and Descriptions

### 1.2.1 Catch Basin & Manholes

A catch basin (CB) is a sub-surface junction structure that typically has only one outlet pipe (where water exists) and may have from zero to several pipes entering it. It has multiple functions. It is used at locations where pipes must make a bend or where different pipe sizes or materials need to join. This allows pipes to remain straight and be serviced. It may have a grated inlet at the top to collect surface runoff or a solid cover to prevent runoff from entering. CBs fitted with a grate tops tend to be the part that required the most frequent service, particularly where can be covered with leaves.

The CB structure is typically made of concrete. The CB can either be a Type 1 structure (a 2 foot by 2.5 foot) rectangular box structure or a larger round, cylindrical structure with a minimum 4 feet diameter that is called a Type 2 structure. These larger CBs are often referred to as a manhole as they are designed to allow a person to climb into it for service reasons. They are also used for deeper and/or larger diameter pipes.

The 'catch' part of the basin name is either 1.5 foot or 2 foot deep (or deeper) sump designed to collect the settling type of debris (sediment).



Inspection and maintenance tasks are described in **Section 2.4**.

## 1.2.2 Downspout System

The roof downspouts convey roof stormwater runoff to the Rain Gardens or the perforated Stub-out trenches. This system is made up of the roof gutters, the downspout pipes, and screens or filters for leaf or other debris removal. Where roof dispersion is employed for flow control, splash bocks and/or additional buried pipe are used. The system is designed to deliver the roof stormwater runoff to the appropriate facility.

### How it works

A primary screen enables the action of the water to wash the screen and minimize maintenance. An internal secondary stainless steel screen keeps mosquitoes and vermin out of downpipes.

The elliptical outer screen can be adjusted to 4 different angles faces to accommodate various rainfall intensities of and amounts of debris. After observing the performance of the filter, the screen can be adjusted until the best operating setting is achieved.

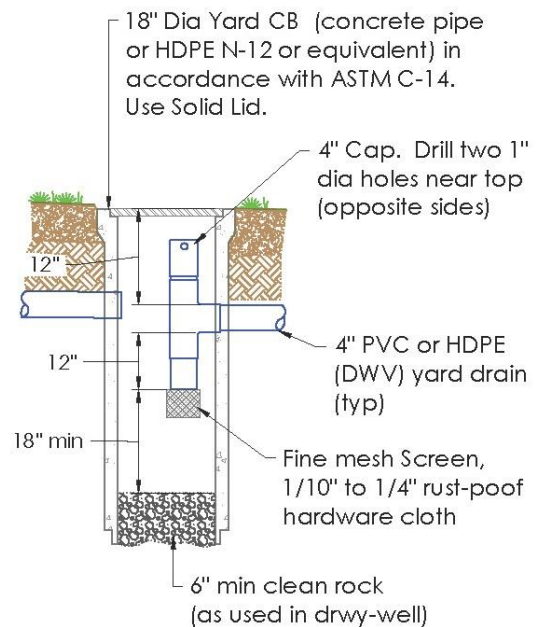
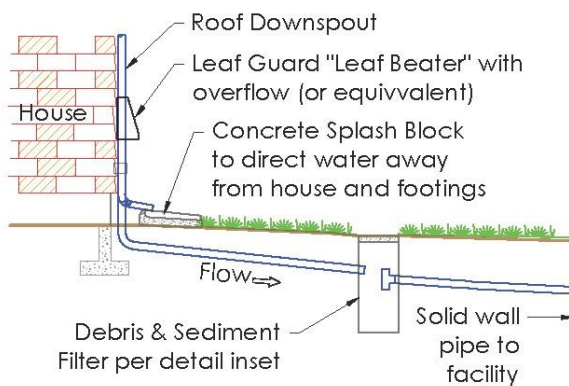
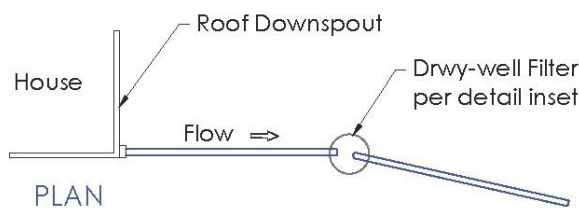
### Installation

The Leaf Beater® is usually mounted directly under the roof gutter, however it can be mid-mounted on a wall to make it easier to access for cleaning.

RainHarvest Systems, LLC  
<http://www.rainharvest.com/filtration/pre-filtration/downspout-filters.asp>



DOWNSPOUT DEBRIS SCREEN



PROFILE

DRY-WELL FILTER DETAIL

## DOWNSPOUT RUNOFF MANAGEMENT SYSTEMS

Inspection and maintenance tasks are described in **Section 2.3**.



### 1.2.3 Bio-cell Facilities

The **bio-retention cell** performs three primary jobs:

The first job is to collect and hold the stormwater runoff from the streets, driveways, and rooftops and enable this water to drain into the soils beneath it. This process is called infiltration. The facility is designed to direct all of the stormwater run for all storm events up to what is termed the '100 year' storm into the ground to become 'groundwater'.

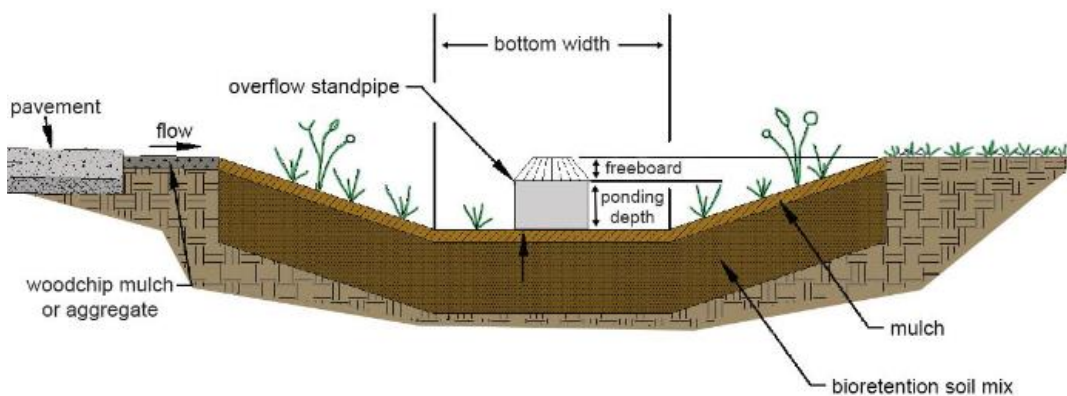
When bigger storms arrive, especially storms that are back-to-back, the ponding area will start to fill up. For extreme events or if a problem arises with the soils ability to absorb water occurs, water will start to flow out of the device called the Overflow Standpipe, which will send this excess to the street system.

The second job is to treat this water by allowing it to percolate through a layer of engineered soils (a.k.a. **(amended soils)**) that line the facility. The paved areas are known as Pollutant Generating Impervious Surface (**PGIS**) since cars, truck, and other motorized vehicles travel over them. The vehicles drip oils, fuels, antifreeze, and contaminated water from tail-pipes. They also track materials, deposit tiny rubber particles, rust, and other metals on the roadway. When rain falls, particularly the first rain after a long dry stretch, much to most of these pollutants get washed into the street storm system, depending on how big the storm event is.

The amended soils and the various plants the line the bio-cell provide the treatment work through chemical, biological, and physical properties of plants, soil microbes, and the mineral aggregate and organic matter in soils to transform, remove, or retain pollutants from stormwater runoff. The plants also provide additional flow control as they intercept and evaporate rainfall as well as uptake moisture from the soils and transpire it.

A layer of clean crushed rock is provided beneath the amended soils layer to provide an interface between the native soils and also enhance the infiltration process by providing additional pore space or 'void' volume' for the water to collect into as is percolated downward.

A typical schematic section of the bio-cell follows.



Inspection and maintenance tasks are described in **Section 2.5**.

## Section 2 – Inspection / Maintenance Sheets

### 2.1 Contact Information

**City of Marysville**  
80 Columbia Avenue  
Marysville, WA 98270  
360-363-8100  
[www.marysvillewa.gov](http://www.marysvillewa.gov)

**Facilities Management:**

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**Owner / Maintenance Personnel:**

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## 2.2 Amended Soils

Name: \_\_\_\_\_ Phone/Email: \_\_\_\_\_ Date/Time Inspected:

Facility Location (CODE): \_\_\_\_\_ Weather:

Maintenance Component Defect [Frequency]	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed	Describe work done -and/or - Observations and Notes
<b>General</b>			
Soil media (maintain high organic soil content) [A]	Vegetation not fully covering ground surface.	Re-mulch landscape beds with 2-3 inches of mulch until the vegetation fully closes over the ground surface	
Soil media (maintain high organic soil content) [Ongoing]	None. Preventative maintenance	Return leaf fall and shredded woody materials from the landscape to the site as mulch.	
Soil media (maintain high organic soil content) [Ongoing]	None. Preventative maintenance	On turf areas, mulch-mow or leave the clippings (well distributed) to build turf health	
Soil media (maintain high organic soil content) [Ongoing]	None. Preventative maintenance	Avoiding broadcast use of pesticides (bug and weed killers) like 'weed & feed', which damage the soil life.	
Soil media (maintain high organic soil content) [A]	None. Preventative maintenance	Where fertilization is needed (mainly turf and annual flower beds), a moderate fertilization program which relies on natural organic fertilizers (like compost) or slow release synthetic balanced fertilizers.	

Maintenance Component Defect [Frequency]	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed	Describe work done -and/or - Observations and Notes
Compaction [A]	Soils become waterlogged, do not appear to be infiltrating.	To remediate, aerate soil, till or further amend soil. If drainage is still slow, consider investigating alternative causes (e.g., high wet-season groundwater levels, low permeability soils). Also consider land use and protection from compacting activities. If areas are turf, aerate compacted areas and top dress them with ¼-½ inch of compost to renovate them.	
Erosion/scouring [A]	Areas of potential erosion are visible.	Take steps to repair or prevent erosion. Identify and address the causes of erosion.	
Grass/vegetation [A]	Less than 75% of planted vegetation is healthy with a generally good appearance.	Take appropriate maintenance actions (e.g., remove/replace plants)	
Noxious weeds [M]	Listed noxious vegetation is present.	See the Snohomish City noxious weed list. By law, noxious weeds must be removed and disposed immediately. It is strongly encouraged that herbicides and pesticides not be used in order to protect water quality.	
Weeds [Q]	Weeds are present.	Remove and dispose of weed material. It is strongly encouraged that herbicides and pesticides not be used in order to protect water quality.	

## 2.3 Downspout System

Name: \_\_\_\_\_ Phone/Email: \_\_\_\_\_ Date/Time Inspected:

Facility Location (CODE): \_\_\_\_\_ Weather:

Maintenance Component/ Defect [Frequency]	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed	Describe work done -and/or - Observations and Notes
<b>Downspout Pipe or Conduit</b>			
1 Conduit plugged, bent, or crimped [A,F]	If downspout conduit is plugged, bent, or crimped or in any way hindered from delivering roof water to splash pad or block.	Cleaned or replaced down spout.	
<b>Downspout Filter or Screen</b>			
2 Trash and Debris Accumulation [B,F]	Trash and debris accumulated in or about the screen or filter blocking more that 40 percent of the filter area.	No trash or debris from is present on or around the filter.	
<b>Cleanout Stand-pipe or Yard CB</b>			
3 Flow appearing out of top of stand-pipe/ cleanout. [M,F]	Any flow from the top of cleanout stand-pipe is a sign of blockage in the downstream portion of pipe. Down spout splash block is missing or moved from downspout outfall or is cracked or broken, allowing water to saturate area near foundation.	Blockage removed from downstream pipe or Splash Block replaced so water is channeled to rain garden or dispersion area.	
4 Regular CB Maintenance [B,F]	Sediment and/or floatable debris exists in sump of yard catch basin.	Clear debris and scoop or vacuum sediments from sump.	
<b>Conveyance Pipes</b>			
5 Obstructions, Including Roots [A]	Root enters or deforms pipe, reducing flow.	Use mechanical methods to remove root if possible (pressure water jet). Chemicals removal prohibited.	
<b>Rock Pad or Splash Blocks</b>			

Maintenance Component/ Defect [Frequency]	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed	Describe work done -and/or - Observations and Notes
6 Missing or Moved Rock [A,F]	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil where pad was originally installed.	Rock pad replaced to design standards. (put the rock back)	
7 Erosion [M,S]	Soil erosion in or adjacent to block or rock pad.	Rock pad replaced to design standards.	

### 2.3.1 Supplemental Maintenance Instructions for Bio-Cells (Rain Gardens)

A Bio-detention Cell (or a Rain Garden) is a stormwater management flow control BMP (best management practice) that was installed to mitigate the stormwater quantity and quality impacts of some or all of the impervious or non-native pervious surfaces on your property.

Bio-detention Cells are vegetated closed depressions or ponds that retain and filter stormwater from an area of impervious surface or non-native pervious surface. Depending on soil conditions, rain gardens may have water in them throughout the wet season and may overflow (through the designated overflow path such as a stand pipe or spillway) during major storm events.

The soil in the rain garden has been enhanced to encourage and support vigorous plant growth that serves to filter the water and sustain infiltration capacity. The size, placement, and design of the rain garden as depicted by the flow control BMP site plan and design details must be maintained and may not be changed. Plant materials may be changed to suit tastes, but chemical fertilizers and pesticides must not be used.

Mulch may be added and additional compost should be worked into the soil over time. Rain gardens must be inspected annually for physical defects. After major storm events, the system should be checked to see that the overflow system is working properly. If erosion channels or bare spots are evident, they should be stabilized with soil, plant material, mulch, or landscape rock. A supplemental watering program may be needed the first year to ensure the long-term survival of the rain garden's vegetation.

Vegetation should be maintained as follows:

- 1 Replace all dead vegetation as soon as possible;
- 2 Remove fallen leaves and debris as needed;
- 3 Remove all noxious vegetation when discovered;
- 4 Manually weed without herbicides or pesticides;
- 5 During drought conditions, use mulch to prevent excess solar damage and water loss.

## 2.4 Catch Basin & Manholes

Name: \_\_\_\_\_ Phone/Email: \_\_\_\_\_ Date/Time Inspected: \_\_\_\_\_

Facility Location (CODE): \_\_\_\_\_ Weather: \_\_\_\_\_

Maintenance Component / Defect [Frequency]	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed	Describe work done -and/or - Observations and Notes
<b>General</b>			
1 Trash & Debris [B,F]	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.	
2 Sediment [S,B,F]	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	
3 Structure Damage to Frame and/or Top Slab [B,F]	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch  (Intent is to make sure no material is running into basin if not so designed).	Top slab is free of holes and cracks.	
	Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached	Frame is sitting flush on the riser rings or top slab and firmly attached.	



Maintenance Component / Defect [Frequency]	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed	Describe work done -and/or - Observations and Notes
4 Fractures or Cracks in Basin Walls/Bottom [B,F]	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.	
	Grout fillet has separated or cracked wider than 1/2 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 re-grouted and secure at basin wall.	
5 Settlement/ Misalignment [A,F]	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.	
6 Vegetation [B,F]	<del>Vegetation growing across and blocking more than 10% of the basin opening.</del>	<del>No vegetation blocking opening to basin.</del>	
	<del>Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.</del>	<del>No vegetation or root growth present.</del>	
7 Contamination and Pollution [B,F]	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 pollution present.	
<b>Catch Basin Cover</b>			
8 Cover Not in Place [A,F]	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed	
9 Locking Mechanism Not Working [B,F]	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.	

Maintenance Component / Defect [Frequency]	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed	Describe work done -and/or - Observations and Notes
10 Cover Difficult to Remove [B,F]	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.	
<b>Metal Grates (If Applicable)</b>			
11 Grate opening Unsafe [B,F]	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.	
12 Trash and Debris [B,F]	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.	
13 Damaged or Missing. [B,F]	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.	
<b>Manhole</b>			
14 Cover Not in Place [F]	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed.	
15 Locking Mechanism Not Working [A,F]	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread (may not apply to self-locking lids).	Mechanism opens with proper tools.	
<b>Ladder</b>			
16 Ladder Rungs Unsafe [A,F]	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.	
17 Cover Difficult to Remove [A,F]	One maintenance person cannot remove lid after applying normal lifting pressure. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person.	

## 2.5 Bioretention Cell Facility

Name: \_\_\_\_\_ Phone/Email: \_\_\_\_\_ Date/Time Inspected:

Facility Location (CODE): \_\_\_\_\_ Weather:

Maintenance Component / Defect [Frequency]	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed	Describe work done -and/or - Observations and Notes
<b>Pooling Storage Areas</b>			
1 Trash & Debris [B,F]	Any trash and/or debris which exceed 5 cubic feet per 1,000 square feet (this is about equal to the amount of trash it would take to fill up one standard size garbage can). 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.	No trash or debris removed from site.	
2 Sediment [B,F]	Sediment covers more than 30 percent of the floor area of the bio-cell bottom (pooling area)	No sediment visible on the floor or sidewalls of the bio-cell  (A percolation test pit or test of facility indicates facility is only working at 90% of its designed capabilities. If two inches or more sediment is present, remove).	
3 Poor Vegetation Coverage [B,F]	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. Replant with plugs of grass from the upper slope: plant in the swale bottom at 8-inch intervals. Or reseed into loosened, fertile soil.	

Maintenance Component / Defect [Frequency]	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed	Describe work done -and/or - Observations and Notes
4 Vegetation, groundcovers [B,F]	When the grass becomes excessively tall (greater than 10-inches); 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 unless mulching mower used as part of a regenerative program for minimal pollutant loading area.	
5 Vegetation, landscape [B,F]	See Supplemental Maintenance		
6 Standing Water [M,F]	When water stands in the 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 (if applicable),	
7 Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants. (Coordinate removal/cleanup with local water quality response agency).	Contaminants or pollutants are removed	
8 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.)	
9 Erosion on Side Slopes	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 civil engineer should be consulted to resolve source of erosion.	
<b>Stand-pipes</b>			

Maintenance Component / Defect [Frequency]	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed	Describe work done -and/or - Observations and Notes
10 Debris grate blocked or damaged or standpipe damaged [B,F]	See Control Structure Stand-pipe Maintenance		
<b>Underdrain</b>			
11 Underdrain pipe plugged with root, sediment, or debris. [inspect underdrain orifice tube first] [B,F]	Pond area fills more quickly and/or once filled, pond does not drain overnight.	Use pressure-jet washer through cleanout. Remove orifice tube before cleaning. Pond should drain readily after storms.	
12 Cleanout Stand-pipe [A,F]	Missing or structural damage is apparent.	Repair or place missing or damage components to standards presented in Plat construction Plan set.	
<b>Emergency Overflow Spillway</b>			
13 Rocks Missing [A,F]	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.	
14 Erosion [A,F]	Missing or structural damage is apparent.	Repair or place missing or damage components to standards presented in Plat construction Plan set.	

## 2.6 Amended Soils Preparation and Specifications

### 2.6.1 Restoration Requirements for Disturbed Areas:

Disturbed areas are to be restored per the specifications of the Soils for Salmon BMP T5.13 (See Snohomish County Post-construction Soil Standard, Assistance Bulletin #94). The online document is currently available at:

[www.co.snohomish.wa.us/documents/Departments/PDS/Bulletins/94SoilStandardCombined1011.pdf](http://www.co.snohomish.wa.us/documents/Departments/PDS/Bulletins/94SoilStandardCombined1011.pdf)

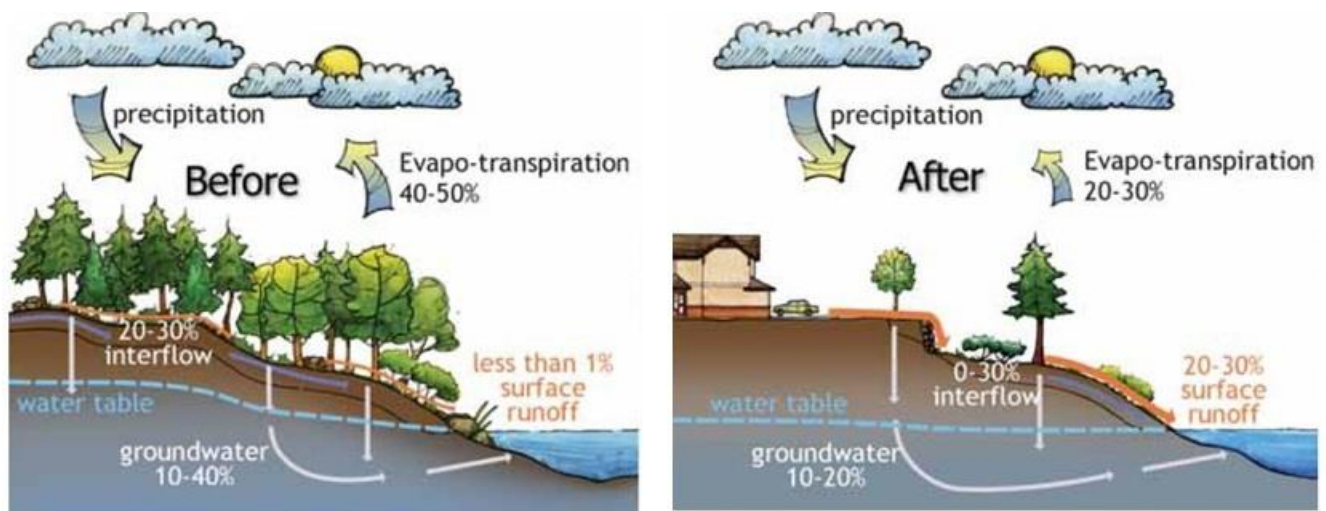
This BMP (Best Management Practice) provides four options for soil restoration:

- **Option 1** - Leave undisturbed native vegetation and soil, and protect from compaction during construction.
- **Option 2** - Amend existing site topsoil or subsoil either at “preapproved” default rates, or at custom calculated rates based on tests of the soil and amendment.
- **Option 3** - Stockpile existing topsoil during grading, and replace it prior to planting. Stockpiled topsoil must also be amended if needed to meet the organic matter or depth requirements, either at a “pre-approved” default rate or at a custom calculated rate.
- **Option 4** - Import topsoil mix of sufficient organic content and depth to meet the requirements.

Of these, only **Option 4** is feasible. If soil repair is required as a result of contamination such as silt and clay content overload as a result of sedimentation or spill, or saturation of environmental pollutant overload, the **amended soils must be replaced** and not further amended, hence only **Option 4** is recommended.

## 2.7 Landscape Requirements

Landscaping is part of the stormwater management system. As in nature, trees, shrubs and plants, and grasses or ground-covers provide an important role in the hydrologic (water) cycle. Puget Sound sees an average annual rainfall of about 40 inches per year. Nearly half of that evaporates in the natural condition. Most of that is due to vegetation.



Before development, almost all rainfall is taken up by plants, evaporates, or infiltrates through the ground.  
Courtesy of Puget Sound Partnership

After conventional development, surface runoff increases significantly while evaporation and infiltration into the ground decrease.

Plants do many other things, such as regulate air temperature, produce oxygen, provide habitat, filter the air, and more. Upkeep of the plant in your yard not only improves the aesthetic and pride of ownership, it also improves the environment. It is also part of the responsibility of homeownership.

### 2.7.1 General Maintenance

After heavy storms, check the inflow and overflow areas to make sure they are still intact and can continue to carry water into and out of the rain garden. Remove any debris or litter in the rain garden that may interfere with flow. Keep the inflow pipe accessible and flush out pipe if necessary. Look for areas where water may not be soaking into the ground. This may be due to fine sediment or compaction of the soil. Remove sediment that may be building up and rake the soil surface. If you suspect compaction, break up and loosen the soil when it is not saturated.

## 2.7.2 Specific Actions

- Maintain access to the bottom of the rain garden for weeding and other tasks. A few strategically placed flat rocks can allow access to the bottom of the rain garden without compaction of the soil.
- Edging around the rain garden (such as pavers, stones, etc.) can facilitate access for maintenance and provide separation from lawn and other landscaped areas.
- Maintain a healthy cover of plants.
- Remove any diseased plants or plant parts and dispose to avoid risk of spreading the disease to other plants.
- Disinfect gardening tools after pruning to prevent the spread of disease.
- Re-stake trees if they need more support, but plan to remove stakes and ties after the first year.

The majority of the following plant suggestions are borrowed from the “**Rain Garden Handbook for Western Washington**”, July 2013 version:

## 2.7.3 Landscape Zones

Rain gardens typically have three planting zones:

**Zone 1** - the bottom of the rain garden which is the wettest area.

**Zone 2** - the side slopes, a periodically wet area.

**Zone 3** - the perimeter area and/or on a berm, a drier soil area.

The following Table provides plant recommendation for maintenance and replacement plans spiciest.



## 2.7.4 Plant Recommendations

**TABLE 1 Bio-cell Plant List**

### ZONE 1

#### Emergents

Slough sedge

(*Carex obnupta*) and smallfruited

Bulrush

(*Scirpus microcarpus*)

#### Ferns

Lady fern

(*Athyrium filix-femina*)

deer fern

(*Blechnum spicant*)

#### Deciduous Shrub

Dwarf red-twig dogwood

(*Cornus sericea* 'Kelsey')

black twinberry

(*Lonicera involucrata*) [larger areas]

### ZONE 2

#### Ferns

Sword fern

(*Polystichum munitum*) and

lady fern

(*Athyrium filix-femina*)

#### Deciduous Shrubs

Snowberry

(*Symphoricarpos albus*)

#### Evergreen Shrubs

Salal

(*Gaultheria shallon*) and boxwood

Honeysuckle

(*Lonicera pileata*)

### ZONE 3

#### Herbaceous Perennials

Wild ginger

(*Asarum caudatum*)

Insideout flower

(*Vancouveria hexandra*), and

western bleeding heart

(*Dicentra formosa*)

#### Ferns

Sword fern

(*Polystichum munitum*)

#### Evergreen Shrubs

Evergreen huckleberry

(*Vaccinium ovatum*)

low Oregon grape

(*Mahonia nervosa*)

#### Deciduous Trees and Large Shrubs

Vine maple

(*Acer circinatum*)

Cascara

(*Frangula purshiana*)

Indian plum

(*Oemleria cerasiformis*)

## 2.7.5 Ground Cover

For yard and ground cover, in and around the bio-cells, or for the road-side bio-swale areas, the following table presents the recommended ground cover seed mixes.

**TABLE 2 Bio-Infiltration Swale and Filter Strip Seed Mixes**

Species	Percent	Description
Hard Fescue	45	Shade, drought and disease resistant. Grows in some of most adverse conditions and heavily shaded areas. It is slow growing and low maintenance; left un-mowed it forms a soft, 4 to 6 inch carpet of grass.
Sheep Fescue	20	Is a bunch grass that forms a soft carpet in a thick stand; requires little maintenance and grows short (under a foot) needing little or no mowing (as described for lawn use). It is very drought hardy. It suppresses weed growth and has heavy root growth protecting against erosion.
Creeping Red Fescue	10	Fescue that spreads by underground rhizomes allowing it to “fill-in” open areas. It is low maintenance and shade tolerant. Used where low-input mowing, fertilization, and irrigation is desired. Foliage does grow taller to 12” with 24” seed stalks. While taller grass is not particularly desired; some Creeping Red Fescue is used to “fill-in” possible bare areas created from bunch grasses.
Poa Supina	10	Best shade grass on market. Has high wear tolerance with aggressive growth that out-competes invasive species. Spreads by stolons forming a good “turf matt”. Un-mowed foliage height is 6 inches with seed head heights of 10 to 12 inches.
Dutch White Clover (prefer ProTime Microclover**, <i>Trifolium repens</i> “Pipolina”)	15	Clover is a legume that will provide nitrogen to the surrounding grasses. Typical Dutch White Clover only grows to 4 to 8 inches. The ProTime Microclover grows even lower (rarely exceeds 6 inches) and is preferred due to its deeper stoloniferous root system making it drought tolerant. Grows in shade or full sun.
<b>Pre-Mix Options</b>		
Hobbs and Hopkins (503) 239-7518 Portland Oregon	100	ProTime 702 Low Profile Erosion Control Mix, genetically low growing and capable of forming dense root mass quickly. This mix uses Microclover and “tetraploid sheep fescue”. Spread per mfg recommendations (typically 5lbs/1000 sf)
Agrivestment LTD (253)383-5014 Warehouse in Oregon (503) 982-8655		The Design mix should be spread at 4 to 5 lbs/1000 sf. Overseeding with Dutch White Clover should be ¼ lb/1000 sf.

\*\*Available as single species from Nichols Garden Nursery [www.nicholsgardennursery.com](http://www.nicholsgardennursery.com) or

Hobbs and Hopkins in mix: [www.protimelawnseed.com](http://www.protimelawnseed.com)