

*Appendix F*

***Post-Construction Stormwater  
Management in New and Redevelopment***

This page intentionally left blank.

***Appendix F.3***

***Stormwater Drainage Facilities Inspection  
Standard Operating Procedure***

---

This page intentionally left blank.

**CITY OF BEND  
STANDARD OPERATING PROCEDURE**

<p><b>Standard Operation of:</b> <b>City of Bend Stormwater Drainage Facility Maintenance Inspections</b></p>	<p><b>Creation Date:</b>  1/3/2020 Revised/Approved: 5/19/2020</p>
<p><b>Approved By: Wendy Edde, CSM, Program Manager</b>  <b>Reviewed By: Wendy Edde</b>  <b>Author: Sean Mulderig</b></p>	<p><b>Revision No or Date:</b>  6/10/2020</p>

**Subject: City of Bend (COB) standard post-construction stormwater drainage facility maintenance inspection process. This standard operating procedure will address pre-inspection research, routine public drainage facility inspections, private drainage facility inspections, and report generation. Implementation of this program is to ensure compliance with City of Bend and DEQ permitting.**

**Scope and Location:**  
Private and public stormwater drainage facilities within the City of Bend.

- I. Location and Coverage**
  - a. Throughout the City limits
  - b. 24-7 as needed (typically working hours)
- II. Enforcement Approach—Post-Construction SW Facility maintenance**
  - a. **Routine Maintenance compliance**
    - i. Maintenance agreement between developer and City of Bend
    - ii. City of Bend Standards and Specifications
    - iii. Oregon DEQ MS4 and WPCF permits
  - b. **Guidance**
    - i. Central Oregon Stormwater Manual

**List of Tools/Equipment/Material:**  
Involved Equipment:

1. E-Plans (Permitted Building Plans)
2. Computers with Code Enforcement tracking (HTE, Excel Spreadsheets, or LEAP Software).
3. Monitoring Equipment (Turbidity Meter and Sludge Judge, both found in vehicle or blue bay)
4. Communication Tools (Printed Outreach Materials)
5. Safety PPE for construction sites (Safety Vest, Steel-Toe Boots, safety glasses, and Hard Hat)

**Hazards Identification:**

1. Standard desk work (minor risk: paper cuts, carpal tunnel, eye strain, etc.)
2. Standard active construction site hazards
3. Standard right-of-way work site hazards
4. Standard private property access, site hazards

**Purpose:** To have a standard, equitable approach for verifying maintenance on and operability of private and public permanent stormwater drainage facilities within the City of Bend.

**1) Inspection Selection**

- i. Inspect new landscaped stormwater facilities before end of warranty to determine acceptability and to form a baseline for future inspections.
- ii. Inspect City ROW landscape facilities at least once per biennium, and preferably at least once per year.
- iii. Inspect 10% of credit program facilities per year (minimum 2 per year)  
(a) random selection so all are inspected at least once within 10 years.
- iv. Inspect 20% of maintenance agreement facilities per year (minimum 2 per year)  
(a) random selection so all are inspected at least once within five years.
- v. Additional inspections as per programs associated with building system knowledge as agreed/time permitting.

**2) Pre-inspection**

- i. Site plan research
  1. Search E-plans and sharepoint to find any applicable drainage plans, maintenance agreements, or drainage reports. Download new information to the stormwater sharepoint sites (see below). Maintenance agreements should have a site plan showing stormwater facility locations attached.  
(a) ROW swale planting plans are located here:  
[https://bendoregon.sharepoint.com/sites/Util\\_SW/Swale%20Planting%20Plans/Forms/AllItems.aspx](https://bendoregon.sharepoint.com/sites/Util_SW/Swale%20Planting%20Plans/Forms/AllItems.aspx)  
(b) Private Maintenance Agreements are located here:  
[https://bendoregon.sharepoint.com/sites/Util\\_SW/Maintenance%20Agreements/Forms/AllItems.aspx](https://bendoregon.sharepoint.com/sites/Util_SW/Maintenance%20Agreements/Forms/AllItems.aspx)  
(c) Maintenance Annual Report Submittals are located here:  
[https://bendoregon.sharepoint.com/sites/Util\\_SW/Private%20Maintenance%20Inspections/Forms/AllItems.aspx](https://bendoregon.sharepoint.com/sites/Util_SW/Private%20Maintenance%20Inspections/Forms/AllItems.aspx)
  2. Cross reference the plan set with our private and/or public stormwater infrastructure asset list
  3. Find specific maintenance requirements for all facilities in inspection area using COB maintenance factsheets or the Central Oregon Stormwater Manual (COSM)
- ii. Educational materials
  1. During all inspections make sure to bring the following materials:

- A. COB Maintenance Fact Sheets
    - i. Porous Pavement
    - ii. Sedimentation Manhole
    - iii. Drywell
    - iv. Catch Basin
    - v. Rain Garden
  - B. Revised COSM Inspection Sheets for City of Bend (see [sharepoint for inspection sheets](#))
2. Hand-out materials should be given to property owners/managers or anyone that has interest in the program.

### 3) Inspections

- i. Public Stormwater Drainage Facility Maintenance Inspections
  - 1. Open the Utility Viewer on BOOM
  - 2. Access the Facility ID and location of specific public drainage facility
  - 3. Cross reference any plan set that we may have on the Q-drive (Q:\IMAGES)
  - 4. Use applicable inspection sheets to perform a maintenance inspection and record all inspection results in the Inspection Tracking Log Book (see [section c](#)), in the facility inspection tab.
  - 5. Throughout the inspection take pictures of proper and improper design, and/or maintenance, while also noting any practices that are and are not in compliance. Use an app on your phone or a camera that includes a date/time stamp on the pictures.
  - 6. Assign a maintenance rating for the facility (see [maintenance rating index on sharepoint](#))
  - 7. If maintenance rating is 4 or 5, notify the stormwater operations and maintenance crew
  - 8. Once maintenance is performed, request pictures from crew or reinspect to verify that corrective actions have been made.
- ii. Private Stormwater Drainage Facility Maintenance Inspections
  - 1. Voluntary Inspections
    - a. Citizens in the City of Bend are welcome to call the Stormwater Compliance Group to schedule a free Stormwater Infrastructure Maintenance Inspection.
    - b. Determine location of site and pull any plans from the Q-drive or E-plans.
    - c. Once specific drainage plans are found, cross reference the asset list with Facility IDs. These Private Facility IDs can be pulled up by the Data Services group.
    - d. Schedule a time a place to meet the property owner or manager.
    - e. The Stormwater Compliance Specialist will walk the property with the manager/owner.
    - f. Measure sediment levels in Catch Basins, Sediment Manholes, Drywells, and any other sump facilities.
    - g. Use applicable inspection sheets to perform maintenance inspections and record all inspection results in the Inspection Tracking Log Book (see [section c](#)), in the facility inspection tab. Note instances of low impact development

site designs and include those in your inspection report as beneficial.

- h. Throughout the inspection take pictures of proper and improper design, and/or maintenance, while also noting any practices that are and are not in compliance. Use an app on your phone or a camera that includes a date/time stamp on the pictures.
- i. Assign a maintenance rating for each of the facilities ([see maintenance rating index on sharepoint](#))
- j. Incorporate any newly known low impact development site designs and stormwater facilities into the City's private GIS database working with Data Services personnel.
- k. Generate an inspection report and send it to owner/manager. Here is an example inspection report: [https://bendoregon.sharepoint.com/sites/Util\\_SW/WorkingInternal/Forms/AllItems.aspx?id=%2Fsites%2FUtil%5FSW%2FWorkingInternal%2FStormwater%20Facility%20Inspection%20Report%5FO%2EB%2E%20Riley%20Rd%2E%20Elementray%20School%2Epdf&parent=%2Fsites%2FUtil%5FSW%2FWorkingInternal](https://bendoregon.sharepoint.com/sites/Util_SW/WorkingInternal/Forms/AllItems.aspx?id=%2Fsites%2FUtil%5FSW%2FWorkingInternal%2FStormwater%20Facility%20Inspection%20Report%5FO%2EB%2E%20Riley%20Rd%2E%20Elementray%20School%2Epdf&parent=%2Fsites%2FUtil%5FSW%2FWorkingInternal)

### iii. Credit Program Inspection

- a. A select few properties within the City are receiving COB Utility Bill credits for exceeding Stormwater management requirements. These locations are a high priority in terms of routine inspections.
- b. When property is scheduled to be inspected, determine who is responsible for stormwater maintenance. Send them a letter requesting a time and date to perform the inspection. An example inspection request letter can be found here: [https://bendoregon.sharepoint.com/:w:/r/sites/Util\\_SW/\\_layouts/15/Doc.aspx?sourcedoc=%7B32AF032B-54DC-4CFD-A629-2B88811C31BC%7D&file=Private%20Stormwater%20Facilities%20Inspection%20Letter\\_Walmart.docx&action=default&mobileredirect=true](https://bendoregon.sharepoint.com/:w:/r/sites/Util_SW/_layouts/15/Doc.aspx?sourcedoc=%7B32AF032B-54DC-4CFD-A629-2B88811C31BC%7D&file=Private%20Stormwater%20Facilities%20Inspection%20Letter_Walmart.docx&action=default&mobileredirect=true)
- c. Pull any plans from the Drainage Report, Q-drive, or E-plans.
- d. Once specific drainage plans are found, cross reference the asset list with Facility IDs. These Private Facility IDs can be pulled up by the Data Services group.
- e. Schedule a time a place to meet the property owner or manager.
- f. The Stormwater Compliance Specialist will walk the property with the manager/owner.
- g. Measure sediment levels in Catch Basins, Sediment Manholes, Drywells, and any other sump facilities.
- h. Use applicable inspection sheets to perform maintenance inspections and record all inspection results in the



Inspection Tracking Log Book (see section c), in the facility inspection tab.

- i. Throughout the inspection take pictures of proper and improper design, and/or maintenance, while also noting any practices that are and are not in compliance. Use an app on your phone or a camera that includes a date/time stamp on the pictures. Note instances of low impact development site designs and include those in your inspection report as beneficial.
- j. Assign a maintenance rating for each of the facilities (see maintenance rating index on sharepoint)
- k. Generate an inspection report and send it to owner/manager.
- l. Incorporate any newly known low impact development site designs and stormwater facilities into the City's private GIS database working with Data Services personnel.
- m. If the facility is no longer functional or an inspection within a reasonable time is refused, forward to stormwater audit staff (senior program analyst) for modifications of the credit amount.

iv. Maintenance Agreement Inspection

- a. Properties that have a maintenance agreement with the COB need to have their facilities inspected on a routine basis.
- b. When property is scheduled to be inspected, determine who is responsible for stormwater maintenance. Send them a letter requesting a time and date to perform the inspection with reference to the maintenance agreement.
- c. Pull any plans from the Drainage Report, Q-drive, or E-plans.
- d. Once specific drainage plans are found, cross reference the asset list with Facility IDs. These Private Facility IDs can be pulled up by the Data Services group.
- e. Schedule a time and a place to meet the property owner or manager.
- f. The Stormwater Compliance Specialist will walk the property with the manager/owner.
- g. Measure sediment levels in Catch Basins, Sediment Manholes, Drywells, and any other sump facilities.
- h. Use applicable inspection sheets to perform maintenance inspections and record all inspection results in the Inspection Tracking Log Book (see section c), in the facility inspection tab. Note instances of low impact development site designs and include those in your inspection report as beneficial.
- i. Throughout the inspection take pictures of proper and improper design, and/or maintenance, while also noting any practices that are and are not in compliance. Use an app on your phone or a camera that includes a date/time stamp on the pictures.

- j. Assign a maintenance rating for each of the facilities ([see maintenance rating index on sharepoint](#))
  - k. Generate an inspection report and send it to owner/manager.
  - l. Incorporate any newly known low impact development site designs and stormwater facilities into the City's private GIS database working with Data Services personnel.
- v. Maintenance Inspection of Properties Without a Maintenance Agreement
- a. Properties that do not have a maintenance agreement with the COB will be offered to have their facilities inspected on a routine basis. (We will start with voluntary inspections; often these will be done as part of other projects, or in areas where there may be drainage issues).
  - b. When property is scheduled to be inspected, determine who is responsible for stormwater maintenance. Send them a letter offering an inspection and requesting a time and date to perform the inspection with reference to an incentives that may be provided or benefits as a result.
  - c. Pull any plans from the Drainage Report, Q-drive, or E-plans.
  - d. Once specific drainage plans are found, cross reference the asset list with Facility IDs. These Private Facility IDs can be pulled up by the Data Services group.
  - e. Schedule a time and a place to meet the property owner or manager.
  - f. The Stormwater Compliance Specialist will walk the property with the manager/owner.
  - g. Measure sediment levels in Catch Basins, Sediment Manholes, Drywells, and any other sump facilities.
  - h. Use applicable inspection sheets to perform maintenance inspections and record all inspection results in the Inspection Tracking Log Book ([see section c](#)), in the facility inspection tab.
  - i. Throughout the inspection take pictures of proper and improper design, and/or maintenance, while also noting any practices that are and are not in compliance. Use an app on your phone or a camera that includes a date/time stamp on the pictures. Note instances of low impact development site designs and include those in your inspection report as beneficial.
  - j. Assign a maintenance rating for each of the facilities ([see maintenance rating index on sharepoint](#))
  - k. Generate an inspection report and send it to owner/manager.
  - l. Incorporate any newly known low impact development site designs and stormwater facilities into the City's private GIS database working with Data Services personnel.

#### 4) Inspection Tracking and Report Generation

- a. During any inspection, record information outlined in the “Stormwater Facility Inspection Sheets”. This inspection sheet was developed by the City of Bend with consideration from the Central Oregon Stormwater Manual. Here is the link to the inspection sheets:

[https://bendoregon.sharepoint.com/:w:/r/sites/Util\\_SW/\\_layouts/15/Doc.aspx?sourcedoc=%7B743BAADE-F995-4DCB-ADD7-206FEBB2EBED%7D&file=Water%20Quality%20Facility%20Field%20Inspection%20Sheet.docx&action=default&mobileredirect=true&DefaultItemOpen=1](https://bendoregon.sharepoint.com/:w:/r/sites/Util_SW/_layouts/15/Doc.aspx?sourcedoc=%7B743BAADE-F995-4DCB-ADD7-206FEBB2EBED%7D&file=Water%20Quality%20Facility%20Field%20Inspection%20Sheet.docx&action=default&mobileredirect=true&DefaultItemOpen=1)

- b. All information in the “Stormwater Facility Inspection Sheets” needs to be recorded in the “Inspection Tracking Log Book” in the “facility inspection tab”. Here is the link to the spreadsheet:  
[https://bendoregon.sharepoint.com/:x:/r/sites/Util\\_SW/\\_layouts/15/Doc.aspx?sourcedoc=%7BE45AB641-22AA-4BB2-A55B-75F5215A24F0%7D&file=Inspection%20Tracking%20Log%20Book.xlsx&action=default&mobileredirect=true&DefaultItemOpen=1](https://bendoregon.sharepoint.com/:x:/r/sites/Util_SW/_layouts/15/Doc.aspx?sourcedoc=%7BE45AB641-22AA-4BB2-A55B-75F5215A24F0%7D&file=Inspection%20Tracking%20Log%20Book.xlsx&action=default&mobileredirect=true&DefaultItemOpen=1)
- c. Once all inspected facilities have been recorded, generate a report and send it to property owner/manager. Here is an example inspection report:

[https://bendoregon.sharepoint.com/:w:/r/sites/Util\\_SW/\\_layouts/15/Doc.aspx?sourcedoc=%7BD56F3040-D440-4871-8279-BAFDCA4171E3%7D&file=Stormwater%20Facility%20Inspection%20Report\\_Tuscany%20Pines%20Phase%202%20SubDiv.docx&action=default&mobileredirect=true&DefaultItemOpen=1](https://bendoregon.sharepoint.com/:w:/r/sites/Util_SW/_layouts/15/Doc.aspx?sourcedoc=%7BD56F3040-D440-4871-8279-BAFDCA4171E3%7D&file=Stormwater%20Facility%20Inspection%20Report_Tuscany%20Pines%20Phase%202%20SubDiv.docx&action=default&mobileredirect=true&DefaultItemOpen=1)

- d. Separately, report number of inspections by type internally for monthly report by 10<sup>th</sup> of the month following. Include summaries of inspection activities in the post-construction control section of annual report for the period July 1 – June 30<sup>th</sup> each year; the annual report is due to DEQ by no later than November 1 of each year.

***Appendix F.1***

***Stormwater Facility Inspection Forms***

---

This page intentionally left blank.

## Inspection and Maintenance Checklist Catch Basin Inserts

Facility ID: \_\_\_\_\_

Date of Inspection: \_\_\_\_\_

Type of Inspection:  Routine  Re-Inspection<sup>1</sup>

Inspector(s): \_\_\_\_\_

Maintenance Rating: \_\_\_\_\_<sup>2</sup>

Question	Yes	No	NA	Comments
1. Is the facility accessible for inspection? Yes, if the inspector is able to do a visual inspection.				
2. Is the facility free of damage? Yes, if there is no structural damage from post installation activities that would hinder the facility's performance (holes/tears in fabric, broken metal frame, missing components, etc.).				
3. Is the facility free of significant trash and debris accumulation? Yes, if the facility is less than 50% full of trash or debris (green waste, weeds, etc.).				
4. Is the facility free of excessive sediment? Yes, if the facility is less than 50% full of sediment. Note that if sediment is clogging the fabric and is preventing adequate drainage, it is appropriate to check No and include a note.				
5. Is the facility free of other visual pollutants? Yes, if there are no signs of non-sediment pollutants like oil, grease, fertilizers, pesticides, etc.				
6. Is the facility free of unpleasant odors? Yes, if there are no foul smelling odors.				

### Inspection and Maintenance Checklist

7. Is the facility free of standing water? Yes, if the BMP is free of standing water.				
8. Is the irrigation system working correctly?			X	
9. Is the facility free of erosion/scouring?			X	
10. Is the facility well vegetated?			X	
11. Is the facility free of excessive vegetation?			X	
12. Is the "rip-rap" associated with the facility in adequate condition?			X	
13. Are the facility inlets/outlets free of obstructions? Yes, if the inlets and outlets are free of objects that could prevent flow in or out of the facility.				
14. Is the filter media in an acceptable condition? Yes, if oil absorbent material is present and still in functioning condition.				

<sup>1</sup> Re-inspection of a previously-noted maintenance issue

<sup>2</sup> Refer to Stormwater Facility Maintenance Rating Criteria Attachment

## Inspection and Maintenance Checklist Conveyance System

Facility ID: \_\_\_\_\_ Date of Inspection: \_\_\_\_\_ Type of Inspection:  Routine  Re-Inspection<sup>1</sup>

Inspector(s): \_\_\_\_\_ Maintenance Rating: \_\_\_\_\_<sup>2</sup>

Question	Yes	No	NA	Comments
1. Is the facility accessible for inspection? Yes, if the inspector is able to do a visual inspection.				
2. Is the facility free of damage? Yes, if there is no structural damage from post installation activities that would hinder the conveyance of water.				
3. Is the facility free of significant trash and debris accumulation? Yes, if the facility contains no trash or debris.				
4. Is the facility free of excessive sediment? Yes, if sediment on the bottom of the conveyance system is not altering the flow of water or higher than 20% of the design depth.				
5. Is the facility free of other visual pollutants? Yes, if there are no signs of non-sediment pollutants like oil, grease, fertilizers, pesticides, etc.				
6. Is the facility free of unpleasant odors? Yes, if there are no foul smelling odors.				



### Inspection and Maintenance Checklist

7. Is the facility free of standing water? Yes, if the BMP is free of standing water.				
8. Is the irrigation system working correctly?			X	
9. Is the facility free of erosion/scouring?			X	
10. Is the facility well vegetated?			X	
11. Is the facility free of excessive vegetation? Yes, if no vegetation is observed growing through the conveyance system.				
12. Is the "rip-rap" associated with the facility in adequate condition?			X	
13. Are the facility inlets/outlets free of obstructions? Yes, if the inlets and outlets are free of objects that could prevent flow in or out of the facility.				
14. Is the filter media in an acceptable condition?			X	

<sup>1</sup> Re-inspection of a previously-noted maintenance issue

<sup>2</sup> Refer to Stormwater Facility Maintenance Rating Criteria Attachment

## Inspection and Maintenance Checklist

# Drywell

Facility ID: \_\_\_\_\_

Date of Inspection: \_\_\_\_\_

Type of Inspection:  Routine  Re-Inspection<sup>1</sup>

Inspector(s): \_\_\_\_\_

Maintenance Rating: \_\_\_\_\_<sup>2</sup>

Question	Yes	No	NA	Comments
1. Is the facility accessible for inspection? Yes, if the inspector is able to do a visual inspection.				
2. Is the facility free of damage? Yes, if there is no structural damage from post installation activities that would hinder the facilities performance (e.g., holes/tears in filter fabric, warped or broken inlet).				
3. Is the facility free of significant trash and debris accumulation? Yes, if there is less than 2 feet of accumulated debris, sediment, and trash.				
4. Is the facility free of excessive sediment? Yes, if there is less than 2 feet of accumulated debris, sediment, and trash.				
5. Is the facility free of other visual pollutants? Yes, if there are no signs of non-sediment pollutants like oil, grease, fertilizers, pesticides, etc.				
6. Is the facility free of unpleasant odors? Yes, if there are no foul smelling odors.				
7. Is the facility free of standing water?				

### Inspection and Maintenance Checklist

Yes, if the facility is free of standing water at least 72 hours after a rain event.				
8. Is the irrigation system working correctly?			X	
9. Is the facility free of erosion/scouring?			X	
10. Is the facility well vegetated?			X	
11. Is the facility free of excessive vegetation? Yes, if no vegetation is observed growing in the facility.				
12. Is the "rip-rap" associated with the facility in adequate condition?			X	
13. Are the facility inlets/outlets free of obstructions? Yes, if the inlets are free of objects that could prevent flow in to the facility.				
14. Is the filter media in an acceptable condition?			X	

<sup>1</sup> Re-inspection of a previously-noted maintenance issue

<sup>2</sup> Refer to Stormwater Facility Maintenance Rating Criteria Attachment

## Inspection and Maintenance Checklist Vegetated Filter Strip

Facility ID: \_\_\_\_\_

Date of Inspection: \_\_\_\_\_

Type of Inspection:  Routine  Re-Inspection<sup>1</sup>

Inspector(s): \_\_\_\_\_

Maintenance Rating: \_\_\_\_\_<sup>2</sup>

Question	Yes	No	NA	Comments
1. Is the facility accessible for inspection? Yes, if the inspector is able to do a visual inspection.				
2. Is the facility free of damage? Yes, if there is no structural damage from post installation activities that would hinder the facility's performance (e.g., rodent holes, trampling).				
3. Is the facility free of significant trash and debris accumulation? Yes, if the facility does not contain significant amounts of trash or debris.				
4. Is the facility free of excessive sediment? Yes, if sediment depth does not exceed 2 inches or more than 10% of the vegetated area, or if sediment in any area is not above the height of the vegetation.				
5. Is the facility free of other visual pollutants? Yes, if there are no signs of non-sediment pollutants like oil, grease, fertilizers, pesticides, etc.				
6. Is the facility free of unpleasant odors? Yes, if there are no foul smelling odors.				

### Inspection and Maintenance Checklist

7. Is the facility free of standing water? Yes, if the BMP is free of standing water.				
8. Is the irrigation system working correctly? Yes, if the sprinklers are in good condition (i.e. not broken), and there are no signs of over-watering, and the vegetation is healthy.				
9. Is the facility free of erosion/scouring? Yes, if the facility is free of eroded or scoured areas due to high flows, wind, or flow channelization.				
10. Is the facility well vegetated? Yes, if vegetated cover does not contain sparse, bare, or eroded patches in significant areas of the facility. Yes, if vegetation is sparse, but is installed per plans.				
11. Is the facility free of excessive vegetation? Yes, if planted vegetation is not excessively tall, and there are no nuisance weeds present that appear to be overgrowing planted vegetation.				
12. Is the "rip-rap" associated with the facility in adequate condition? Yes, if the rip-rap is present, functional, and not full of sediment.				
13. Are the facility inlets/outlets free of obstructions? Yes, if flow is spread evenly over the entire filter strip width.				
14. Is the filter media in an acceptable condition?			X	

<sup>1</sup> Re-inspection of a previously-noted maintenance issue

<sup>2</sup> Refer to Stormwater Facility Maintenance Rating Criteria Attachment

## Inspection and Maintenance Checklist Vegetated Swale (Non-Infiltration)

Facility ID: \_\_\_\_\_

Date of Inspection: \_\_\_\_\_

Type of Inspection:  Routine  Re-Inspection<sup>1</sup>

Inspector(s): \_\_\_\_\_

Maintenance Rating: \_\_\_\_\_<sup>2</sup>

Question	Yes	No	NA	Comments
1. Is the facility accessible for inspection? Yes, if the inspector is able to do a visual inspection.				
2. Is the facility free of damage? Yes, if there is no structural damage from post installation activities that would hinder the facility's performance (e.g., rodent holes, trampling).				
3. Is the facility free of significant trash and debris accumulation? Yes, if the facility does not contain significant amounts of trash or debris.				
4. Is the facility free of excessive sediment? Yes, if sediment depth does not exceed 2 inches or more than 10% of the vegetated area, or if sediment in any area is not above the height of the vegetation.				
5. Is the facility free of other visual pollutants? Yes, if there are no signs of non-sediment pollutants like oil, grease, fertilizers, pesticides, etc.				
6. Is the facility free of unpleasant odors? Yes, if there are no foul smelling odors.				

### Inspection and Maintenance Checklist

7. Is the facility free of standing water? Yes, if the BMP is free of standing water.				
8. Is the irrigation system working correctly? Yes, if the sprinklers are in good condition (i.e. not broken), and there are no signs of over-watering, and the vegetation is healthy.				
9. Is the facility free of erosion/scouring? Yes, if the facility is free of eroded or scoured areas due to high flows, wind, or flow channelization.				
10. Is the facility well vegetated? Yes, if vegetated cover does not contain sparse, bare, or eroded patches in significant areas of the facility. Yes, if vegetation is sparse, but is installed per plans.				
11. Is the facility free of excessive vegetation? Yes, if planted vegetation is not excessively tall, and there are no nuisance weeds present that appear to be overgrowing planted vegetation.				
12. Is the "rip-rap" associated with the facility in adequate condition? Yes, if the rip-rap is present, functional, and not full of sediment.				
13. Are the facility inlets/outlets free of obstructions? Yes, if the inlets and outlets are free of objects that could prevent flow in or out of the facility, excluding energy dissipation devices located at the inlet/outlet.				
14. Is the filter media in an acceptable condition?			X	

<sup>1</sup> Re-inspection of a previously-noted maintenance issue

<sup>2</sup> Refer to Stormwater Facility Maintenance Rating Criteria Attachment

## Inspection and Maintenance Checklist Green Roof

Facility ID: \_\_\_\_\_ Date of Inspection: \_\_\_\_\_ Type of Inspection:  Routine  Re-Inspection<sup>1</sup>

Inspector(s): \_\_\_\_\_ Maintenance Rating: \_\_\_\_\_<sup>2</sup>

Question	Yes	No	NA	Comments
1. Is the facility accessible for inspection? Yes, if the inspector is able to do a visual inspection.				
2. Is the facility free of damage? Yes, if there is no structural damage from post installation activities that would hinder the facility's performance (e.g., rodent holes, trampling).				
3. Is the facility free of significant trash and debris accumulation? Yes, if the facility does not contain significant amounts of trash or debris.				
4. Is the facility free of excessive sediment? Yes, if there are no signs of excessive sediment added to the facility.				
5. Is the facility free of other visual pollutants? Yes, if there are no signs of non-sediment pollutants like oil, grease, fertilizers, pesticides, etc.				
6. Is the facility free of unpleasant odors? Yes, if there are no foul smelling odors.				



### Inspection and Maintenance Checklist

7. Is the facility free of standing water? Yes, if the BMP is free of standing water.				
8. Is the irrigation system working correctly? Yes, if the sprinklers are in good condition (i.e. not broken), and there are no signs of over-watering, and the vegetation is healthy.				
9. Is the facility free of erosion/scouring? Yes, if the facility is free of eroded or scoured areas due to high flows, wind, or flow channelization.				
10. Is the facility well vegetated? Yes, if vegetation covers over 90% of facility and does not contain sparse, bare, or eroded patches.				
11. Is the facility free of excessive vegetation? Yes, if planted vegetation is not excessively tall, and nuisance weeds cover no more than 20% of the facility.				
12. Is the "rip-rap" associated with the facility in adequate condition?			X	
13. Are the facility inlets/outlets free of obstructions? Yes, if flow is spread evenly over the entire surface of the green roof.				
14. Is the filter media in an acceptable condition?			X	

<sup>1</sup> Re-inspection of a previously-noted maintenance issue

<sup>2</sup> Refer to Stormwater Facility Maintenance Rating Criteria Attachment

## Inspection and Maintenance Checklist Bio-Infiltration Swale/Bio-Infiltration Basin

Facility ID: \_\_\_\_\_ Date of Inspection: \_\_\_\_\_ Type of Inspection:  Routine  Re-Inspection<sup>1</sup>

Inspector(s): \_\_\_\_\_ Maintenance Rating: \_\_\_\_\_<sup>2</sup>

Question	Yes	No	NA	Comments
1. Is the facility accessible for inspection? Yes, if the inspector is able to do a visual inspection.				
2. Is the facility free of damage? Yes, if there is no structural damage from post installation activities that would hinder the facility's performance (e.g., rodent holes, trampling).				
3. Is the facility free of significant trash and debris accumulation? Yes, if the facility does not contain significant amounts of trash or debris.				
4. Is the facility free of excessive sediment? Yes, if sediment depth does not exceed 2 inches or more than 10% of the vegetated area, or if sediment in any area is not above the height of the vegetation.				
5. Is the facility free of other visual pollutants? Yes, if there are no signs of non-sediment pollutants like oil, grease, fertilizers, pesticides, etc.				

### Inspection and Maintenance Checklist

<p>6. Is the facility free of unpleasant odors? Yes, if there are no foul smelling odors.</p>				
<p>7. Is the facility free of standing water? Yes, if the facility is free of standing water at least 72 hours after a rain event.</p>				
<p>8. Is the irrigation system working correctly? Yes, if the sprinklers are in good condition (i.e. not broken), and there are no signs of over-watering, and the vegetation is healthy.</p>				
<p>9. Is the facility free of erosion/scouring? Yes, if the facility is free of eroded or scoured areas due to high flows, wind, or flow channelization.</p>				
<p>10. Is the facility well vegetated? Yes, if vegetated cover does not contain sparse, bare, or eroded patches in significant areas of the facility. Yes, if vegetation is sparse, but is installed per plans.</p>				
<p>11. Is the facility free of excessive vegetation? Yes, if planted vegetation is not excessively tall, and there are no nuisance weeds present that appear to be overgrowing planted vegetation.</p>				
<p>12. Is the "rip-rap" associated with the facility in adequate condition? Yes, if the rip-rap is present, functional, and not full of sediment.</p>				
<p>13. Are the facility inlets/outlets free of obstructions? Yes, if the inlets/outlets/bypass are free of objects, sediment build up, or excessive vegetation, which could prevent flow in or out of the facility, excluding energy dissipation devices located at the inlet/outlet. Yes, if runoff sheet flows evenly into the facility.</p>				

## Inspection and Maintenance Checklist Infiltration Trench

Facility ID: \_\_\_\_\_

Date of Inspection: \_\_\_\_\_

Type of Inspection:  Routine  Re-Inspection<sup>1</sup>

Inspector(s): \_\_\_\_\_

Maintenance Rating: \_\_\_\_\_<sup>2</sup>

Question	Yes	No	NA	Comments
1. Is the facility accessible for inspection? Yes, if the inspector is able to do a visual inspection.				
2. Is the facility free of damage? Yes, if there is no structural damage from post installation activities that would hinder the facility's performance (low gravel, eroding sidewalls, etc.).				
3. Is the facility free of significant trash and debris accumulation? Yes, if the facility does not contain significant amounts of trash or debris (green waste, weeds, rocks, etc.).				
4. Is the facility free of excessive sediment? Yes, if sediment depth does not exceed 2 inches or more than 10% of the surface treatment area.				
5. Is the facility free of other visual pollutants? Yes, if there are no signs of non-sediment pollutants like oil, grease, fertilizers, pesticides, etc.				
6. Is the facility free of unpleasant odors? Yes, if there are no foul smelling odors.				

### Inspection and Maintenance Checklist

7. Is the facility free of standing water? Yes, if the facility is free of standing water at least 72 hours after a rain event.				
8. Is the irrigation system working correctly?			X	
9. Is the facility free of erosion/scouring? Yes, if the facility is free of eroded or scoured areas due to high flows, wind, or flow channelization.				
10. Is the facility well vegetated?			X	
11. Is the facility free of excessive vegetation? Yes, if vegetation does not cover 10% of the surface or more.				
12. Is the "rip-rap" associated with the facility in adequate condition?				
13. Are the facility inlets/outlets free of obstructions? Yes, if the inlets and outlets are free of objects that could prevent flow in or out of the facility.				
14. Is the filter media in an acceptable condition?			X	

<sup>1</sup> Re-inspection of a previously-noted maintenance issue

<sup>2</sup> Refer to Stormwater Facility Maintenance Rating Criteria Attachment

## Inspection and Maintenance Checklist Media Filter (e.g., Stormfilter)

Facility ID: \_\_\_\_\_

Date of Inspection: \_\_\_\_\_

Type of Inspection:  Routine  Re-Inspection<sup>1</sup>

Inspector(s): \_\_\_\_\_

Maintenance Rating: \_\_\_\_\_<sup>2</sup>

Question	Yes	No	NA	Comments
1. Is the facility accessible for inspection? Yes, if the inspector is able to do a visual inspection.				
2. Is the facility free of damage? Yes, if there is no structural damage from post installation activities that would hinder the facility's performance (broken filters, warped or broken inlet, damaged forebay, etc.).				
3. Is the facility free of significant trash and debris accumulation? Yes, if the trash, debris, and sediment levels are below 6" in the forebay, below 0.25" on top of the cartridges, below 4" at the bottom of the vault, or below the manufacturer's recommended maintenance levels.				
4. Is the facility free of excessive sediment? Yes, if the trash, debris, and sediment levels are below 6" in the forebay, below 0.25" on top of the cartridges, below 4" at the bottom of the vault, or below the manufacturer's recommended maintenance levels.				
5. Is the facility free of other visual pollutants? Yes, if there are no signs of non-sediment pollutants like oil, grease, fertilizers, pesticides, etc.				

### Inspection and Maintenance Checklist

6. Is the facility free of unpleasant odors? Yes, if there are no foul smelling odors.				
7. Is the facility free of standing water? Yes, if the facility is free of standing water at least 72 hours after a rain event.				
8. Is the irrigation system working correctly?			X	
9. Is the facility free of erosion/scouring?			X	
10. Is the facility well vegetated?			X	
11. Is the facility free of excessive vegetation?			X	
12. Is the "rip-rap" associated with the facility in adequate condition?			X	
13. Are the facility inlets/outlets free of obstructions? Yes, if the inlets and outlets are free of objects that could prevent flow in or out of the facility.				
14. Is the filter media in an acceptable condition? Yes, if the cartridge media is in functioning condition per maintenance specifications.				

<sup>1</sup> Re-inspection of a previously-noted maintenance issue

<sup>2</sup> Refer to Stormwater Facility Maintenance Rating Criteria Attachment

## Inspection and Maintenance Checklist Oil/Water Separator

Facility ID: \_\_\_\_\_

Date of Inspection: \_\_\_\_\_

Type of Inspection:  Routine  Re-Inspection<sup>1</sup>

Inspector(s): \_\_\_\_\_

Maintenance Rating: \_\_\_\_\_<sup>2</sup>

Question	Yes	No	NA	Comments
1. Is the facility accessible for inspection? Yes, if the inspector is able to do a visual inspection.				
2. Is the facility free of damage? Yes, if there is no structural damage from post installation activities that would hinder the facility's performance (broken filters, warped or broken inlet, damaged forebay, etc.).				
3. Is the facility free of significant trash and debris accumulation? Yes, if the trash, debris, and sediment levels are below 6 inches at the bottom of the vault, or below the manufacturer's recommended maintenance levels.				
4. Is the facility free of excessive sediment? Yes, if the trash, debris, and sediment levels are below 6 inches at the bottom of the vault, or below the manufacturer's recommended maintenance levels.				
5. Is the facility free of other visual pollutants? Yes, if there is less than 1 inch of oil or grease accumulation at the surface of the water. Yes, if no evidence of fertilizers, pesticides, vector breeding habitat, etc.				
6. Is the facility free of unpleasant odors? Yes, if there are no foul smelling odors.				



### Inspection and Maintenance Checklist

7. Is the facility free of standing water?			X	
8. Is the irrigation system working correctly?			X	
9. Is the facility free of erosion/scouring?			X	
10. Is the facility well vegetated?			X	
11. Is the facility free of excessive vegetation?			X	
12. Is the "rip-rap" associated with the facility in adequate condition?			X	
13. Are the facility inlets/outlets free of obstructions? Yes, if the inlets and outlets are free of objects that could prevent flow in or out of the facility.				
14. Is the filter media in an acceptable condition?			X	

<sup>1</sup> Re-inspection of a previously-noted maintenance issue

<sup>2</sup> Refer to Stormwater Facility Maintenance Rating Criteria Attachment

## Inspection and Maintenance Checklist Detention System (Closed/Open)

Facility ID: \_\_\_\_\_

Date of Inspection: \_\_\_\_\_

Type of Inspection:  Routine  Re-Inspection<sup>1</sup>

Inspector(s): \_\_\_\_\_

Maintenance Rating: \_\_\_\_\_<sup>2</sup>

Question	Yes	No	NA	Comments
1. Is the facility accessible for inspection? Yes, if the inspector is able to do a visual inspection.				
2. Is the facility free of damage? Yes, if there is no structural damage from post installation activities that would hinder the facility's performance (e.g., rodent holes, trampling).				
3. Is the facility free of significant trash and debris accumulation? Yes, if the facility does not contain significant amounts of trash or debris.				
4. Is the facility free of excessive sediment? Yes, if sediment does not exceed 15% total capacity in any given area.				
5. Is the facility free of other visual pollutants? Yes, if there are no signs of non-sediment pollutants like oil, grease, fertilizers, pesticides, etc.				
6. Is the facility free of unpleasant odors? Yes, if there are no foul smelling odors.				

### Inspection and Maintenance Checklist

<p>7. Is the facility free of standing water?</p>			X	
<p>8. Is the irrigation system working correctly? Yes, if the sprinklers are in good condition (i.e. not broken), and there are no signs of over-watering, and the vegetation is healthy.</p>				
<p>9. Is the facility free of erosion/scouring? Yes, if the facility is free of eroded or scoured areas due to high flows, wind, or flow channelization.</p>				
<p>10. Is the facility well vegetated? Yes, if vegetated cover does not contain sparse, bare, or eroded patches in significant areas of the facility. Yes, if vegetation is sparse, but is installed per plans.</p>				
<p>11. Is the facility free of excessive vegetation? Yes, if planted vegetation is not excessively tall, and there are no nuisance weeds present that appear to be overgrowing planted vegetation.</p>				
<p>12. Is the "rip-rap" associated with the facility in adequate condition? Yes, if the rip-rap is present, functional, and not full of sediment.</p>				
<p>13. Are the facility inlets/outlets free of obstructions? Yes, if the inlets/outlets/bypass are free of objects, sediment build up, or excessive vegetation, which could prevent flow in or out of the facility, excluding energy dissipation devices located at the inlet/outlet. Yes, if runoff sheet flows evenly into the facility.</p>				
<p>14. Is the filter media in an acceptable condition?</p>			X	

## Inspection and Maintenance Checklist Porous Pavement/Pavers

Facility ID: \_\_\_\_\_

Date of Inspection: \_\_\_\_\_

Type of Inspection:  Routine  Re-Inspection<sup>1</sup>

Inspector(s): \_\_\_\_\_

Maintenance Rating: \_\_\_\_\_<sup>2</sup>

Question	Yes	No	NA	Comments
1. Is the facility accessible for inspection? Yes, if the inspector is able to do a visual inspection.				
2. Is the facility free of damage? Yes, if there is no structural damage from post installation activities that would hinder the facility's performance (degraded pavement, broken pavers, cracks, etc.).				
3. Is the facility free of significant trash and debris accumulation? Yes, if the facility does not contain significant amounts of trash or debris.				
4. Is the facility free of excessive sediment? Yes, if sediment is not preventing/altering the infiltration of stormwater.				
5. Is the facility free of other visual pollutants? Yes, if there are no signs of non-sediment pollutants like oil, grease, fertilizers, pesticides, etc.				
6. Is the facility free of unpleasant odors? Yes, if there are no foul smelling odors.				

### Inspection and Maintenance Checklist

7. Is the facility free of standing water? Yes, if the facility is free of standing water at least 72 hours after a rain event.				
8. Is the irrigation system working correctly?			X	
9. Is the facility free of erosion/scouring?			X	
10. Is the facility well vegetated?			X	
11. Is the facility free of excessive vegetation? Yes, if vegetation does not cover 10% of the surface or more.				
12. Is the "rip-rap" associated with the facility in adequate condition?			X	
13. Are the facility inlets/outlets free of obstructions?			X	
14. Is the filter media in an acceptable condition?			X	

<sup>1</sup> Re-inspection of a previously-noted maintenance issue

<sup>2</sup> Refer to Stormwater Facility Maintenance Rating Criteria Attachment

## Inspection and Maintenance Checklist Sedimentation Manhole

Facility ID: \_\_\_\_\_

Date of Inspection: \_\_\_\_\_

Type of Inspection:  Routine  Re-Inspection<sup>1</sup>

Inspector(s): \_\_\_\_\_

Maintenance Rating: \_\_\_\_\_<sup>2</sup>

Question	Yes	No	NA	Comments
1. Is the facility accessible for inspection? Yes, if the inspector is able to do a visual inspection.				
2. Is the facility free of damage? Yes, if there is no structural damage from post installation activities that would hinder the facility's performance (broken tee/snout, warped or broken inlet, etc.).				
3. Is the facility free of significant trash and debris accumulation? Yes, if the trash, debris, and sediment levels are below 50% of sump depth or one foot below the tee/snout/outlet.				
4. Is the facility free of excessive sediment? Yes, if the trash, debris, and sediment levels are below 50% of sump depth or one foot below the tee/snout/outlet.				
5. Is the facility free of other visual pollutants? Yes, if there are no signs of non-sediment pollutants like oil, grease, fertilizers, pesticides, etc.				
6. Is the facility free of unpleasant odors? Yes, if there are no foul smelling odors.				

### Inspection and Maintenance Checklist

7. Is the facility free of standing water?			X	
8. Is the irrigation system working correctly?			X	
9. Is the facility free of erosion/scouring?			X	
10. Is the facility well vegetated?			X	
11. Is the facility free of excessive vegetation?			X	
12. Is the "rip-rap" associated with the facility in adequate condition?			X	
13. Are the facility inlets/outlets free of obstructions? Yes, if the inlets and outlets are free of objects that could prevent flow in or out of the facility.				
14. Is the filter media in an acceptable condition?			X	

<sup>1</sup> Re-inspection of a previously-noted maintenance issue

<sup>2</sup> Refer to Stormwater Facility Maintenance Rating Criteria Attachment

## Inspection and Maintenance Checklist Wet Pond

Facility ID: \_\_\_\_\_ Date of Inspection: \_\_\_\_\_ Type of Inspection:  Routine  Re-Inspection<sup>1</sup>

Inspector(s): \_\_\_\_\_ Maintenance Rating: \_\_\_\_\_<sup>2</sup>

Question	Yes	No	NA	Comments
1. Is the facility accessible for inspection? Yes, if the inspector is able to do a visual inspection.				
2. Is the facility free of damage? Yes, if there is no structural damage from post installation activities that would hinder the facility's performance.				
3. Is the facility free of significant trash and debris accumulation? Yes, if the facility does not contain significant amounts of trash or debris.				
4. Is the facility free of excessive sediment? Yes, if sediment build up is not affecting the flow of water into the pond or its storage capacity.				
5. Is the facility free of other visual pollutants? Yes, if there are no signs of non-sediment pollutants like oil, grease, fertilizers, pesticides, etc.				
6. Is the facility free of unpleasant odors? Yes, if there are no foul smelling odors.				



### Inspection and Maintenance Checklist

7. Is the facility free of standing water?			X	
8. Is the irrigation system working correctly?			X	
9. Is the facility free of erosion/scouring? Yes, if the facility is free of eroded or scoured areas due to high flows, wind, or flow channelization.				
10. Is the facility well vegetated? Yes, if vegetated cover does not contain sparse, bare, or eroded patches along the shoreline.				
11. Is the facility free of excessive vegetation? Yes, if planted vegetation is not excessively tall, and there are no nuisance weeds present that appear to be overgrowing planted vegetation.				
12. Is the "rip-rap" associated with the facility in adequate condition? Yes, if the rip-rap is present, functional, and not full of sediment.				
13. Are the facility inlets/outlets free of obstructions? Yes, if the inlets/outlets/bypass are free of objects, sediment build up, or excessive vegetation, which could prevent flow in or out of the facility, excluding energy dissipation devices located at the inlet/outlet. Yes, if runoff sheet flows evenly into the facility.				
14. Is the filter media in an acceptable condition?			X	

<sup>1</sup> Re-inspection of a previously-noted maintenance issue

<sup>2</sup> Refer to Stormwater Facility Maintenance Rating Criteria Attachment

## Inspection and Maintenance Checklist Catch Basin

Facility ID: \_\_\_\_\_

Date of Inspection: \_\_\_\_\_

Type of Inspection:  Routine  Re-Inspection<sup>1</sup>

Inspector(s): \_\_\_\_\_

Maintenance Rating: \_\_\_\_\_<sup>2</sup>

Question	Yes	No	NA	Comments
1. Is the facility accessible for inspection? Yes, if the inspector is able to do a visual inspection.				
2. Is the facility free of damage? Yes, if there is no structural damage from post installation activities that would hinder the facility's performance (broken tee/snout, warped or broken inlet, etc.).				
3. Is the facility free of significant trash and debris accumulation? Yes, if the trash, debris, and sediment levels are below 50% of sump depth or one foot below the tee/snout/outlet.				
4. Is the facility free of excessive sediment? Yes, if the trash, debris, and sediment levels are below 50% of sump depth or one foot below the tee/snout/outlet.				
5. Is the facility free of other visual pollutants? Yes, if there are no signs of non-sediment pollutants like oil, grease, fertilizers, pesticides, etc.				
6. Is the facility free of unpleasant odors? Yes, if there are no foul smelling odors.				

### Inspection and Maintenance Checklist

7. Is the facility free of standing water?			X	
8. Is the irrigation system working correctly?			X	
9. Is the facility free of erosion/scouring?			X	
10. Is the facility well vegetated?			X	
11. Is the facility free of excessive vegetation?			X	
12. Is the "rip-rap" associated with the facility in adequate condition?			X	
13. Are the facility inlets/outlets free of obstructions? Yes, if the inlets and outlets are free of objects that could prevent flow in or out of the facility.				
14. Is the filter media in an acceptable condition?			X	

<sup>1</sup> Re-inspection of a previously-noted maintenance issue

<sup>2</sup> Refer to Stormwater Facility Maintenance Rating Criteria Attachment

***Appendix F.2***

***Inspection Tracking Log Book***

---

The page intentionally left blank.

City of Bend (FY2019-20)

Stormwater Facilities Inspection Tracking Log

Facility ID	Date of Inspection	Time	Type of Inspection	Drainage	Comments	Maintenance Rating Following Inspection	Last Rain Event
DSWL00038	6/17/2020	1519	Routine	Infiltrates (No Overflow)	Small swale with grass. No actions needed.	1	<72hrs ago
DSWL00193	6/17/2020	1519	Routine	Infiltrates (No Overflow)	Small swale with rock channel bottom. No actions needed.	0	<72hrs ago
DSWL00213	5/26/2020	1145	Warranty	Infiltrates (No Overflow)	Small swale with rock channel bottom. No apparent plantings. Some sediment deposition near inlet.	2	>72hrs ago
DSWL00212	5/22/2020	830	Warranty	Infiltrates (No Overflow)	Small swale with buried rock gallery; plantings are in poor shape with excessive invasive weed growth; signs of erosion around base of sprinklers; sediment deposition is evident.	4	>72hrs ago
DSWL00214	5/22/2020	800	Warranty	Infiltrates (No Overflow)	Large pond swale; planted vegetation seems to be in good condition with no significant signs of erosion; sediment deposition is minimal. Pond did not infiltrate within 72 hr timeframe after rain event.	4	>72hrs ago
DWSL00121	11/21/2019	1254	Routine	UIC	Large swale; native vegetation with no signs of erosion; larger vegetation needed; path through swale compacting soils	3	>72hrs ago
DWSL00122	11/21/2019	1253	Routine	UIC	Large swale; native vegetation with no signs of erosion; larger vegetation needed; path through swale compacting soils	3	>72hrs ago
DWSL00123	11/21/2019	1257	Routine	UIC	Large swale; native vegetation with no signs of erosion; larger vegetation needed; path through swale compacting soils	3	>72hrs ago
DWSL00083	11/20/2019	1342	Routine	UIC	sparse native vegetation present; bare dirt with little stormwater storage; slope stabilization/veg needed for DEQ treatment requirement	2	>72hrs ago
DWSL00084	11/20/2019	1327	Routine	UIC	Well vegetated with no signs of erosion	1	>72hrs ago
DWSL00054	11/14/2019	1202	Routine	UIC	Long swale along Mt Washington; minor erosion and lack of vegetation; swale is full of broken glass along eastern portion; pieces small enough to not be an immediate safety threat	4	>72hrs ago
DWSL00055	11/14/2019	1210	Routine	UIC	Very little vegetation present; bare dirt with minor signs of erosion; slope stabilization/veg needed for DEQ treatment requirement	3	>72hrs ago
DWSL00063	11/14/2019	1234	Routine	UIC	No vegetation present; bare rock and gravel with no signs of erosion; veg needed for DEQ treatment requirement; pipe from catch basin could potentially short circuit into drywell	3	>72hrs ago
DWSL00064	11/14/2019	1249	Routine	UIC	Large outfall in canyon; not really a SW treatment LID; well vegetated with minor signs of erosion	2	>72hrs ago
DWSL00066	11/14/2019	1315	Routine	UIC	Large swale; vegetated and no signs of erosion; larger vegetation needed; few pieces of trash	2	>72hrs ago
DWSL00067	11/14/2019	1317	Routine	UIC	Large swale; vegetated and no signs of erosion; larger vegetation needed; few pieces of trash	2	>72hrs ago
DWSL00053	11/12/2019	1415	Routine	UIC	Large retention area in low spot of community; well vegetated and no signs of erosion; two UICs in the retention area	2	>72hrs ago
DCBP001929	10/2/2019	1428	Routine	UIC	<1" accumulated sediment/debris in sump; 2' overlay surrounding catch basin should be installed per plan	4	>72hrs ago
DCBP001935	10/2/2019	1425	Routine	UIC	<3" accumulated sediment/debris in sump	2	>72hrs ago
DCBP001936	10/2/2019	1429	Routine	UIC	<4" accumulated sediment/debris in sump	2	>72hrs ago
DCBP001937	10/2/2019	1430	Routine	UIC	>12" accumulated sediment/debris in sump; sediment needs to be removed	4	>72hrs ago
DCBP001938	10/2/2019	1424	Routine	UIC	<3" accumulated sediment/debris in sump	2	>72hrs ago
DCBP001939	10/2/2019	1423	Routine	UIC	<3" accumulated sediment/debris in sump	2	>72hrs ago
DCBP001940	10/2/2019	1425	Routine	UIC	<3" accumulated sediment/debris in sump	2	>72hrs ago
DDWP001588	10/2/2019	1428	Routine	UIC	little to no floatables present	1	>72hrs ago
DDWP001591	10/2/2019	1425	Routine	UIC	little to no floatables present	1	>72hrs ago
DDWP001592	10/2/2019	1429	Routine	UIC	Cannot locate; buried under landscaping	NA	>72hrs ago
DDWP001593	10/2/2019	1430	Routine	UIC	little to no floatables present	1	>72hrs ago
DDWP001594	10/2/2019	1424	Routine	UIC	little to no floatables present	1	>72hrs ago
DDWP001595	10/2/2019	1423	Routine	UIC	little to no floatables present	1	>72hrs ago
DDWP001596	10/2/2019	1425	Routine	UIC	little to no floatables present	1	>72hrs ago
DSMHP000093	10/2/2019	1425	Routine	UIC	<1" accumulated sediment/debris in sump; little to no floatables present	1	>72hrs ago
DSMHP000094	10/2/2019	1429	Routine	UIC	<1" accumulated sediment/debris in sump; little to no floatables present	1	>72hrs ago
DSMHP000095	10/2/2019	1430	Routine	UIC	<2" accumulated sediment/debris in sump; little to no floatables present	1	>72hrs ago

City of Bend (FY2019-20)

Stormwater Facilities Inspection Tracking Log

Facility ID	Date of Inspection	Time	Type of Inspection	Drainage	Comments	Maintenance Rating Following Inspection	Last Rain Event
DSMHP000096	10/2/2019	1424	Routine	UIC	<1" accumulated sediment/debris in sump; little to no floatables present; plug missing from pipe T	2	>72hrs ago
DSMHP000097	10/2/2019	1423	Routine	UIC	<1" accumulated sediment/debris in sump; little to no floatables present	1	>72hrs ago
DSMHP000098	10/2/2019	1425	Routine	UIC	<1" accumulated sediment/debris in sump; little to no floatables present; plug missing from pipe T	2	>72hrs ago

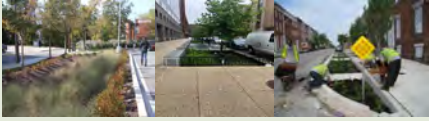
***Appendix F.4***  
***Small Scale BMPs in Urban Areas***  
***Webinar***

---




The page intentionally left blank.

Center for Watershed Protection  
 Watershed & Stormwater Management • Webcast Series



**Small Scale BMPs**  
 May 20, 2020



1

Center for Watershed Protection

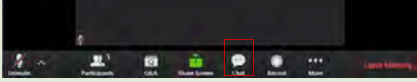
**Welcome to the Webcast**

- **Professional Development Hours** – We are offering PDHs for our watershed and stormwater management webcast series. A registered attendee must watch the entire webcast to be eligible to earn the PDHs. A pdf Certificate of Completion will be sent out after webcast to the person who registered for the webcast. The varying nature of certification requirements for each state means we cannot guarantee that CEU's will be awarded and it is up to the individual to determine if CEU's or PDH's will be awarded based on the policies of their local certifying board. Email [webcast@cwpa.org](mailto:webcast@cwpa.org) with questions.
- **Resources** – After the webcast, we will email a resources sheet, speaker contact information, and the presentation.

2

Center for Watershed Protection

Note: In the screen sharing layout, Zoom automatically switches to full-screen to optimize the document or presentation view.



To Answer a Poll Question – Polling questions appear during the webcast. To answer a poll question, click on the radio button to the left of your answer and click submit. If you select other than please provide an answer in the chat box.


**Chat Box**  
 As an attendee in the webinar, you can chat with other attendees, panelists (including the host), depending on what chat permissions the webinar host has allowed. Read about all attendee controls.

- As an attendee, Chat will be in the controls at the bottom of your screen.
- When you click on chat, the chat window will appear. It will be on the right if you are not in full screen. If you are in full screen, it will appear in a window that you can move around your screen.
- Type your message and press Enter to send it.
  - You can also select who you would like to send the message to by clicking on the drop down next to To:

3

Center for Watershed Protection

**Webcast Team**



Laurie Hawks  
 President  
 Hawks Environmental, LLC

Matthew Werle  
 Consultant  
 GreenBlue Urban

Lily Whitesell  
 Stormwater Outreach Specialist  
 Arlington County Environmental Services

4

Center for Watershed Protection

**POLL QUESTION #1**

How many people are participating in the webcast today at your location?

- Just me
- 2 to 5
- 6 to 10
- More than 10

5

Center for Watershed Protection

**POLL QUESTION #2**

Who are you representing today?

- Municipality/Local Government
- State government
- Federal government
- Private consultant
- Nonprofit organization
- University
- Other (tell us in the chat box)

6

Center for Watershed Protection  
Watershed & Stormwater Management • Webcast Series

### Webcast Outline

- Stormwaterwise Landscapes (Lily Whitesell)
- (Laurie Hawks)
- Urban Trees – An Overlooked Asset In Stormwater Management (Matthew Werle)

7

## STORMWATERWISE LANDSCAPES

ecoaction arlington | ARLINGTON VIRGINIA DEPARTMENT OF ENVIRONMENTAL SERVICES

8

### Arlington, Virginia

- Population 226,400 (2019)
- 26.5 square miles
- 42% impervious
- 32 miles of streams
- 373 miles of storm sewers

9

### About StormwaterWise Landscapes

- Sustainable stormwater incentive program for Arlington private property owners
- Reimbursement/matching grant program
- Pilot year in 2012; HOA/business program added in 2014
- An education and outreach initiative; stormwater MS4 permit requirement
- ~60 residential participants accepted per year; 10 HOAs/businesses
- Participants are selected via lottery process (some preference given if applied more than once, or had a drainage site visit)

10

### StormwaterWise Practices

Practice	Residential Minimum Size	Residential Reimbursement	HOA Minimum Size	HOA Reimbursement
Conservation Landscape	150 square feet	\$1000	300 square feet	\$2000
Permeable Pavement	150 square feet	\$2500	300 square feet	\$4000
Rain Garden	100 square feet	\$1500	150 square feet	\$3000
Pavement Removal	150 square feet	\$1500	300 square feet	\$3000

Reimbursement is 50% of project cost, up to the cap for each practice. Total reimbursement per property is capped at \$2500 for residential, \$4000 for HOA.

11

### Project Costs

Practice	Typical Project Cost	Minimum size (Homeowners)	Cost per Square Foot	Reimbursement Max (Homeowners)
Conservation Landscape	\$3000	150 square feet	\$5-25	\$1000
Permeable Pavement	\$9,500	100 square feet	\$20-\$30	\$2500
Rain Garden	\$3000 - \$5000	100 square feet	\$20-30	\$1500
Pavement Removal	\$3000	150 square feet	\$4-10	\$1500

12


### Program Timeline

- February – March: Applications received, lottery selection process, notifications and participant agreements returned
- April – May: Site visits and recommendation reports
- By June 30, participants select project type and contact at least one contractor
- By August 15, participants/contractors submit plans
- By October 31, project installation completed
- By January 30, participants submit receipts and reimbursement request

13

### StormwaterWise Contractors


- Homeowners hire contractors for the project
- Rain gardens and permeable pavers require trained contractors
- Annual contractor training in August
- Specifications, guidance and contractor list provided online



14

### Funding

- Fiscal agent – EcoActionArlington
- \$80,000 NFWF grant for 2013-14
- County Stormwater Fund
- 3 County staff currently work on program, ~30% of 1 FTE;+ EcoAction staff time
- Annual budget \$120,000; private investment has averaged about 3 times public investment




Year	ROI	Private Investment	Public Investment
2018	3.6	240,326	65,048
2017	3.2	\$191,542	\$59,462
2016	3.0	\$124,936	\$41,116

15

### Program Impact

**2013-2019**

- 300 projects
- Drainage area managed by projects = 4.6 acres
- Impervious area treated = 1.5 acre
- Approx 4 lbs/yr P, 50 lbs/yr N
- 164 conservation landscapes
- 61 permeable pavement
- 57 rain gardens
- 14 pavement removal
- 5 cisterns




16

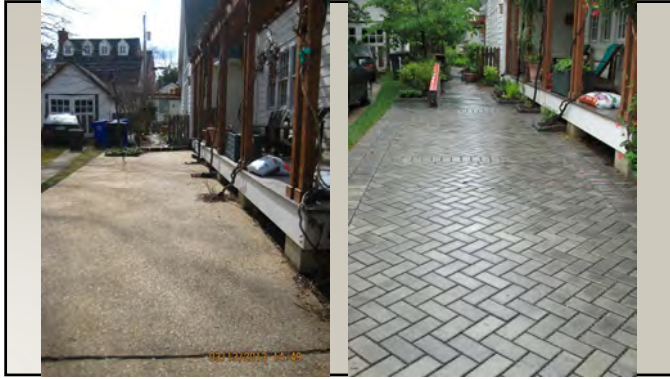
### Permeable Pavement



17



18



19



20



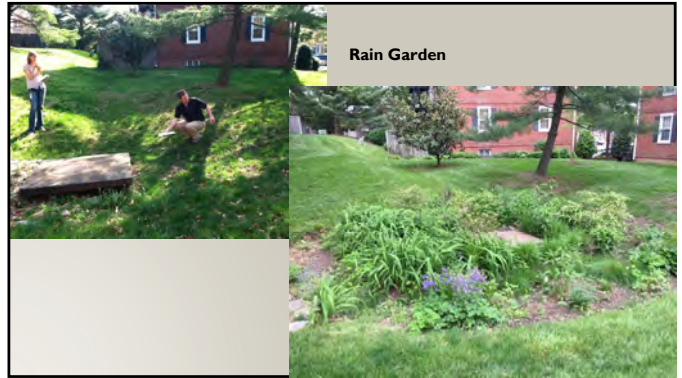
21



22



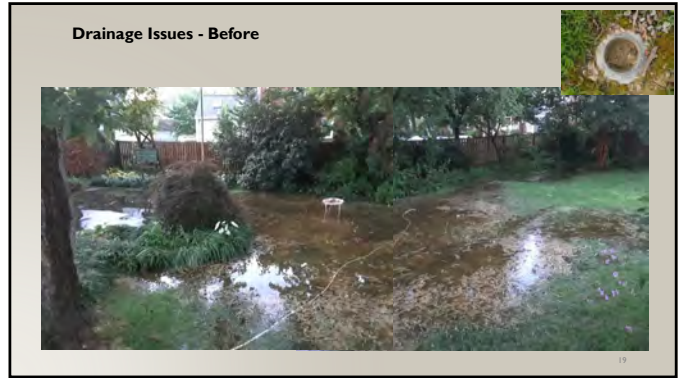
23



24



25



26



27



28



29



30



31



32



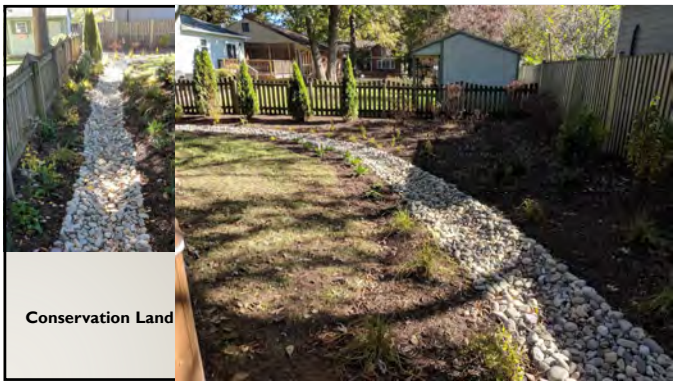
33



34



35



36



Conservation Landscape

37



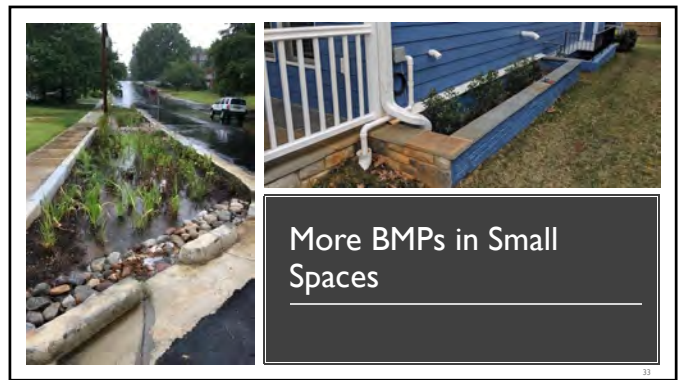
Conservation Landscape

38



Conservation Landscape

39



More BMPs in Small Spaces

40

### Participant Feedback

In a survey, 97% of program participants said they would recommend the program to their neighbor, and 95% said they felt they are making a difference for water quality. Some feedback from participants is below:

- We are certainly much better consumers and stewards for stormwater than we were before.
- Both rain gardens are working just as we had hoped, and I know we have reduced our runoff into Four Mile Run. We are proud to be a part of this very worthwhile program!
- I had a good experience and I am thrilled with the results.
- We feel good that we not only solved our water drainage problem, but we also helped our neighbor with their water problem. cannot get over the difference! Thank you so much!!
- Without StormwaterWise and your help, this never would have happened. I will never be able to express my gratitude!

41

### Questions?

Lily Whitesell  
 Stormwater Outreach Specialist  
 Office of Sustainability and Environmental Management  
 Department of Environmental Services  
 Arlington County  
[lwhitesell@arlingtonva.us](mailto:lwhitesell@arlingtonva.us)  
 703-228-3042


42



City of Roswell  
**Myrtle Street Permeable  
 Pavers**

CWP May 20, 2020

Laurie Hawks / President  
 Hawks Environmental



43

## Agenda


- Introduction
- Stormwater background
- Shared Stormwater Facility Policy
- Permeable Paver Project
- Benefits and challenges
- Questions



44

## Introduction


- Incorporated in 1854
- Northern Suburb of Atlanta, population of ~95,000
- Historic downtown area with aging storm infrastructure
- Vibrant community with cultural events, festivals, business community
- Quality of life
- 2017 GMA Live Work Play



45

## Introduction


- Water resources integral part of history and identity
- Many parks located near streams and river
- 8 major watersheds
- 5 impaired streams, including Chattahoochee River



46

## Stormwater Background


- Strong development/ redevelopment demand
- Land is at a premium - stormwater ponds, BMPs take up valuable real estate
- Older areas difficult to meet current requirements
- Stormwater infrastructure lacking or aged
- Flooding in some areas



47

## Shared Stormwater Facilities

- Recognized need for creative solutions to stormwater management
- Around 2015
  - Shared Stormwater Facilities policy established
  - BMP Revolving Fund and Green Infrastructure Implementation project (USEPA 319(b) grant)



48

### Shared Stormwater Facilities Policy

- Established policy that allows
- Two or more private entities to share in establishment and/or maintenance of stormwater management facility
  - The City may establish a facility and provide credits for private community to voluntarily purchase
  - The City and one or more private entities to share in establishment and/or maintenance of stormwater management facility



### Shared Stormwater Facilities Policy

- Private Applicants
- Application/approval process
  - Hydrology study/design criteria
  - Impervious acre treated is unit benefit
  - Project cost based on fair market value and contribution of each partner
  - MOA with all parties – plan, responsibilities, ROW, funding, ownership, O&M
  - Implementation



49

50

### Shared Stormwater Facilities Policy

- City Projects
- Modify ordinance to allow purchase of credits in-lieu of on-site stormwater treatment
  - Set up separate fund
  - Sell and track credits – credit unit, value, use, tracking, approved sub-basin



### Myrtle Street Permeable Pavers

USEPA 319(h) grant

- “BMP Revolving Fund and Green Infrastructure Implementation”
- Demonstrate Green Infrastructure
- Permeable pavers
- Install project in City property/ROW
- Build facility in area experiencing redevelopment pressure



51

52

### Myrtle Street Permeable Pavers

- Impaired Hog Waller Creek watershed
- Underground gravel reservoir to hold and treat stormwater,
- High preliminary infiltration rates
- Provide voluntary credits for sale
- County library purchased credit



### Myrtle Street/Zion Circle



53

54



Base Stone Layer and  
Compaction



61

Concrete Cut Off Wall



62

Homeowner Access



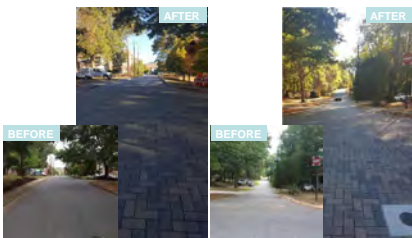
63

System Outlet



64

Myrtle Street/Zion Circle

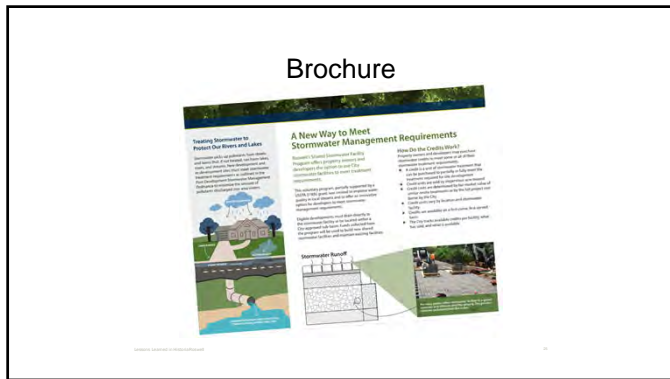


65

Ribbon Cutting



66




67

### Lesson Learned Shared Facilities Policy

- Benefits
  - Flexibility for developers and city to meet stormwater requirements
  - Option for re-development, difficult urban sites
  - Ease of permitting
  - Expanded use of land on site
- Challenges
  - City staff time, policy, and fund set up
  - Negotiations, each site unique
  - Developers and City work on different time frames (City needs Mayor and Council approval)
- Moving forward
  - WQ onsite, detention only in shared facility

68

## Thank you. Questions?



**Laurie Hawks**  
Hawks Environmental  
[lhawks@hawks-env.com](mailto:lhawks@hawks-env.com)  
678.231.6433


69

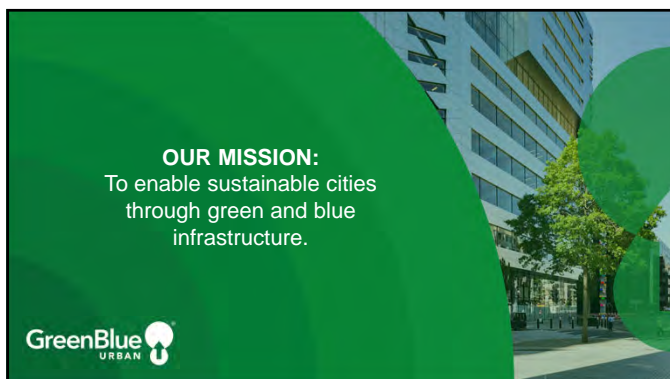


70

### OUR MISSION:

To enable sustainable cities through green and blue infrastructure.





71



- Urban Tree Planting Systems
- Bioretention Tree Pits
- Combined Tree/Stormwater Systems



(866) 282-2743  
[www.greenblue.com](http://www.greenblue.com)



72



73



74

**Designing for Healthy Urban Trees: THE STORMWATER BENEFITS FROM TREES**

- Transpiration
- Interception
- Reduced Throughfall
- Increased Infiltration
- Phytoremediation

GreenBlue URBAN

75

**Designing for Healthy Urban Trees: THE STORMWATER BENEFITS FROM TREES**

- Aesthetic – 52%
- Stormwater – 31%
- Energy – 12%
- Air Quality – 4%
- CO<sub>2</sub> – 1%

Benefit	Percentage	Value
Aesthetic	52%	\$41,006,799
Stormwater	31%	\$24,114,485
Energy	12%	\$9,703,847
Air Quality	4%	\$2,820,721
CO <sub>2</sub>	1%	\$1,156,214

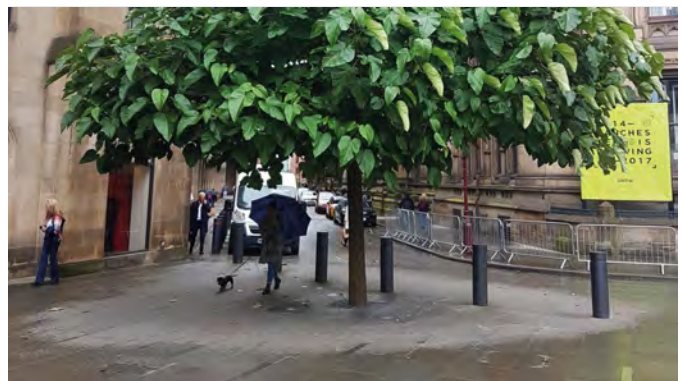
Environmental & Economic Benefits  
S&T Institute Consultants  
May 2011

GreenBlue URBAN

76



77



78

**More Roots = More Stormwater Management**




100 gallons  
376 litres  
of stormwater  
absorbed per day

Dr. Kim D. Cooper, University of Georgia, and the Rural Soil Community Program Director

**GreenBlue URBAN**  
Establishing the future urban landscape

URBAN TREES - AN OVERLOOKED ASSET IN STORMWATER MANAGEMENT

79



One tree within 880ft<sup>3</sup> / 25m<sup>3</sup> of uncompacted soil can attenuate more than 1,450 gallons of stormwater.

**GreenBlue URBAN**

URBAN TREES - AN OVERLOOKED ASSET IN STORMWATER MANAGEMENT

80

**Phytoremediation**

Soil media evidence suggests it can remove anywhere from 50-80% of hydrocarbons, >70% of phosphorous and >60% of nitrogen.



**GreenBlue URBAN**  
Establishing the future urban landscape

URBAN TREES - AN OVERLOOKED ASSET IN STORMWATER MANAGEMENT

81




*What is your vision?*

**GreenBlue URBAN**

URBAN TREES - AN OVERLOOKED ASSET IN STORMWATER MANAGEMENT

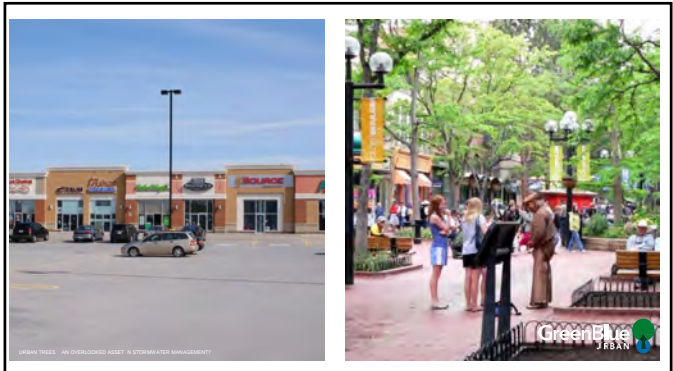
82



**GreenBlue URBAN**

URBAN TREES - AN OVERLOOKED ASSET IN STORMWATER MANAGEMENT

83



**GreenBlue URBAN**

URBAN TREES - AN OVERLOOKED ASSET IN STORMWATER MANAGEMENT

84



85



86

URBAN TREES THAT ARE LESS SUCCESSFUL

The average life span of a tree in an urban area is <13 years

87

Designing for Healthy Urban Trees:  
**STREET TREE DESIGN FAILURES**

- Compacted Soil
- Lack of Soil Volume
- Lack of Root Management
- Lack of Stormwater Management

88

Designing for Healthy Urban Trees:  
**A WELL-DESIGNED SYSTEM FOR STREET TREES**

- Uncompacted Soil =
  - Increased Tree Canopy Size
    - (Interception / Transpiration / Reduced Throughfall)
  - Increased Stormwater Infiltration in Soil
    - (Stormwater Reduction / Phytoremediation)

89

Trees are an excellent resource for stormwater management

Sustainable and eco-friendly

Make sure trees are healthy, mature and strategically planted

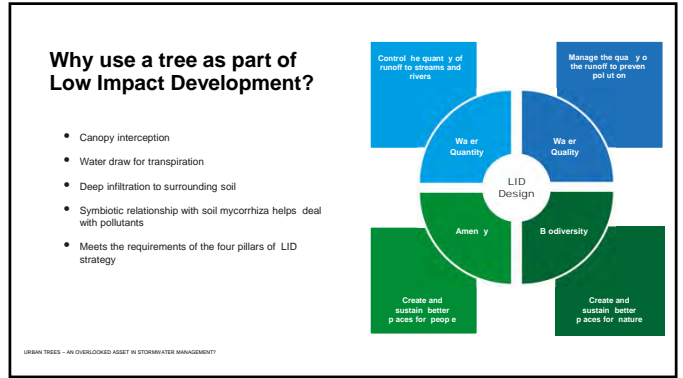
URBAN TREES - AN OVERLOOKED ASSET IN STORMWATER MANAGEMENT

90





91



92



93



94



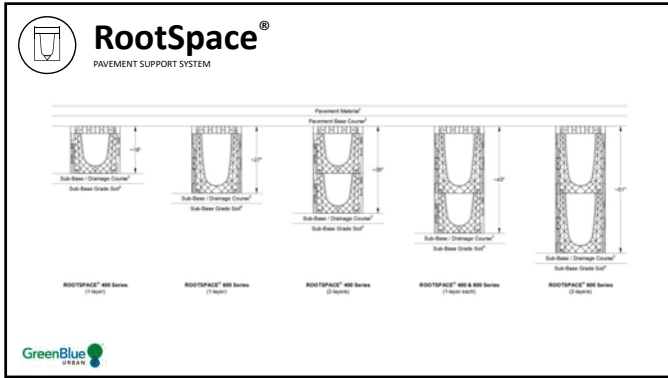
95

RootSpace®  
PAVEMENT LOAD CAPACITY CHART

Pavement Design <sup>1</sup>	Pavement Thickness (in)	ASPHALT OVER CONCRETE (AOC) - 1.5" MIN. ASPHALT OVER 4" MIN. CONCRETE				ASPHALT OVER ASPHALT (AOA) - 4" MIN. ASPHALT OVER 4" MIN. ASPHALT		CONCRETE OVER CONCRETE (COC) - 4" MIN. CONCRETE OVER 4" MIN. CONCRETE	
		ASPHALT 1.5" MIN.	ASPHALT 1.5" MIN.	ASPHALT 1.5" MIN.	ASPHALT 1.5" MIN.	ASPHALT 4" MIN.	ASPHALT 4" MIN.	CONCRETE 4" MIN.	CONCRETE 4" MIN.
1.5" ASPHALT OVER CONCRETE (AOC) - 1.5" MIN. ASPHALT OVER 4" MIN. CONCRETE	1.5"	✓	✓	✓	✓	20,000 lbs	20,000 lbs	20,000 lbs	20,000 lbs
1.5" ASPHALT OVER ASPHALT (AOA) - 4" MIN. ASPHALT OVER 4" MIN. ASPHALT	1.5"	✓	✓	✓	✓	20,000 lbs	20,000 lbs	20,000 lbs	20,000 lbs
1.5" ASPHALT OVER CONCRETE (AOC) - 1.5" MIN. ASPHALT OVER 4" MIN. CONCRETE	1.5"	✓	✓	✓	✓	20,000 lbs	20,000 lbs	20,000 lbs	20,000 lbs
1.5" ASPHALT OVER ASPHALT (AOA) - 4" MIN. ASPHALT OVER 4" MIN. ASPHALT	1.5"	✓	✓	✓	✓	20,000 lbs	20,000 lbs	20,000 lbs	20,000 lbs
1.5" ASPHALT OVER CONCRETE (AOC) - 1.5" MIN. ASPHALT OVER 4" MIN. CONCRETE	1.5"	✓	✓	✓	✓	20,000 lbs	20,000 lbs	20,000 lbs	20,000 lbs
1.5" ASPHALT OVER ASPHALT (AOA) - 4" MIN. ASPHALT OVER 4" MIN. ASPHALT	1.5"	✓	✓	✓	✓	20,000 lbs	20,000 lbs	20,000 lbs	20,000 lbs
1.5" ASPHALT OVER CONCRETE (AOC) - 1.5" MIN. ASPHALT OVER 4" MIN. CONCRETE	1.5"	✓	✓	✓	✓	20,000 lbs	20,000 lbs	20,000 lbs	20,000 lbs
1.5" ASPHALT OVER ASPHALT (AOA) - 4" MIN. ASPHALT OVER 4" MIN. ASPHALT	1.5"	✓	✓	✓	✓	20,000 lbs	20,000 lbs	20,000 lbs	20,000 lbs

GreenBlue URBAN

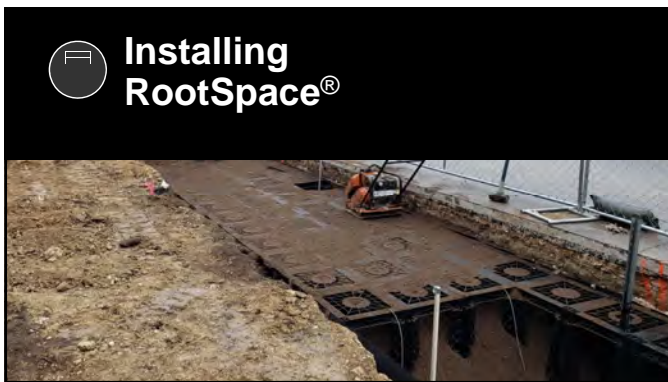
96



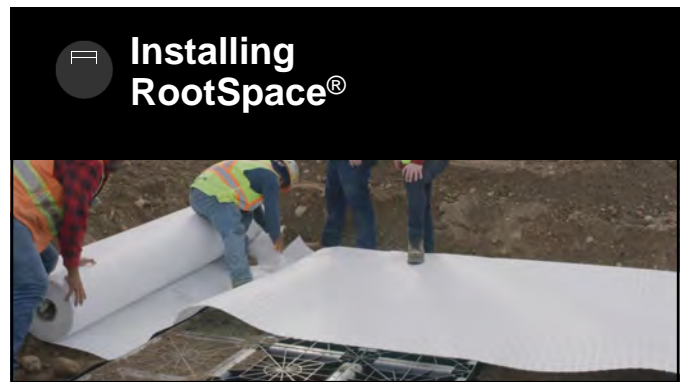
97



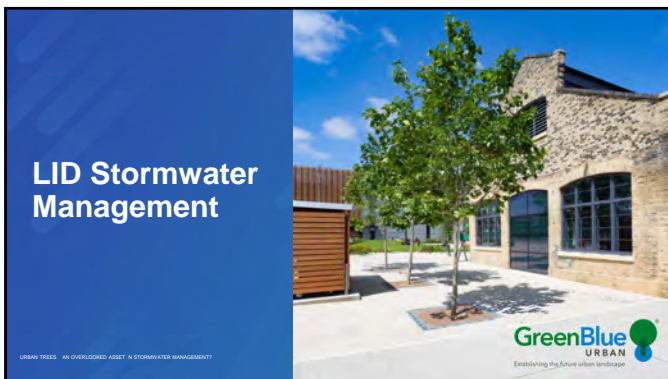
98



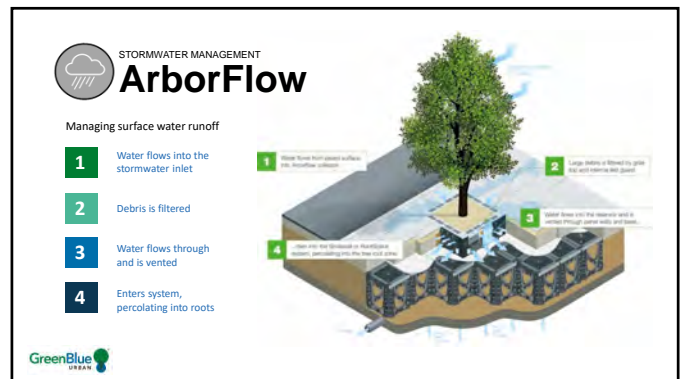
99



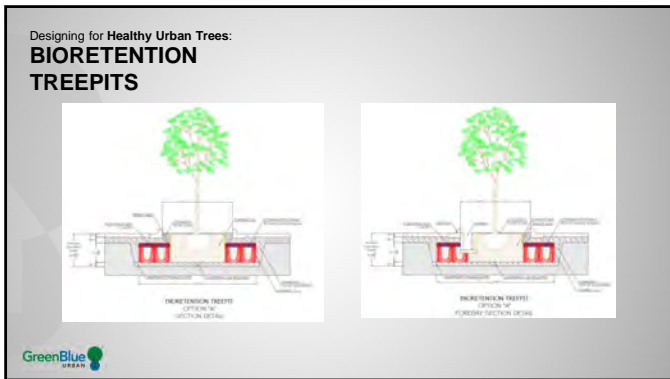
100



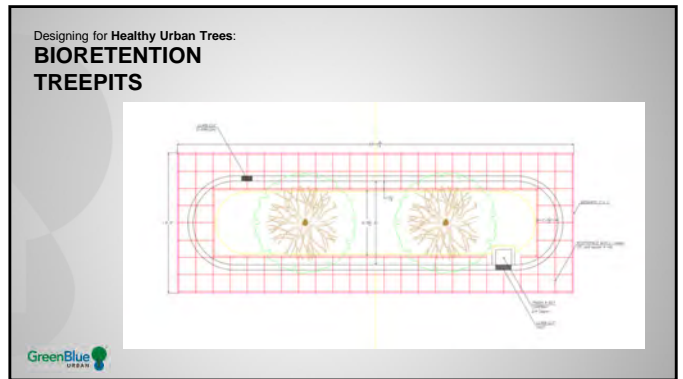
101



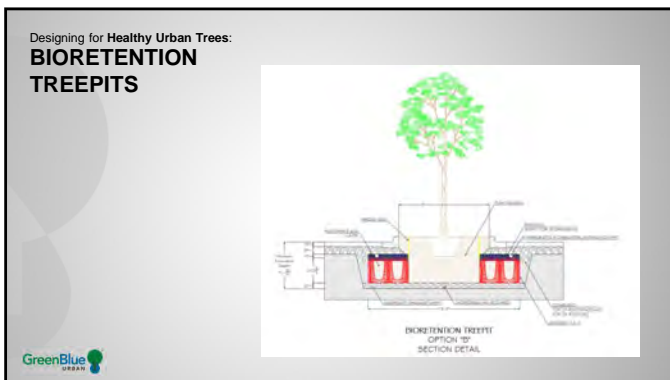
102



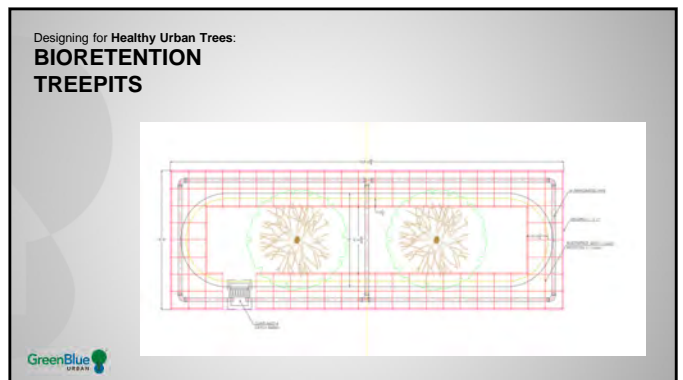
103



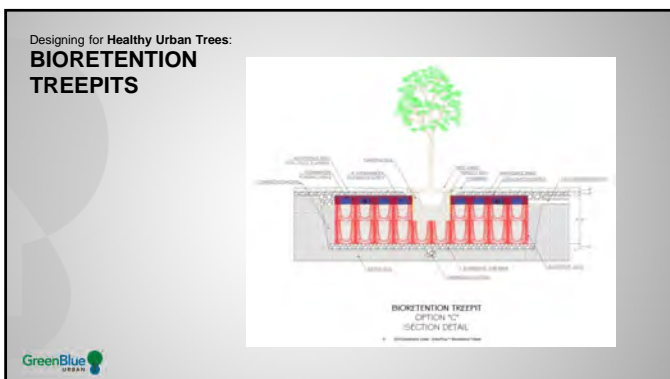
104



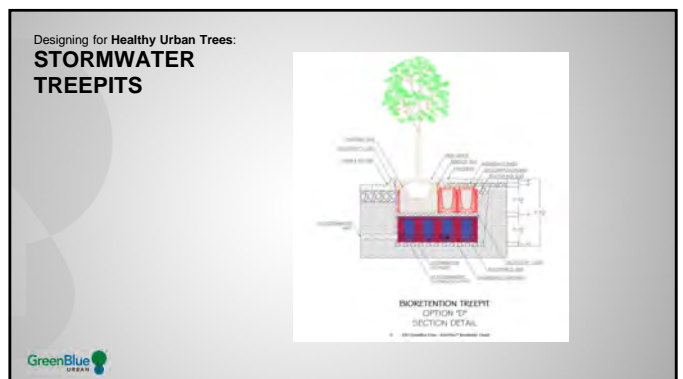
105



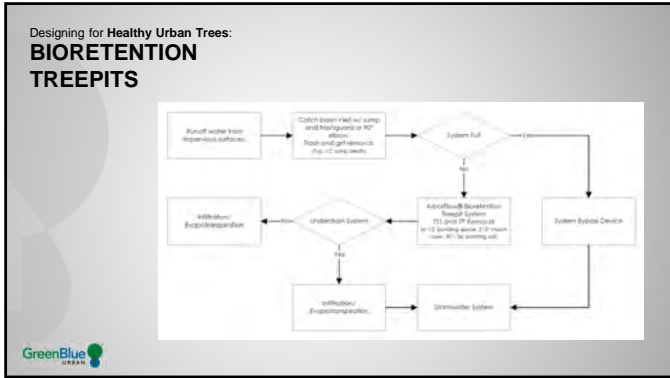
106



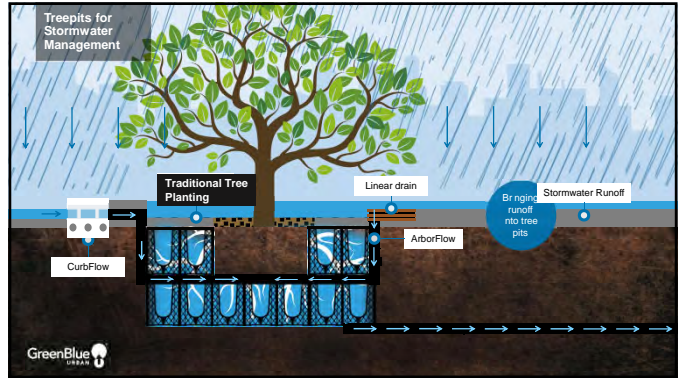
107



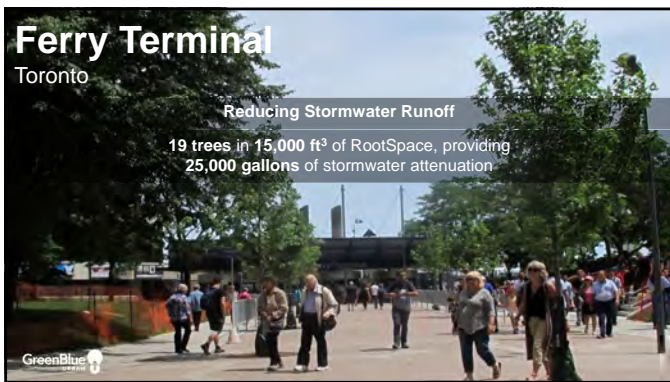
108



109



110



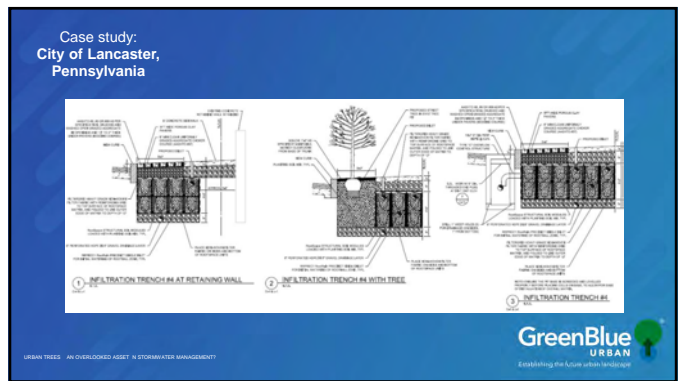
111



112



113




114

Case study:  
City of Lancaster,  
Pennsylvania

- \$2.8 million in air quality, energy, and climate related benefits annually
- Reduced gray infrastructure capital costs of \$120 million
- Reduced wastewater pumping and treatment costs of \$661,000
- Reduced stormwater volumes
- Improved stormwater quality
- Enhanced aesthetics
- Reduced air pollution
- Improved public health
- Increased property values
- Reduced energy costs associated with cooling and heating buildings
- Reduced heat islands and effects

URBAN TREES - AN OVERLOOKED ASSET IN STORMWATER MANAGEMENT



115

Riverwalk  
Illinois




116

Navy Pier  
Illinois

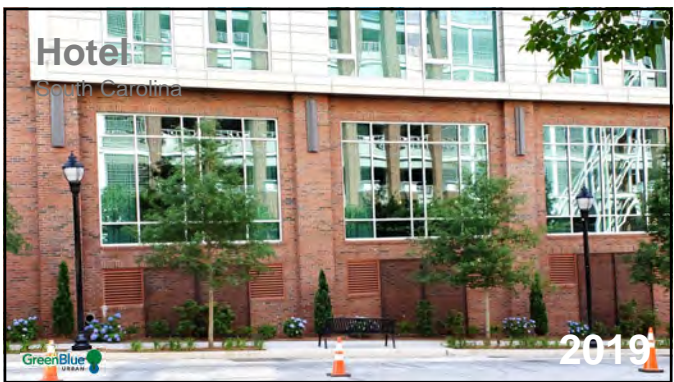


2015 2017




117

Hotel  
South Carolina



2019





118

Luxury Resort  
Tennessee




119

University  
Missouri

120



121



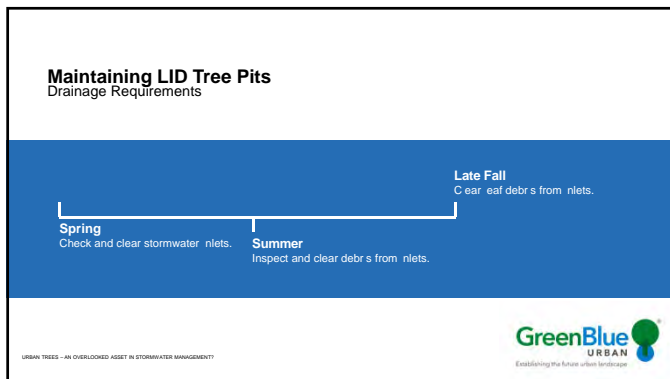
122



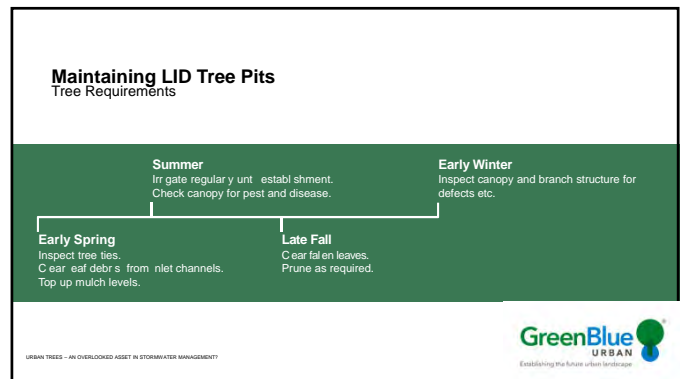
123



124



125



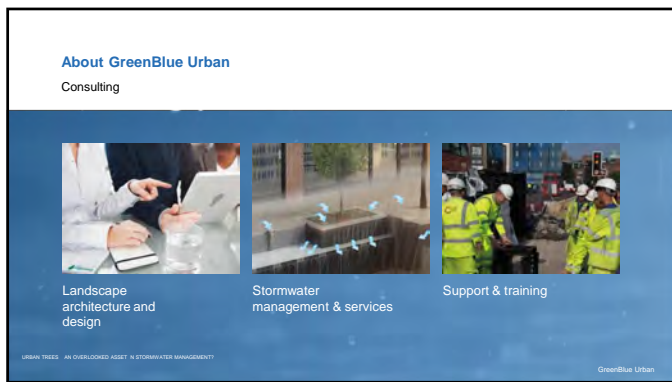
126



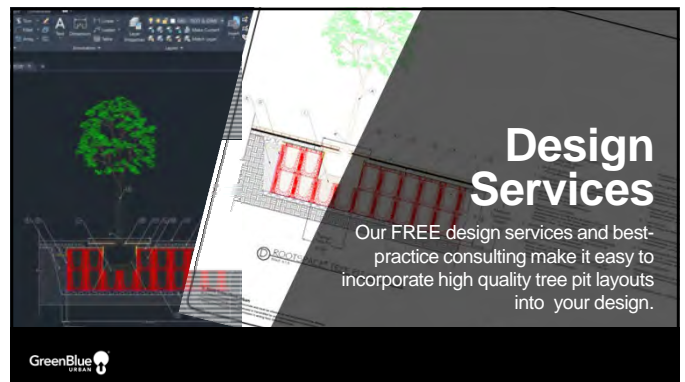
127



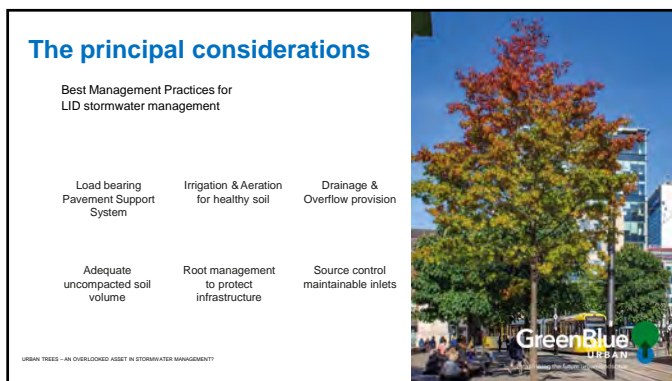
128



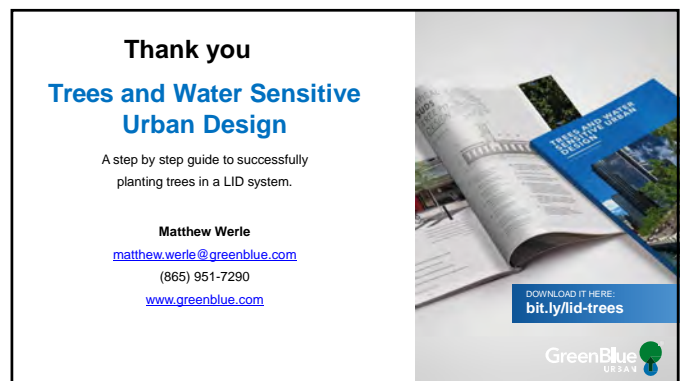
129



130



131




132

**CENTER FOR WATERSHED PROTECTION**

**Post-Webcast Information**

- **Participation Certificate** – Participation certificates are also available. If you have multiple attendees, please save the certificate to your computer. You can type the attendees name in the name field and then print the certificate.



133

**CENTER FOR WATERSHED PROTECTION**

**Thank you for Joining Us Today!**

**Did you know that you can have access to complementary webcasts at the CWP?**

To learn more please contact Karen Titus at [kmt@cw.org](mailto:kmt@cw.org) / 443-392-7836

or visit: <https://www.cwp.org/join-now/>

134

**CENTER FOR WATERSHED PROTECTION**

**Thanks for attending  
Small Scale BMPs  
May 20, 2020**

135



***Appendix F.5***

***Maintenance Guidelines for Pervious Concrete  
Webinar***

---

The page intentionally left blank.



**PAVE AHEAD**  
DURABLE. SUSTAINABLE. CONCRETE.



**Provider Number: G416**  
**Course: DSP101 | 1.0 LU/HSW | 1.0 PDH**

## Designing Pervious Concrete (1 Hour)

AIA-CES Number DSP101: 1.0 LU|HSW (1.0 Hour) | 1.0 PDH for Engineers

Pervious concrete pavement is considered a best management practice by the Environmental Protection Agency (EPA) and is a recommended solution to reducing runoff in the LEED Green Building Rating System. Pervious concrete pavement is ideal for parking areas, sidewalks, patios, tennis courts, roads and driveway. This one-hour webinar provides an introduction to designing a pervious concrete pavement infiltration system.



### Learning Objectives:

- Understand properties of pervious concrete.
- Understand subgrade and subbase requirements for a pervious concrete pavement system.
- Understand structural design of pervious concrete pavement.
- Understand hydrologic design of pervious concrete pavement systems.
- Discuss special requirements for freeze/thaw durability and heavy traffic conditions.

**Who Should Attend:** This Webinar will help civil engineers, architects, landscape architects and public works officials understand the principles behind proper design of pervious concrete. Contractors, product suppliers and land developers will also benefit from this Webinar.

### Instructors:

Philip Kresge, Senior Vice President, Local Paving, NRMCA

Ken Justice, P.E., Senior Director, Local Paving, NRMCA, Certified Pervious Concrete Craftsman



Wendy Edde

Is awarded 1.0 Professional Development Hour  
For the successful completion of the Storm Water  
Solutions webinar:

**Storm Water Compliance Success:  
Using Proactive BMPs to Minimize  
Regulatory Discharges**

July 31st, 2019

Facilitator:  
**Robin Pasteur**  
Publisher, Water Group

A handwritten signature in black ink that reads "Robin Pasteur". The signature is stylized and cursive.

1 Hour Webinar  
1 PDH

Acceptance of this credit is at the discretion of the receiving agency

The page intentionally left blank.

**Operations and Maintenance Costs of Low Impact Development**

<b>LID Measure</b>	<b>Cost of Design/Install</b>	<b>Maintenance Tasks/Costs</b>	<b>Lifespan</b>	<b>Considerations for High Desert Environment</b>	<b>Sources</b>	<b>Applicability</b>
Bioretention Planter	\$5 - \$12 per square foot for residential applications.  \$15 - \$60 per square foot for commercial applications	Sediment removal Debris removal Weed control Landscaping Inspections Dry season watering Replacement of mulch yearly	With proper care, Bioretention planters can last for 15 years without heavy maintenance.	Ideal for desert environments. Using drought tolerant native vegetation helps to remove pollutants from stormwater.  Reduces urban heat island effect through increased vegetation.	-University of Alabama , Costs of Urban Stormwater Control Practices 2006	Commercial Right-of-Way Residential
Bioretention Swale (Rain Garden)	\$20,000 - \$35,000 per facility depending on area.	Sediment removal Trash removal Replanting of dead vegetation Landscaping  \$134/swale/year	With proper maintenance, these systems can last indefinitely.	Using drought tolerant native vegetation, swales can treat a large volume of stormwater. Allows for infiltration directly towards groundwater.	-City of Bend, CIP project bid quotes, 2017-19; Infor, 2019. -University of Alabama, 2006.	Commercial Right-of-Way Residential
Drywell	Installation costs for drywells are anywhere from \$12,000 to \$20,000	Sediment removal Repairing Pipes Removing Contaminants  Regular inspection maintenance - \$2.15-\$11/unit/year Corrective Maintenance/Flood Response - \$90-\$180/unit as needed	30 years with proper upkeep.	A drywell is an underground injection control and must be registered /rule authorized or permitted by Oregon DEQ. Highly permeable desert soils make dry wells ideal for allowing infiltration during periods of heavy precipitation. Excavation via blasting may be required for areas of pink tuff.	-City of Portland , Taking it Underground – Stormwater Solutions Handbook – Environmental Services, 2006. -City of Bend 2019	Commercial Right-of-Way Residential
Sediment Manhole	\$7,000 per facility that measures 4 feet in diameter and 8 feet in depth.	Regular Inspections on a seasonal basis  \$1.50-\$3.50/unit/year Sediment removal via Vactor truck	30 years with proper upkeep.	Because turbidity is a pollutant of concern in the Deschutes river, these facilities are an important part of a treatment train by allowing sediment to settle out before water makes it back into the river. They are an effective spill control in areas of UICs.	-City of Bend, 2017-2019; 2019 -Portland Stormwater Management Manual, O&M Specifications Water Quality Manholes, 2016	Commercial Right-of-Way
Subterranean Infiltration Basin	For an infiltration trench with dimensions 100x10x6 feet \$7,100 - \$16,800	Buffer strip mowing Lawn care Trench Inspection Sediment removal	30 – 45 years with major maintenance at the 15 year mark.	Deeper than they are wide, infiltration trenches are considered underground injection controls (UICs) and must be registered and rule	- City of Portland 2006	Commercial Residential Right-of-Way

LID Measure	Cost of Design/Install	Maintenance Tasks/Costs	Lifespan	Considerations for High Desert Environment	Sources	Applicability
				authorized/permitted by DEQ. Due to moderately rapid permeability, infiltration trenches can help reduce the amount of water lost to evaporation by allowing quicker infiltration.		
Rainwater Catchment Barrel	Small 55 gallon barrel - \$150 Large 5,000 gallon tank – \$2,500 not including installation	Inspections and debris removal Yearly cleaning	20 to 50 years with proper maintenance	With only 12 inches of rain a year, a cistern can help to conserve municipal water that would typically be used to water plants. Serves to provide stormwater benefit only when storage capacity is available during a rain storm.	– City of Portland Cisterns, Environmental Services 2006	Commercial Residential
Permeable Pavement	Permeable Pavers – \$12/Sq.Ft  Grass Pavers - \$10/Sq.Ft  Permeable Asphalt - \$6/Sq.Ft  Porous Concrete - \$4/Sq.Ft	Annual inspection of the entire facility  Power washed every three years  Removal of sediment three times a year to prevent clogging	20 to 40 years with typical routine maintenance.	Permeable pavement can help to increase infiltration in areas that would otherwise have none. Full depth permeable pavement below the frost line can be costly in rocky soils. Early evidence of significant pollutant removal benefit with permeable overcoat only. Longevity may be minimized with studded tires. Best used in low traffic areas such as driveways or walkways/paths. Extra care is necessary to protect pavement from clogging.	-Green Values – National Stormwater Management Calculator 2009 – University of Maryland, Permeable Pavement Fact Sheet 2016	Commercial Residential Right-of-Way
Green Roof	Simple extensive roofs \$10/Sq.Ft  Intensive load roofs - \$25/Sq.Ft.	Periodic watering if precipitation is less than 0.5 inches in a two week period. Removal of weeds Fertilizing plants regularly	With proper care, the roof below the green roof can last for 30 to 50 years.	Green roofs can help to reduce stormwater runoff volume, the amount of heating or cooling a building needs, as well as provide noise reduction. Extensive green roofs weight compares to tile roofs; intensive green roofs are heavier. Structural engineering needs should be considered. Proper installation is critical.	- City of Portland, Environmental Services Cost Benefit Evaluation of Ecoroofs, 2008 -Reducing Urban Heat Islands: Compendium of Strategies Green Roofs 2014	Commercial Residential