



Operation & Maintenance
of Stormwater Control
Measures
Refresher Training
As required by Part I, Section A.3.g.6
of the MS4 NPDES Permit

Stormwater Pollution Prevention



1

Why Am I Taking this Training?

- If you are taking this training, you will learn
 - Common BMPs to manage stormwater
 - Common factors affecting the performance of BMPs
 - Components of the BMPs
 - Indicators that maintenance is needed
 - Frequency and maintenance needs
- This training is for municipal employees and contractors working for municipalities
- Training is required
 - At least once during the permit cycle (typically 5-years) for existing staff
 - New hires shall receive training within one year of their hire date

2



3

Factors Affecting Performance

	Sediment Buildup	Litter & Debris	Pipe Clogging	Invasive Vegetation
Surface Sand or Soil Filter	50%	30%	10%	0%
Infiltration Basins or Trenches	36%	21%	10%	5%
Wet Ponds	26% *	19%	21%	10%
Underground Sedimentation Devices	58%	21%	11%	0%
Rain Gardens	33%	22%	7%	26%
Filter Strips or Swales	21%	26%	5%	26%

* PAH's becoming a significant concern for wet pond sediments
 • Maintenance Survey of 38 cities and counties in Minnesota and Wisconsin
 • Multiple-answers allowed

Erickson, A.J., Gulliver, J.S., Weiss, P.T., and Wilson, C.B. (2009). "Survey of Stormwater BMP Maintenance Practices." Proceedings of the Universities Council on Water Resources/National Institutes for Water Resources Annual Conference, July 7-9, Chicago, IL.

4

Maintenance Cycle

- Inspect
 - At regular intervals
 - Use checklist
 - Inlets, outlets, storage, upstream drainage area, downstream impacts etc.
 - Vegetation management
 - Infiltration
 - Sediment accumulation
 - Trash and debris
- Maintain
- Track
 - Inventory of existing practices
 - Maintenance and inspection
 - Documentation for legal action
 - Relate design to performance


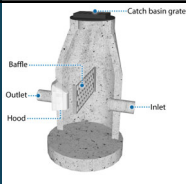
5

Catch Basins

6

Catch Basins

- Designed to catch pollutants in a sump
- Visually inspect before cleaning
- Clean when sump is 1/3 full
- Collect and properly dispose waste material (liquid and solid)
 - drying beds → solid waste landfill
 - wastewater treatment plant
- Solid/liquid waste defined as "liquid industrial by-product" under Part 121 of NREPA
- Refer to EGLE for additional information



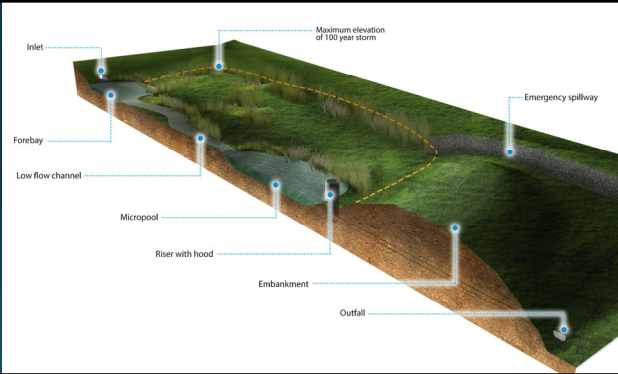
7



Detention

8

Detention Components



9

Detention O&M	Task	Frequency	Indicator that maintenance is needed	Maintenance notes
	Forebay inspection	2-4 times/year	Internal erosion or excessive sediment, trash, or debris accumulation	Check for sediment accumulation to ensure that forebay capacity is as designed. Remove any accumulated sediment.
	Practice inspection	1 time/year	Excessive sediment, trash, and/or debris accumulation in the practice	Remove any accumulated sediment. Adjacent pervious areas might need to be regraded.
	Outlet inspection and maintenance	2-4 times/year	Accumulation of litter and debris in practice, large debris around outlet, internal erosion	Remove litter, leaves, and debris to reduce the risk of outlet clogging and to improve practice aesthetics. Erosion should be repaired and stabilized.
	Mowing	2-12 times/year	Overgrown vegetation on embankment or adjacent areas	Frequency depends on location and desired aesthetic appeal.
	Embankment inspection	1 time/year	Erosion at embankment	Repair eroded areas and revegetate.
	Remove and replace dead vegetation	2-4 times/year	Dead plants or excessive open areas in practice	Within the first year, 10% of plants can die. Survival rates increase with time.
	Temporary watering	1 time/2-3 days for the first 2-2 months	Until establishment and in severe drought	Watering after the initial year might be required.
	Nuisance wildlife management	Biweekly or as needed	Animals, feces, or burrows evident in or around practice. Excessive mosquitoes.	Maintain diverse vegetated shelf around entire practice. Eliminate monocultures and replace with diverse, flowing vegetation. Employ qualified wildlife management professionals if needed.
	Fertilization	1 time initially	Upon planting	One-time spot fertilization for first year vegetation.

10



Subsurface Storage

11

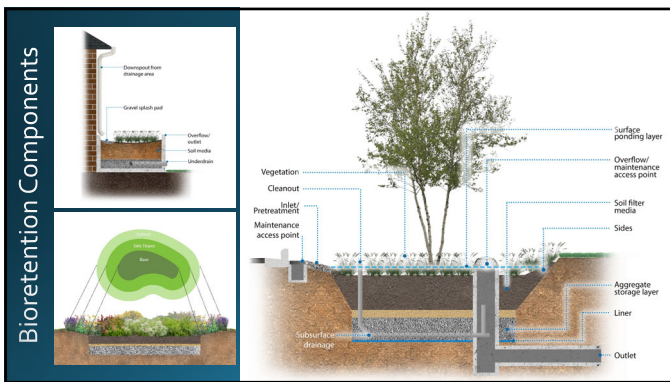
Subsurface Storage

- Bottom may be solid or allow infiltration (refer to infiltration O&M)
- Pretreatment required
 - CB
 - Manufactured treatment device
 - Filtration

12



13



14

Task	Frequency	Indicator maintenance is needed	Maintenance Notes
Catchment inspection	Weekly or biweekly with routine property maintenance	Excessive sediment, trash, or debris accumulation on the surface of bioretention	Permanently stabilize any exposed soil and remove any accumulated sediment. Adjacent pervious areas might need to be regraded.
Inlet inspection	Weekly or biweekly with routine property maintenance	Internal erosion or excessive sediment, trash, or debris accumulation	Check for sediment accumulation to ensure that flow into the bioretention is as designed. Remove any accumulated sediment.
Litter and leaf litter removal	Weekly or biweekly with routine property maintenance	Accumulation of litter and leafy debris in the bioretention area	Litter and leaves should be removed to reduce the risk of outlet clogging, reduce nutrient inputs to the bioretention area and to improve facility aesthetics.
Pruning	Prune dead and broken branches annually and deciduous shrubs every 2-5 years	Overgrown vegetation that interferes with access, lines of sight or safety	Nutrients in runoff often cause bioretention vegetation to flourish.
Mowing	2-12 times/year	Overgrown vegetation that interferes with access, lines of sight or safety	Frequency depends on location and desired aesthetic appeal
Mulch removal and replacement	1 time/2-3 years	Less than 4 inches of mulch remains on the surface	Mulch accumulation reduces available surface water storage volume. Removing decomposed mulch also increases surface infiltration rate of fill soil. Remove decomposed fraction and top off with fresh mulch to a total depth of 4 inches
Temporary watering	1 time/2-3 days for first 1-3 months, sporadically after establishment	Until established and during severe droughts	Watering after the initial year might be required.
Fertilization	1 time initially	Upon planting	One-time spot fertilization for first year vegetation.
Remove and replace dead plants	1 time/year	Dead plants	Plant die-off tends to be highest during the first year (commonly 50% or greater). Survival rates increase with time.
Outlet inspection	Monthly	Erosion at outlet	Remove any accumulated mulch or sediment.
Miscellaneous upkeep	12 times/year	Tasks include trash collection, plant health, spot weeding, removing invasive species, and removing mulch from the overflow device.	

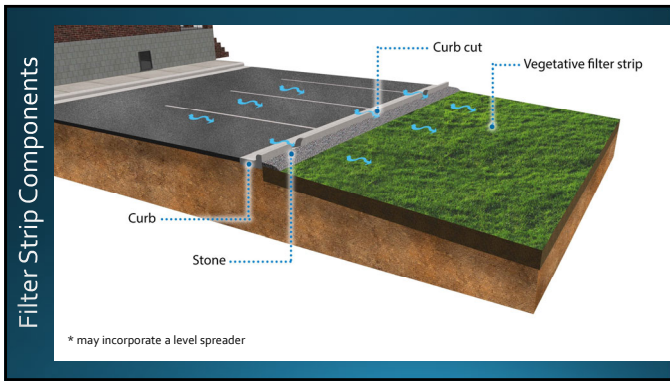
15



16



17



18

Filter Strips O&M

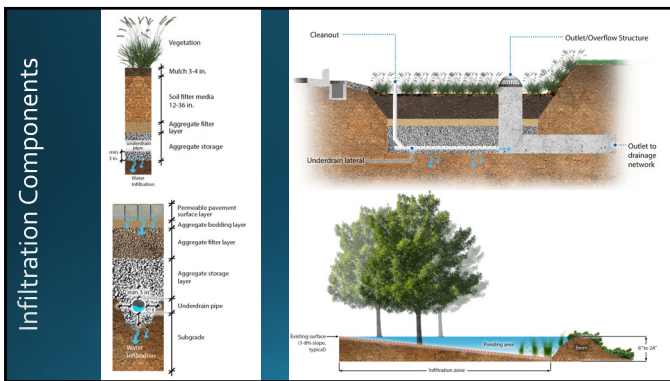
- Vegetated practice like bioretention
- Often turf grass → mow
- Objective is to spread the water out as sheet flow
- Look for concentrated flow areas (rills and gullies) correct as needed

19



Infiltration Basin and Trenches


20



21

Permeable Pavement Testing

- Equipment**
 - A square 2-foot by 2-foot wooden frame: May be constructed from an 8-foot 2 x 4 piece of lumber.
 - Grout, plumbers' putty, or silicon.
 - Blocks – to weigh frame against testing surface. Can also just stand on frame.
 - 5-gallon bucket filled with water.
- Preparation**
 - Find a flat area on the permeable surface and remove any debris.
 - Place wooden frame in place; use grout, silicone, or plumbers' putty to adhere to surface.
 - Place blocks or have a person stand on top of wooden frame to create a watertight seal to the surface.
- Test**
 - Quickly pour the 5 gallons of water into the frame and begin timing.
 - Record the time it takes for all standing water to infiltrate through surface.



Time it takes Water to Infiltrate	Results	Type of Maintenance Needed
< 30 sec	Newly Installed / Recently Maintained	No additional maintenance needed.
30-90 sec	Acceptable – Continue Preventative Maintenance.	Area will need to be clean with Regenerative Air sweeper either this visit or next.
90-300 sec	Partially Clogged	Area NEEDS to be cleaned with Regenerative Air Sweeper/Vacuum
>300 sec	Clogged – Vac Truck	Clean permeable surface with Vac Truck.

25

Permeable Pavement O&M	Task	Frequency	Indicator maintenance is needed	Maintenance notes
	Catchment inspection	Annual	Sediment accumulation on adjacent impervious surfaces or in voids/joints of permeable pavement	Stabilize any exposed soil and remove any accumulated sediment. Adjacent pervious areas might need to be graded to drain away from the pavement.
	Miscellaneous upkeep	Weekly or biweekly during routine property maintenance	Trash, leaves, weeds, or other debris accumulated on permeable pavement surface	Immediately remove debris to prevent migration into permeable pavement voids. Identify source of debris and remedy problem to avoid future deposition.
	Preventative vacuum/ regenerative air street sweeping	Twice a year (spring after snowmelt and autumn after leaves fall) in higher sediment areas	N/A	Pavement should be swept with a vacuum power or regenerative air street sweeper at least twice per year to maintain infiltration rates.
	Replace fill materials	As needed	For paver systems, whenever void space between joints becomes apparent or after vacuum sweeping	Replace bedding fill material to keep fill level with the paver surface.
	Restorative vacuum/ regenerative air street sweeping	As needed	Surface infiltration test indicates inferior performance or water is ponding on pavement surface during rainfall	Pavement should be swept with a vacuum power or regenerative air street sweeper to restore infiltration rates.

26


Permeable Pavement Winter Considerations

DO:

- Plow snow carefully by either setting the blade about 1/2 inch above the pavement surface or use a rubberized blade tip.
- Pile snow in adjacent grassy areas so that sediments and pollutants in the snowmelt can be partially treated before they reach the permeable pavement.
- Follow all manufacturer recommendations for winter maintenance procedures.

DO NOT:

- Use abrasives such as sand or cinders on permeable pavement surfaces or on adjacent surfaces. These products speed clogging of the permeable pavement surface.
- Use deicing salts on pervious concrete, pervious concrete pavers or grid pavement systems planted with vegetation. Deicing salts in all other applications should be used moderately and only when necessary.
- Use brush attachments for snow removal in paver applications that require aggregate in the joints or on grid pavement systems with loose aggregate or soil.

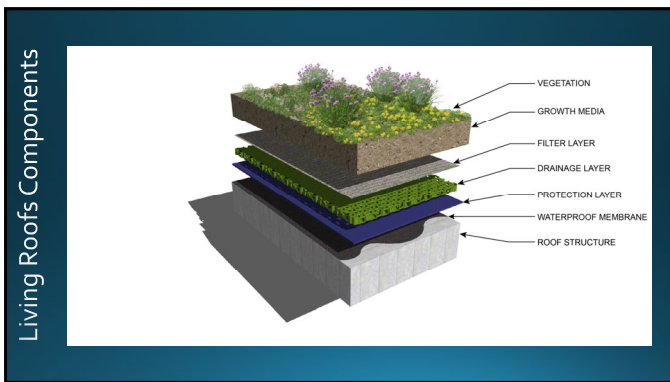


27



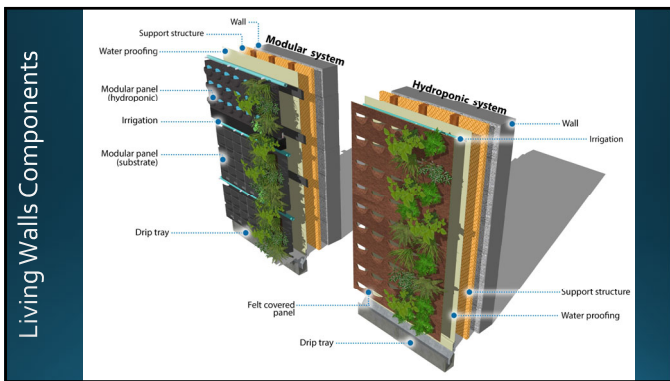
Living Roofs and Walls

28



Living Roofs Components

29



Living Walls Components

30

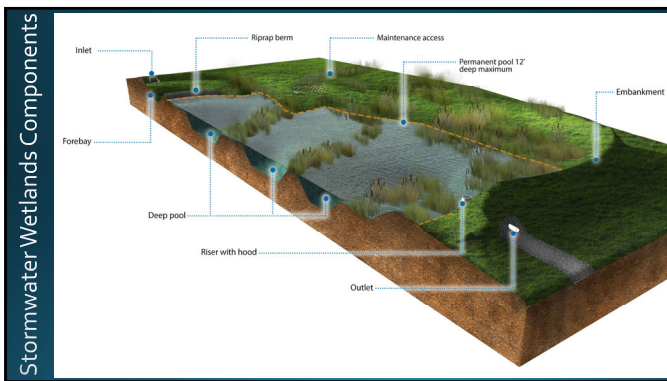
Task	Frequency	Indicator maintenance is needed	Maintenance notes
Media inspection	2 times/year	Internal erosion of media from runoff or wind scour, exposed underlayment components	Replace eroded media and vegetation. Adopt additional erosion prevention practices as appropriate.
Liner inspection	1 time/year	Liner is exposed or tenants have experienced leaks	Evaluate liner for cause of leaks. Repair or replace as necessary.
Outlet inspection	2 times/year	Accumulation of litter and debris around the roof drain or scupper or standing water in adjacent areas	Litter, leaves, and debris should be removed to reduce the risk of outlet clogging. If sediment has accumulated in the gravel drain buffers, remove and replace the gravel.
Vegetation inspection	1 time/year	Dead plants or excessive open areas on living roof	Within the first year, 10% of plants can die. Survival rates increase with time.
Invasive vegetation	2 times/year	Presence of unwanted or undesirable species	Remove undesired vegetation. Evaluate living roof for signs of excessive water retention.
Temporary watering	1 time/2-3 days for first 1-2 months	Vegetation has not yet reached maturity after one growing season, or if vegetation begins to wilt during extended periods of drought/heat	Watering after the first year might be required.
Winterize irrigation system	1 time/year	Nighttime temperatures are approaching freezing in Autumn.	Freezing temperatures can cause pipes to burst and can damage the irrigation system if one is used.

31



Stormwater Wetlands

32



33

Trees O&M

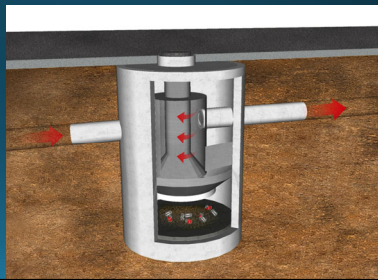
Task	Suggested Frequency	Indicator maintenance is needed	Maintenance Notes
Watering	Only during severe droughts or during periods of excessively high temperatures	Leaves may begin to wilt or brown at the edges	Supply 1 or 2 inches of water per watering as necessary
Pruning	Prune dead and broken branches annually. Prune for structure every 3-5 years	Dead or broken branches are visible, branches cross, compete with central leader or are spaced too close together	Structural pruning should be completed by a certified arborist
Mulch replacement	1 or 2 times per year for the first 3-5 years	Less than 2 inches of mulch remains on the surface	Mulch helps to retain moisture in the first few years after planting to protect growing roots
Assess tree health	Visually assess during routine maintenance	Look for signs of insect infestation or tree diseases	Appropriate corrective actions must be determined by a professional arborist or other qualified individual

In addition to the bioretention inspection and maintenance task

37

Manufactured Treatment Devices

- Example types
 - Hydrodynamic separators
 - Screens
 - Baskets
 - Filters
- Maintenance
 - Refer to manufacturer guidelines
 - Highly variable



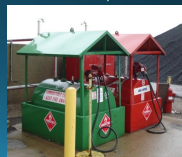
38

Secondary Containment

- A second barrier or an outer wall of a double enclosure which will contain leaks and spills from a storage container.
- Precipitation Management
 - Ability to store the 25-year 24-hour storm + the required containment volume
 - Remove precipitation between storm events
 - Gravity drains not allowed
 - Pumps operated manually
- Precipitation contaminated with spilled waste is regulated either as
 - hazardous waste (Part 111 of 1994 PA 451), or
 - Liquid industrial waste (Part 121 or Part 31 of PA 451)

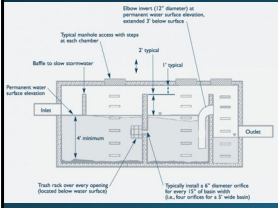
Regulated substances:

- Flammable and combustible materials
- Hazardous substances
- Hazardous waste
- Materials included on the federal CERCLA list
- Materials included on the state Critical Materials Register
- Oil and other petroleum-based products or waste
- Salt (calcium chloride and sodium chloride)



39

Oil Water Separators



- Multi-chambered structures designed to remove sediment and oils from stormwater
- Appropriate for small areas which produce heavy loads of hydrocarbons and sediment such as roads, parking lots, gas stations and convenience stores
- Provide little or no treatment of fine sediments and soluble pollutants
- Often used as pretreatment
- Clean at least twice per year. Additional cleaning may be required based on pollutant loads
- Clean by pumping out the contents and haul to approved disposal site

40

Pump Stations

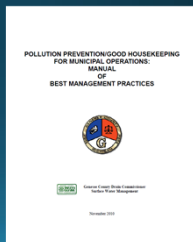
- Complex maintenance
- Customized O&M



41

Additional Information

- [GCDC Surface Water Management \(gcdcswm.com\)](http://gcdcswm.com)
- www.ClearGeneseeWater.org
- [EGLE – Stormwater Program www.mt.gov/eglestormwater](http://www.mt.gov/eglestormwater)
- [US EPA Stormwater Discharges from Municipal Sources https://www.epa.gov/npdes/stormwater-discharges-municipal-sources](https://www.epa.gov/npdes/stormwater-discharges-municipal-sources)



42



43

Thank you

Genesee County Drain Commissioner
Surface Water Management
4608 Beecher Road
Flint, MI 48532
Office (810) 732-1590
Fax (810) 732-1474
www.gcdswm.com

With support from
Tetra Tech
3497 Coollidge Rd
East Lansing, MI 48823
(517) 316-3940
www.tetratech.com



44
