

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



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



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.

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



BIORETENTION MAINTENANCE INSPECTION FORM

Facility Number: _____ Date: _____ Time: _____
 Subdivision Name: _____ Watershed: _____
 Weather: _____ Inspector(s): _____
 Date of Last Rainfall: _____ Amount: _____ Inches Streets: _____
 Mapbook Location: _____ GPS Coordinates: _____
 Property Classification: Residential ** Government ** Commercial ** Other _____
 Confined ** Unconfined ** Barrel Size _____ As-built Plan Available? Yes ** No **
 Is Facility Inspectable? Yes ** No ** Why? _____ Comments Specific Location(s): _____

Scoring Breakdown:
 N/A = Not Applicable 1 = Monitor (potential for future problem exists) * Use open space in each section to further explain scoring as needed
 NI = Not Investigated 2 = Routine Maintenance Required
 0 = Not a Problem 3 = Immediate Repair Necessary

1. Outfall Channel(s) from Facility

| | N/A | NI | 0 | 1 | 2 | 3 |
|--|-----|----|---|---|---|---|
| Woody growth within 5' of outfall barrel | | | | | | |
| Outfall channel functioning | | | | | | |
| Manholes, frames and covers | | | | | | |
| Released water undercutting outlet | | | | | | |

GENERAL MAINTENANCE CARD

BMP Site: RC-5
 Location: St. George Road (Richmond Creek Watershed)
 Facility: Constructed Storm Water Wetland

Main Area of BMP:

1. Monitor area Location A)
2. Monitor structure point Location B)
3. Low Marsh area Location C)
4. High Marsh area Location D)

SHORT TERM MEASURES (FREQUENCY: DAILY TO MONTHLY)

Drainage Inlets:

- 1) Inspect & D: wet/dry surface area
- 2) Visually inspect the inlet pipe
 - Remove accumulated debris by hand to determine use markers if required.
 - Remove sticks using a rake. If required.
- 3) Inspect the 30' long weir wall (see Location C on Fig. 1)
 - Complete Dam Inspection Checklist (attached).
 - Repair cracks/damage, if present.
 - Debris is lodged in weirs, remove manually; use markers if required.
 - Screen weirs/plug by tightening bolts.
- 4) Inspect adjacent catch basins, grates and manhole covers
 - Remove accumulated debris.
 - Clean manhole covers using a broom.

Landscaping Inlets:

- 1) Inspect overall condition of installed vegetation
 - Remove vegetation (weeds) manually, ensuring tree material. Contact Maintenance Specialist for advice.

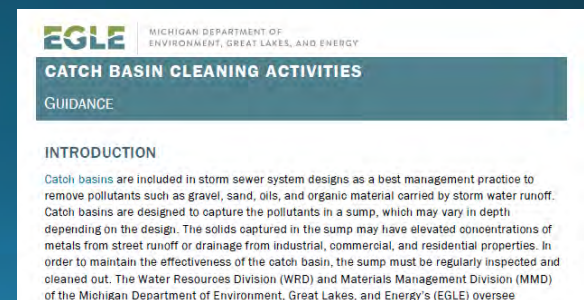
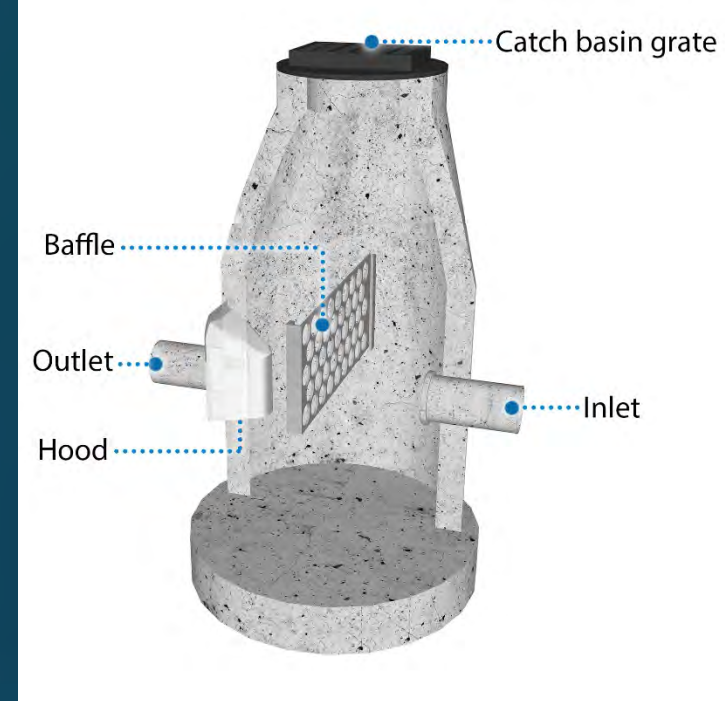




Catch Basins

Catch Basins

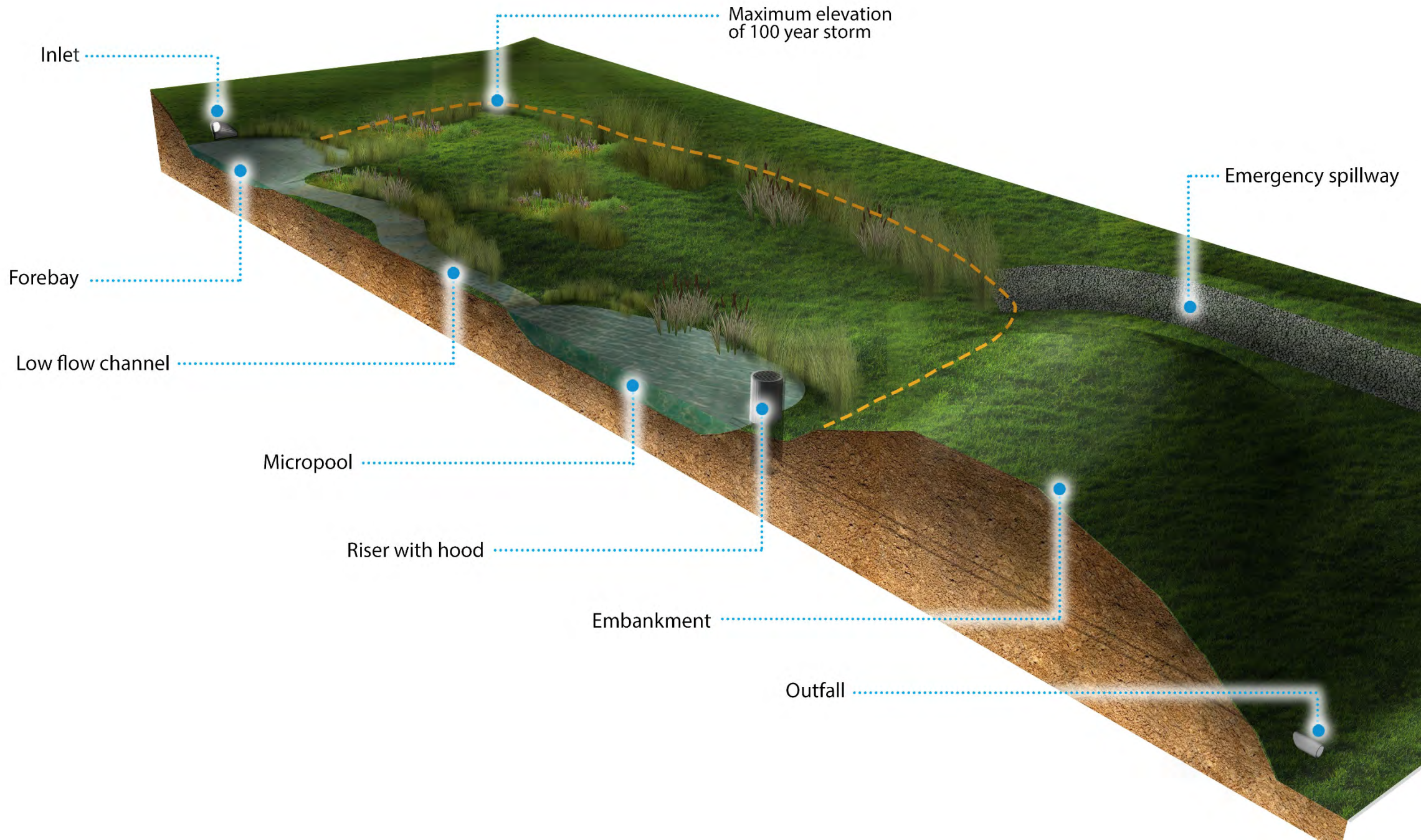
- Designed to catch pollutants in a sump
- Visually inspect before cleaning
- Clean when sump is 1/3 full
- Collect and properly dispose waste material (liquid and solid)
 - drying beds → solid waste landfill
 - wastewater treatment plant
- Solid/liquid waste defined as “liquid industrial by-product”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





Detention

Detention Components



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 1-2 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 mosquitos. | 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. |



Subsurface Storage

Subsurface Storage

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

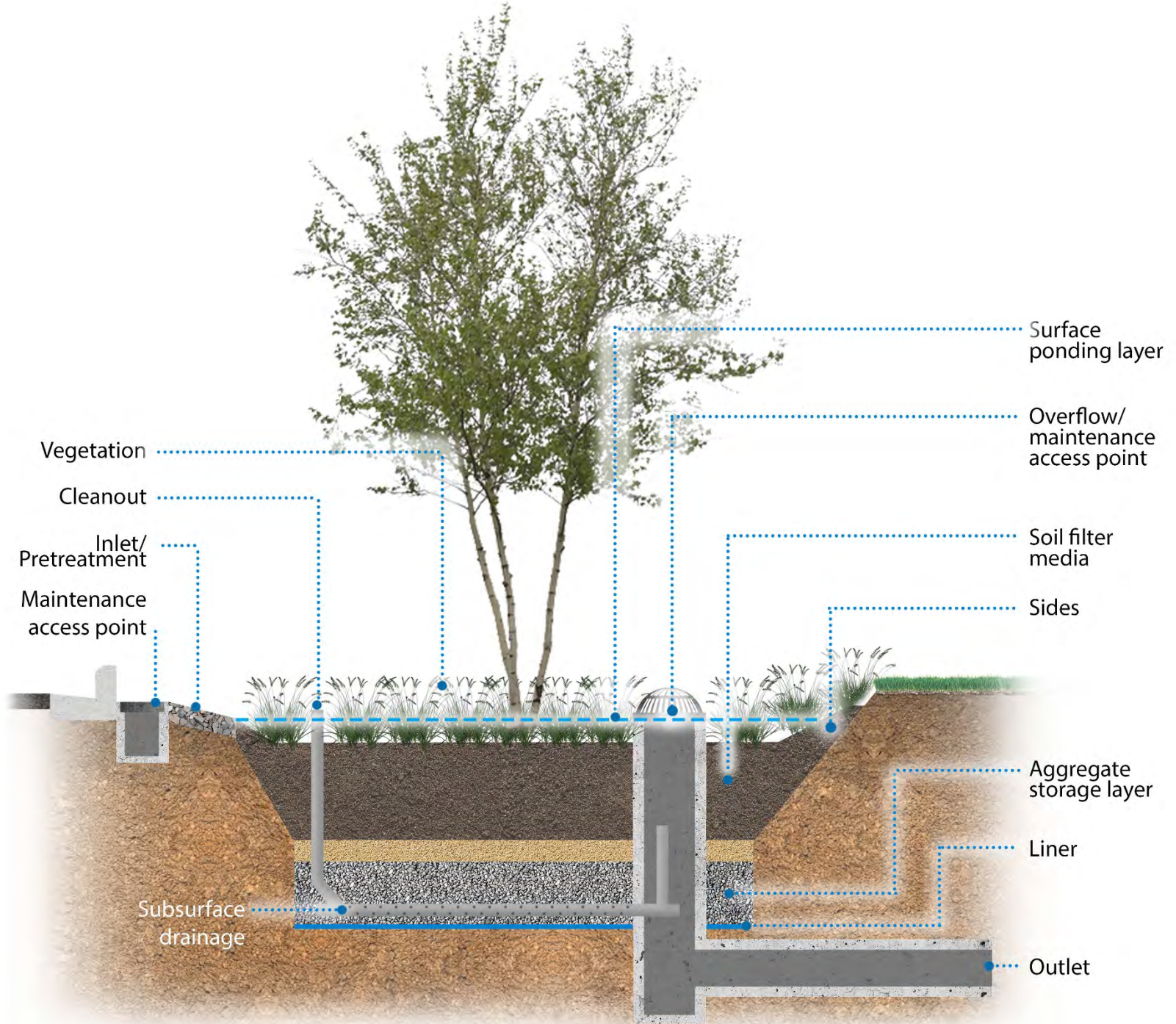
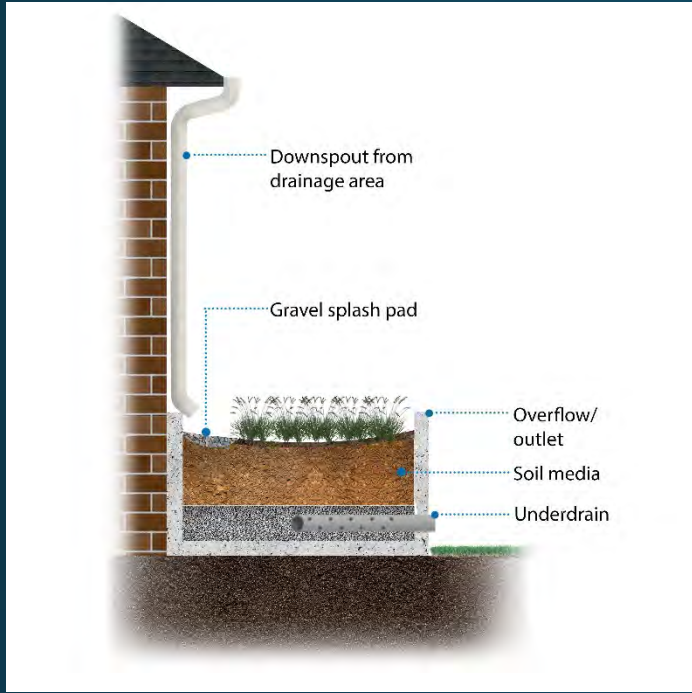




Bioretention



Bioretention Components



Bioretention O&M

| 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 3-5 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 1-2 months, sporatically after establishment | Until established and during sever 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 10% 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. | |

Vegetated Swales

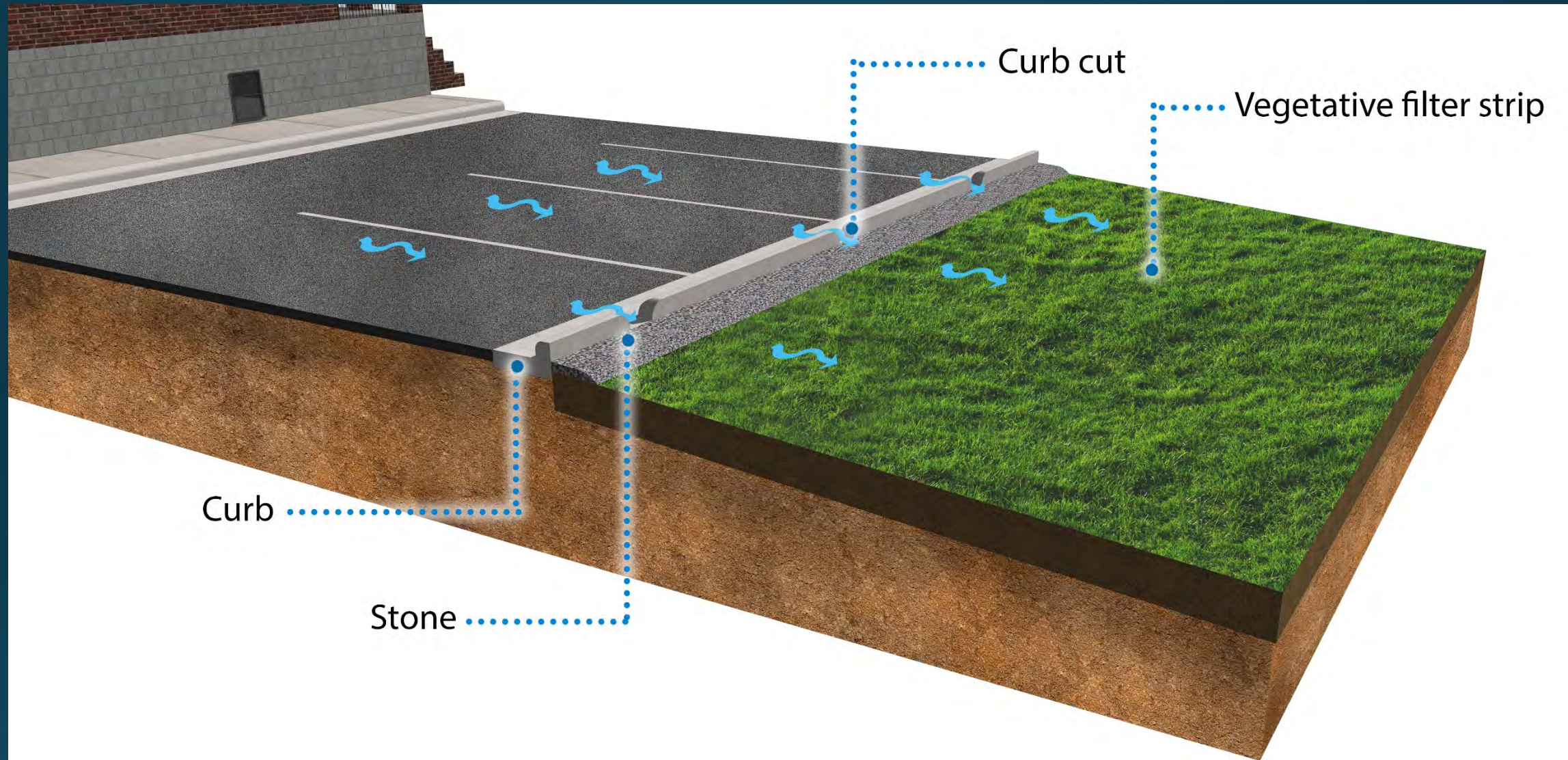
- A form of bioretention
- Look for erosion problems





Filter Strips

Filter Strip Components



* may incorporate a level spreader

Filter Strips O&M

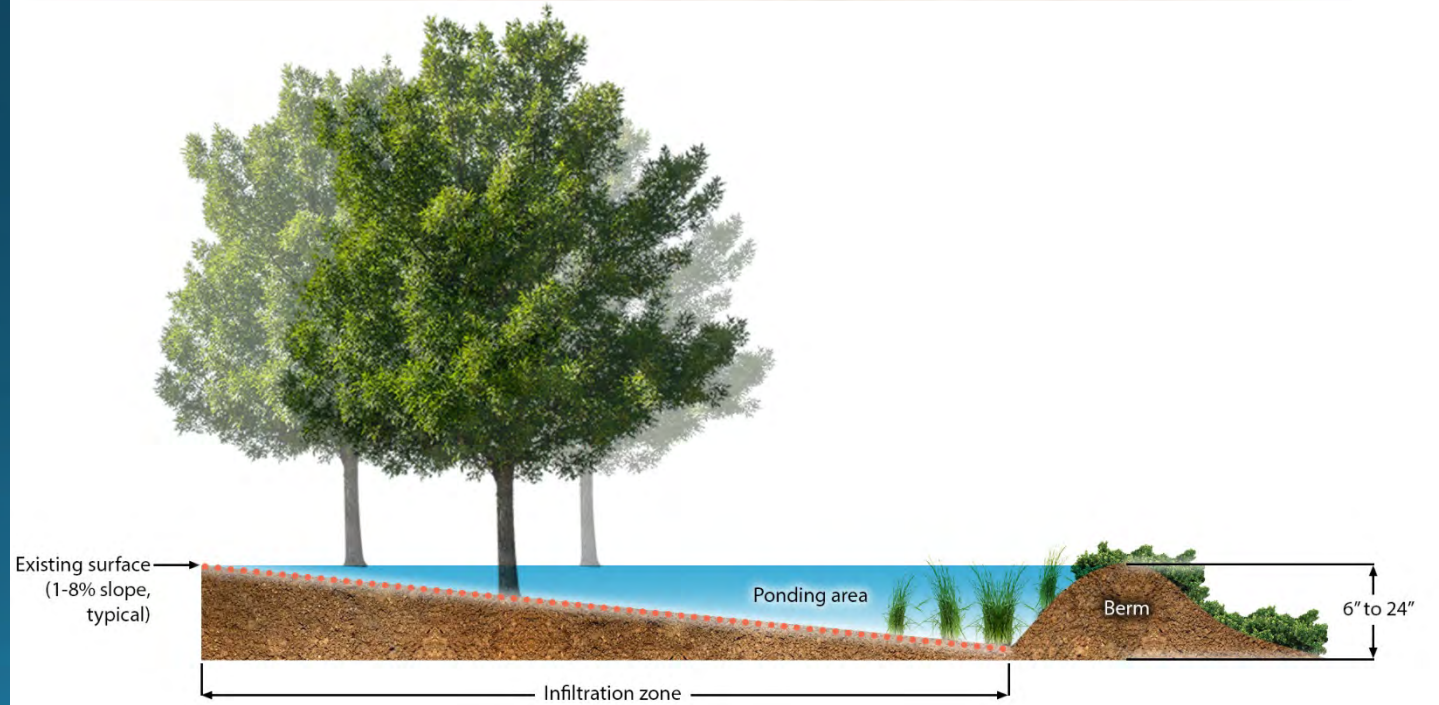
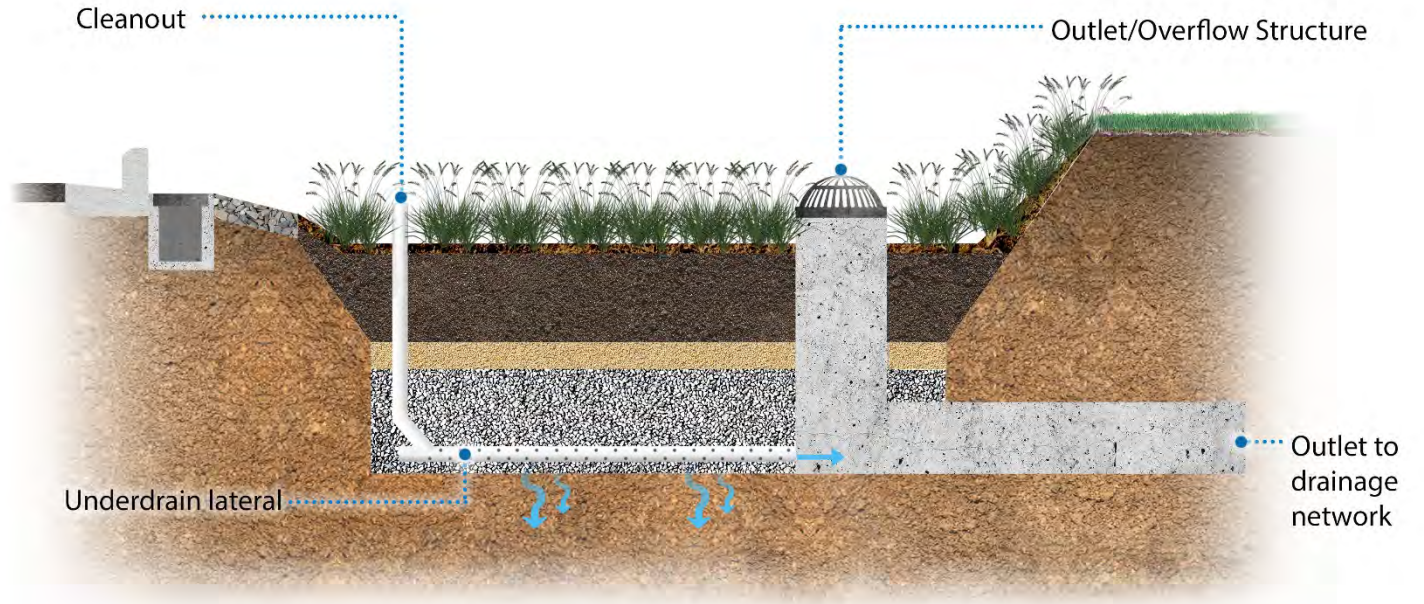
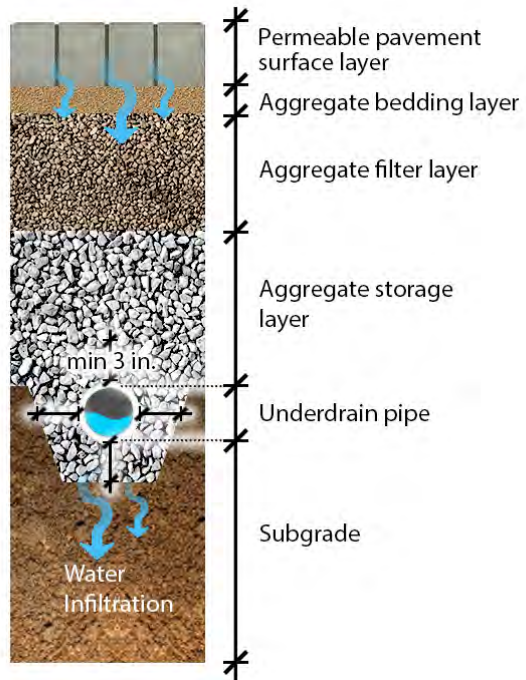
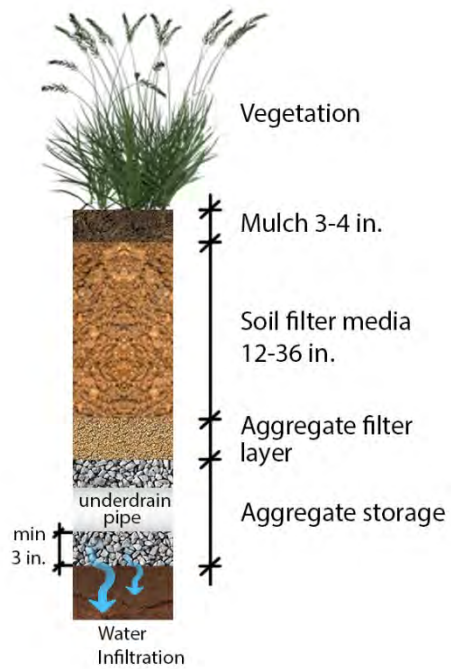
- Vegetated practice like bioretention
- Often turf grass → mow
- Objective is to spread the water out as sheet flow
- Look for concentrated flow areas (rills and gullies) correct as needed



Infiltration Basin and Trenches



Infiltration Components



Infiltration Basin O&M

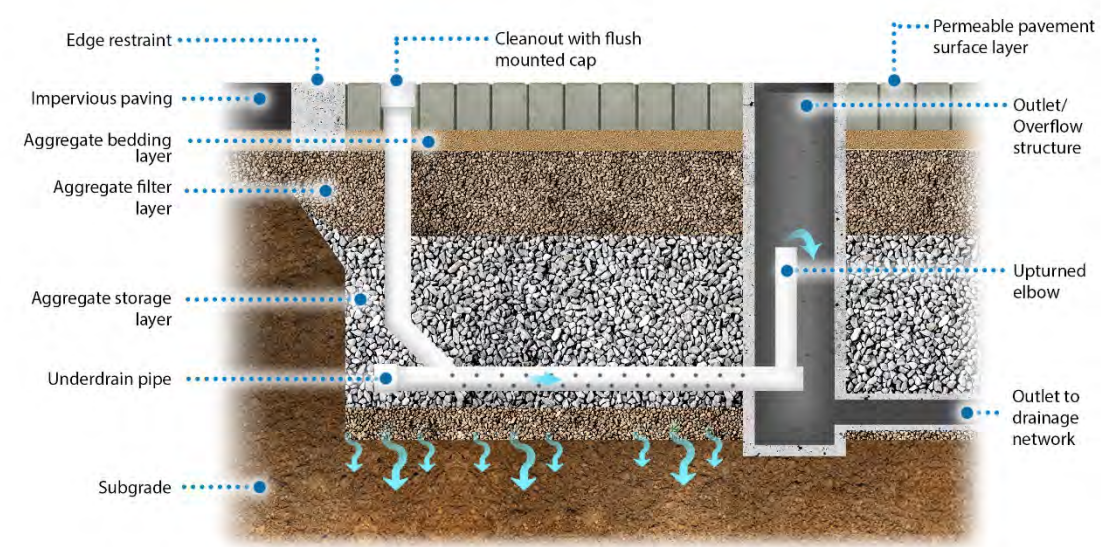
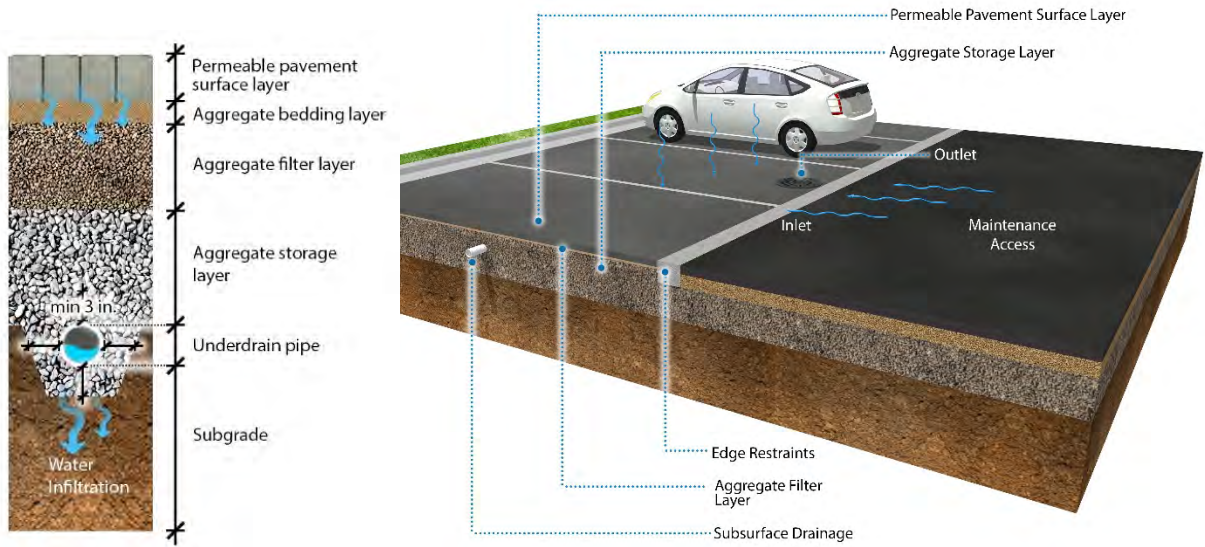
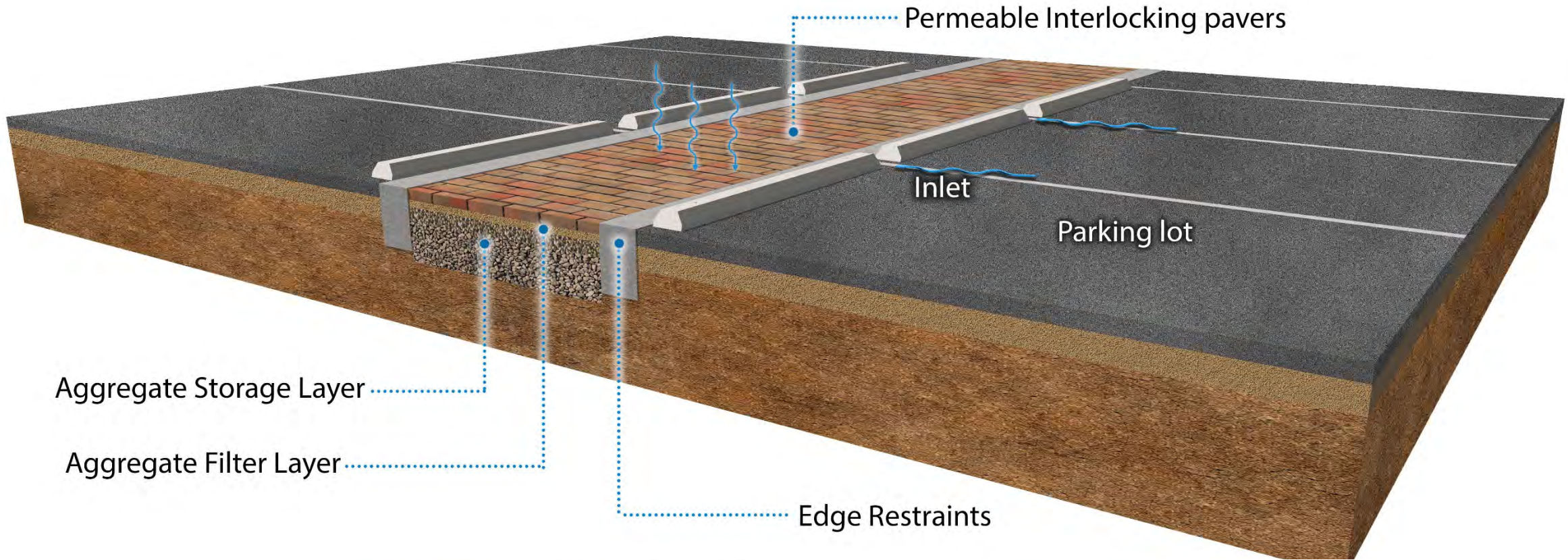
| Task | Frequency | Indicator maintenance is needed | Maintenance notes |
|---|--|---|---|
| Catchment inspection | Weekly or biweekly with routine property maintenance | Excessive sediment, trash, or debris accumulation on the surface of infiltration practice | Permanently stabilize any exposed soil and remove any accumulated sediment. Adjacent pervious areas might need to be regraded. |
| Inspect dewatering duration | After events over 1 inch | If practice does not drain within 72 hours | Monitor drawdown time after significant rain events. |
| Inspect pretreatment/forebay | 2-4 times/year | Internal erosion or excessive sediment, trash, or debris accumulation | Check for sediment accumulation to ensure that flow into the infiltration practice is as designed. Remove any accumulated sediment. |
| Remove sediment from surface of infiltration practice | As needed | Extended drawdown times; excessive sediment | Scrape bottom, remove and properly dispose of sediment; restore original cross section |
| Remove accumulated trash and debris | Quarterly | Accumulation of trash and debris in infiltration area | Trash and debris should be removed to reduce risk of clogging. Properly dispose of all trash and debris removed from site. |



Permeable Pavement



Permeable Pavement Components



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. |

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. |

Permeable Pavement Winter Considerations



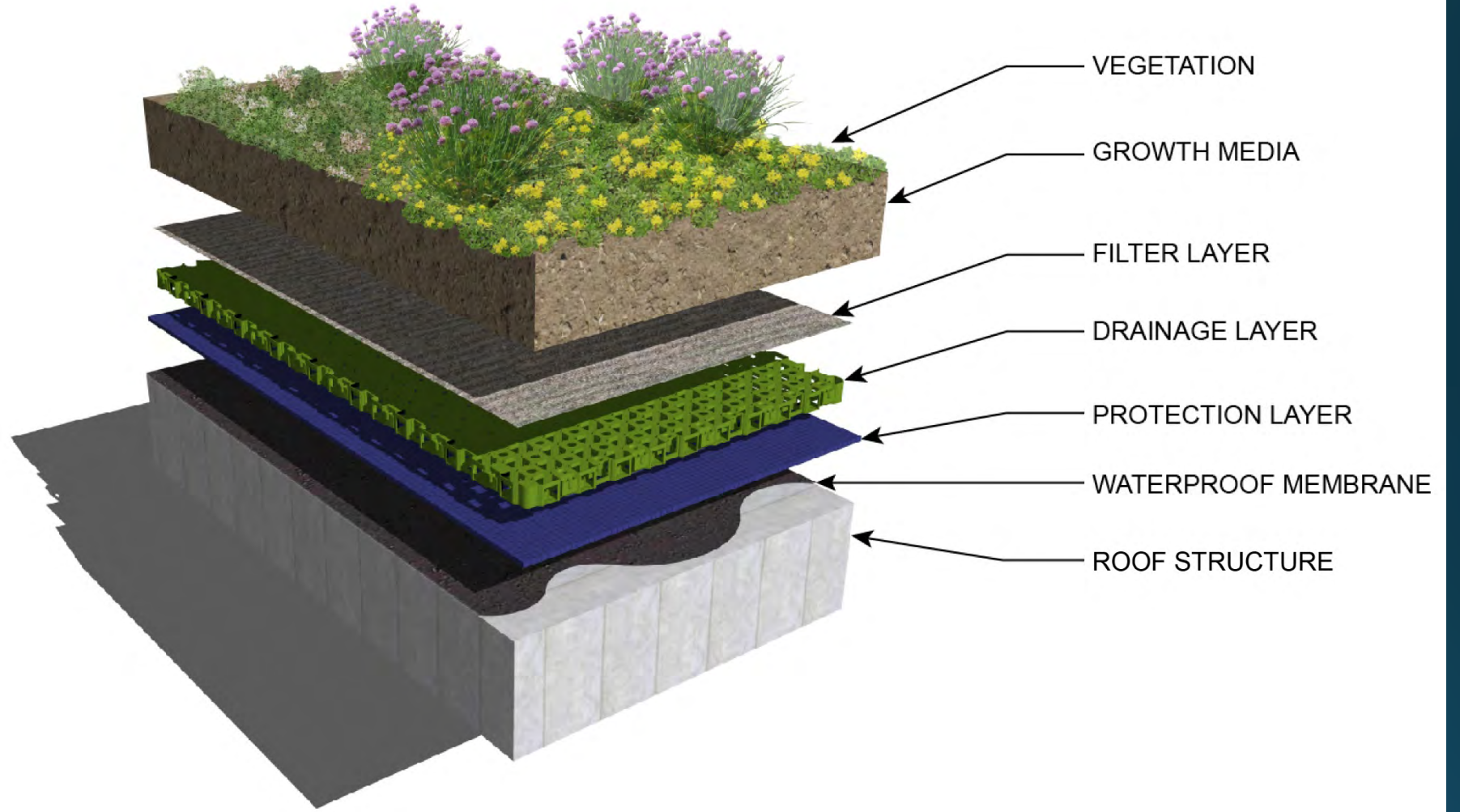
| DO: | DO NOT: |
|---|--|
| <p>Do: Plow snow carefully by either setting the blade about 1/2 inch above the pavement surface or use a rubberized blade tip.</p> | <p>Do Not: Use abrasives such as sand or cinders on permeable pavement surfaces or on adjacent surfaces. These products speed clogging of the permeable pavement surface</p> |
| <p>Do: Pile snow in adjacent grassy areas so that sediments and pollutants in the snowmelt can be partially treated before they reach the permeable pavement.</p> | <p>Do Not: 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.</p> |
| <p>Do: Follow all manufacturer recommendations for winter maintenance procedures.</p> | <p>Do Not: 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.</p> |



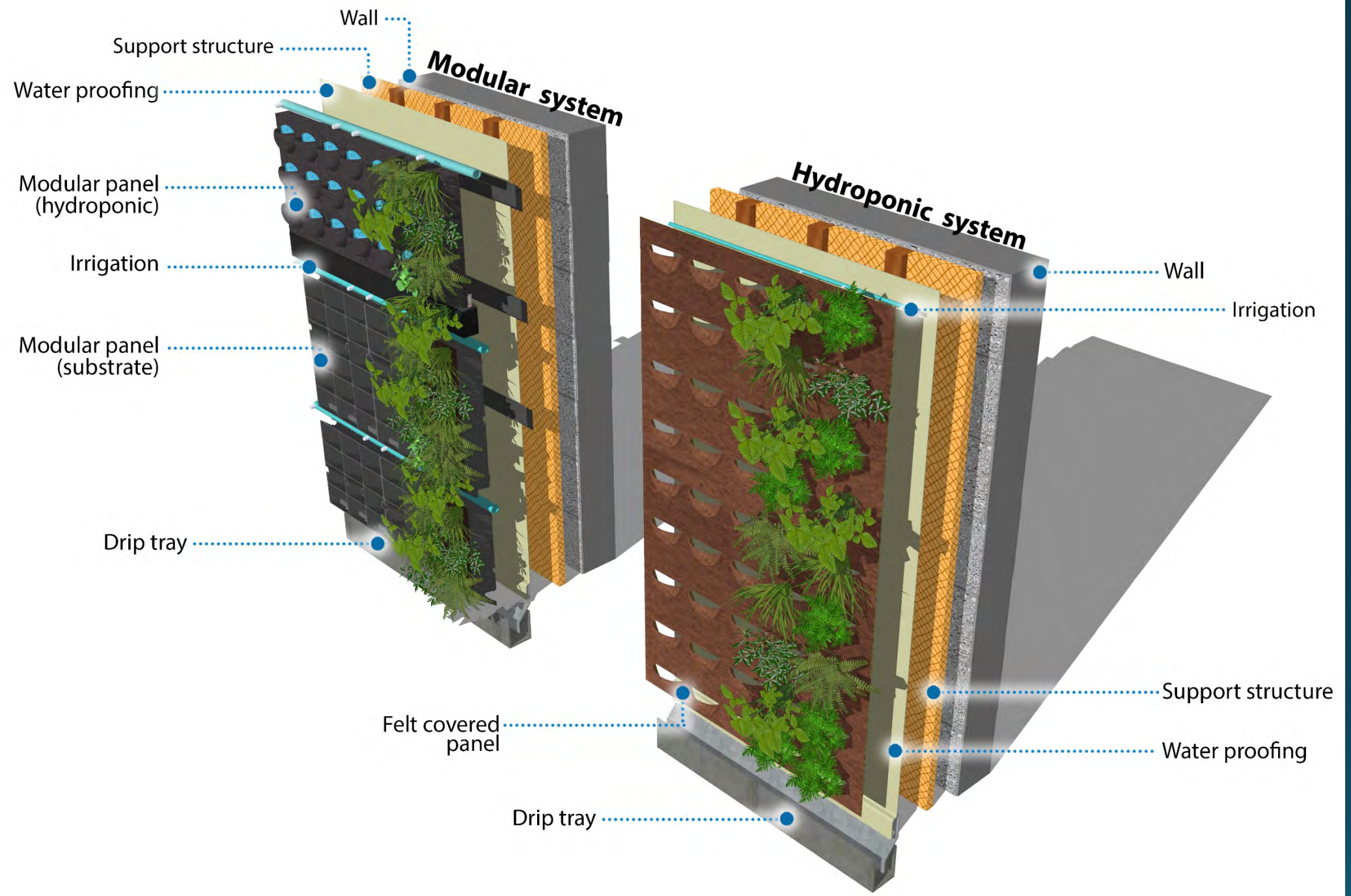
Living Roofs and Walls



Living Roofs Components



Living Walls Components



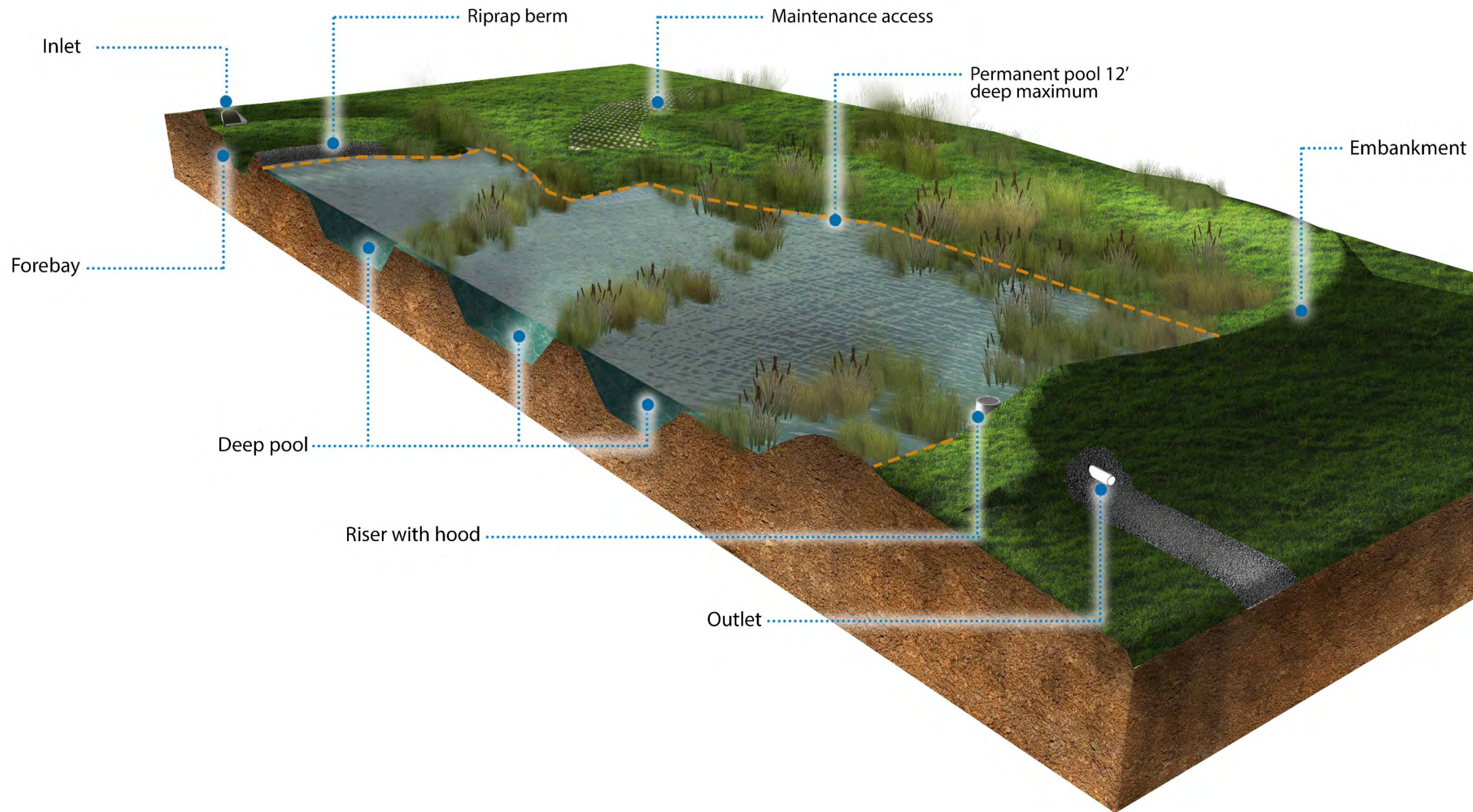
Living Roofs/Walls O&M

| 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. |



Stormwater Wetlands

Stormwater Wetlands Components



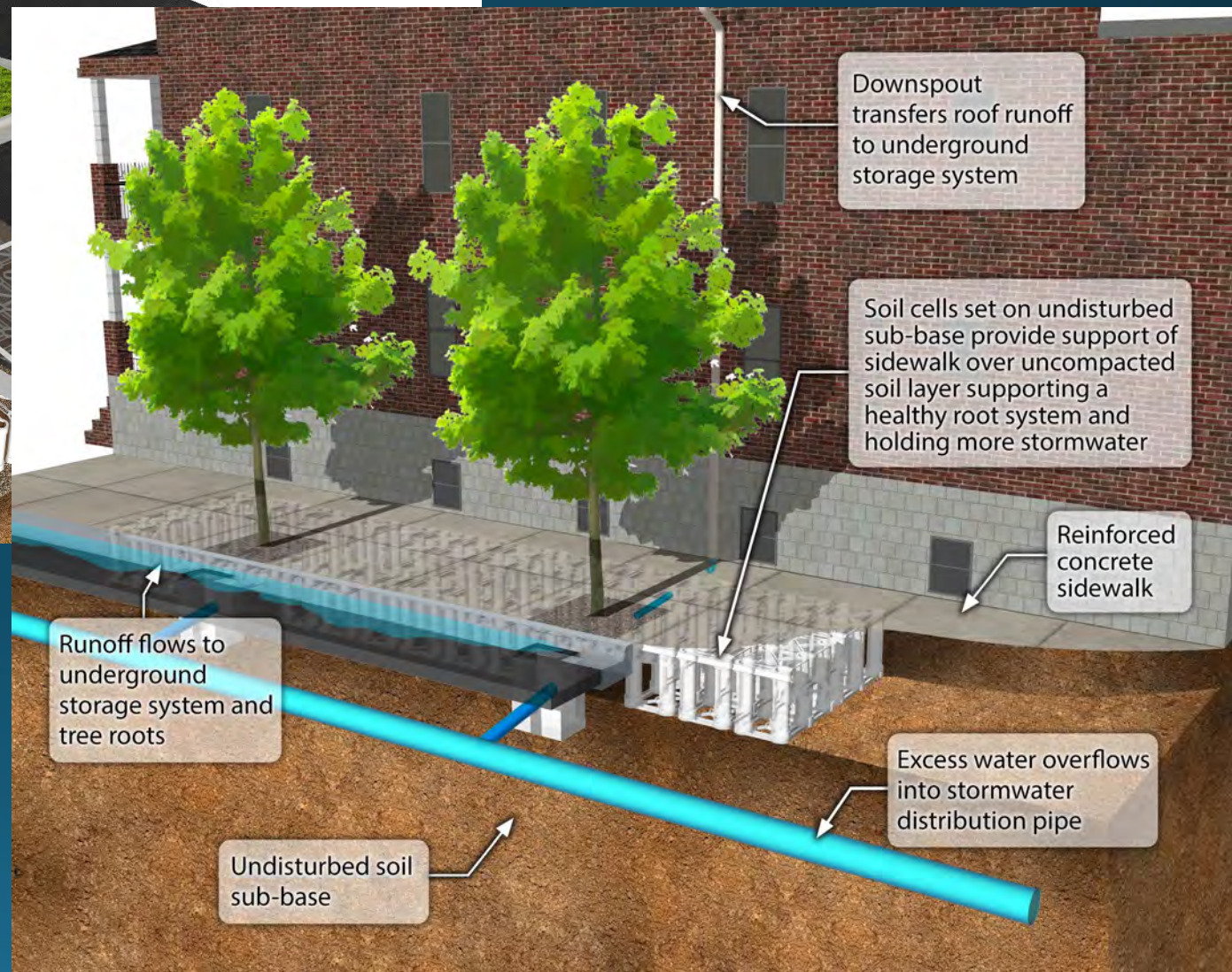
Stormwater Wetlands O&M

| Task | Frequency | Indicator 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. |
| Stormwater wetland inspection | 1 time/year | Excessive sediment, trash, and/or debris accumulation in the wetland | Remove any accumulated sediment. Adjacent pervious areas might need to be regraded. |
| Outlet inspection | 2-4 times/year | Accumulation of litter and debris in wetland area, large debris around outlet, internal erosion | Remove litter, leaves, and debris to reduce the risk of outlet clogging and to improve facility 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 | 1 time/year | Dead plants or excessive open areas in wetland | Within the first year, 10% of plants can die. Survival rates increase with time. |
| Temporary watering | 1 time/2-3 days for the first 1-2 months | Wilting plants during drought conditions | 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 wetland. Excessive mosquitos. | Maintain diverse vegetated shelf around entire wetland. Eliminate monocultures and replace with diverse, flowing vegetation. Employ qualified wildlife management professionals if needed. |
| Fertilization | 1 time initially | Soil test indicates additional fertilizer is needed | One-time spot fertilization for first year vegetation. |



Trees

Tree System Components



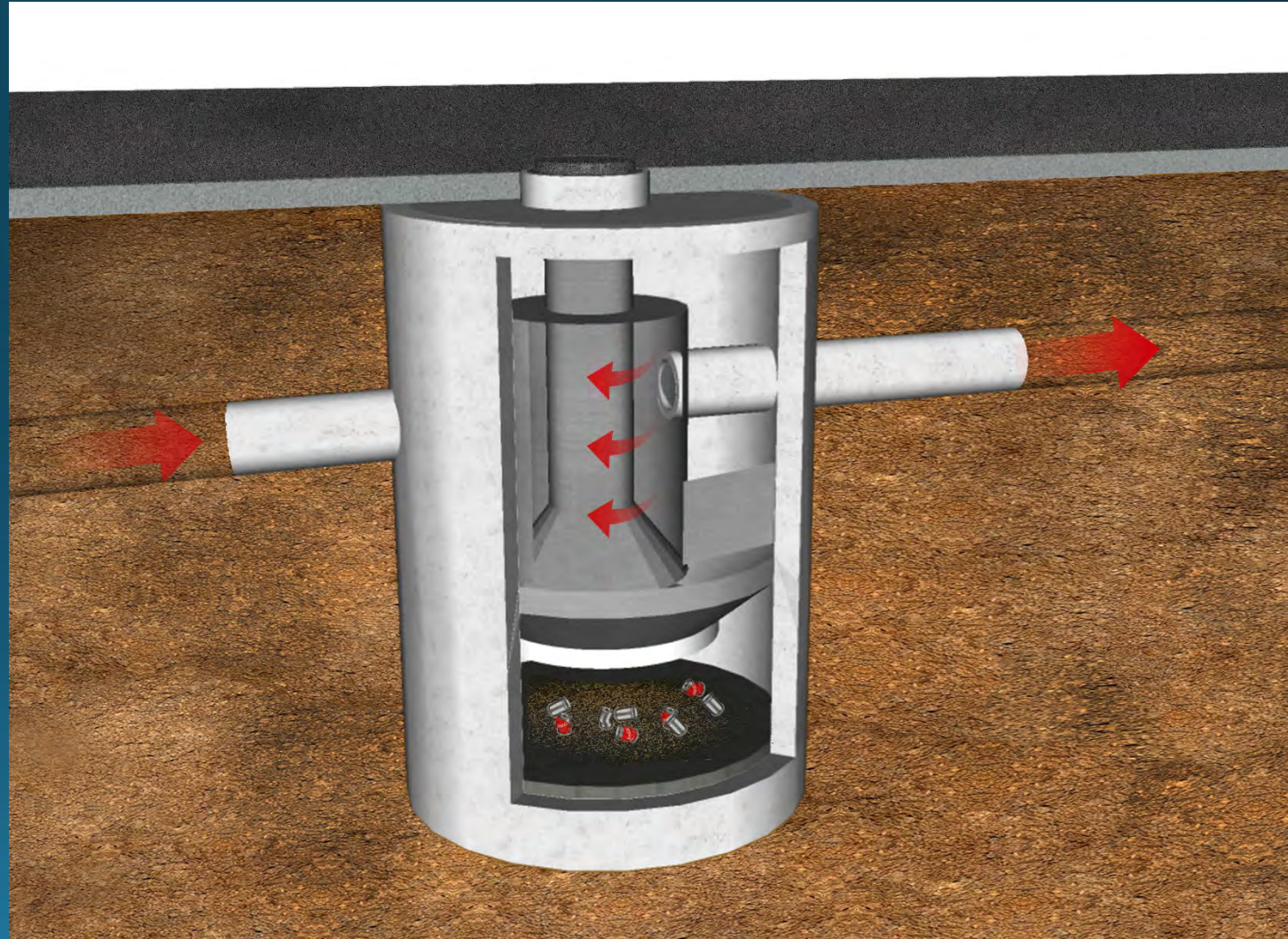
Trees O&M

| 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

Manufactured Treatment Devices

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



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)

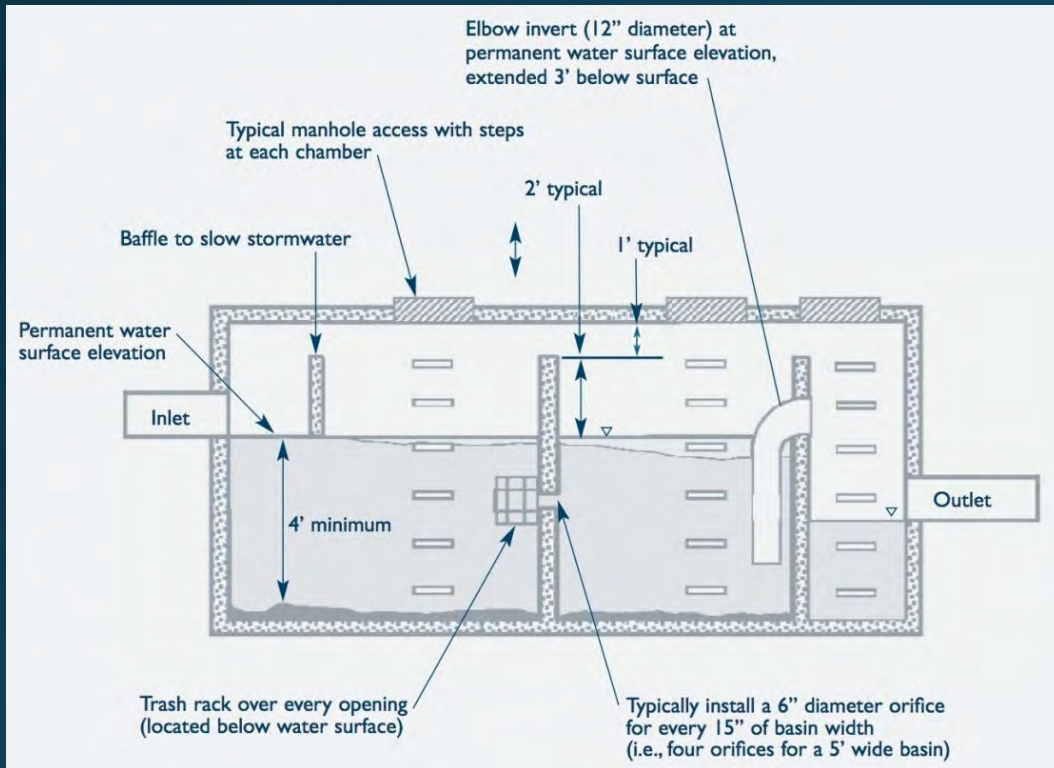
Regulated substances:

- 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)



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



Pump Stations

- Complex maintenance
- Customized O&M



Additional Information

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

POLLUTION PREVENTION/GOOD HOUSEKEEPING
FOR MUNICIPAL OPERATIONS:
MANUAL
OF
BEST MANAGEMENT PRACTICES



Genesee County Drain Commissioner
Surface Water Management

November 2010

Questions?

Thank you

Genesee County Drain Commissioner
Surface Water Management

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