LID and BMP Operation and Maintenance

Jeff Herr, P.E., D.WRE

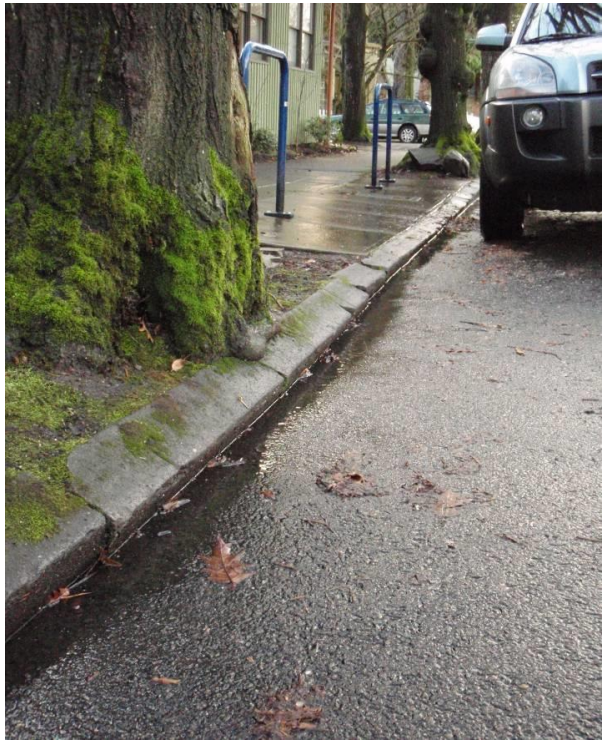
Brown AND Caldwell

Sizing and design

- Drainage and soils
- In-situ infiltration testing/recovery time – retention or filtration?
- Modeling
- Soil contamination testing
- Adjacent basements

Urban forestry

- Protecting existing trees (outside drip line) or remove during construction
- Adding new trees provides multiple benefits



Adjacent property owner concerns

- Maintaining street parking
- Truck turning areas
- Bike parking
- Attractive vegetation
- Timing of construction
- Standing water
- Basement flooding
- Benefits and costs
- Change of neighborhood character

Maintenance

- Public vs. private
- Educate landscapers and property owners
- Irrigation, trash removal, sediment removal, plant replacement
- Evaluate project area characteristics during design
- Develop plan during design
- Will monitoring be performed?

Excavation and Underdrain Installation

Excavated area for engineered soils (3-4 ft) and loosened soil to a depth 2 ft. below proposed bottom of engineered soils.

Installed 6-inch HDPE underdrain and gravel trench with 15-inch risers.

Engineered Soils and Gravel Backfill

Installed engineer soils in 1 ft lifts and watered to consolidate.

Installed gravel trenches across area to aid in runoff distribution.

Backfill Completion and Final Grading

Installed remaining engineered soils in 1 ft lifts and watered to consolidate.

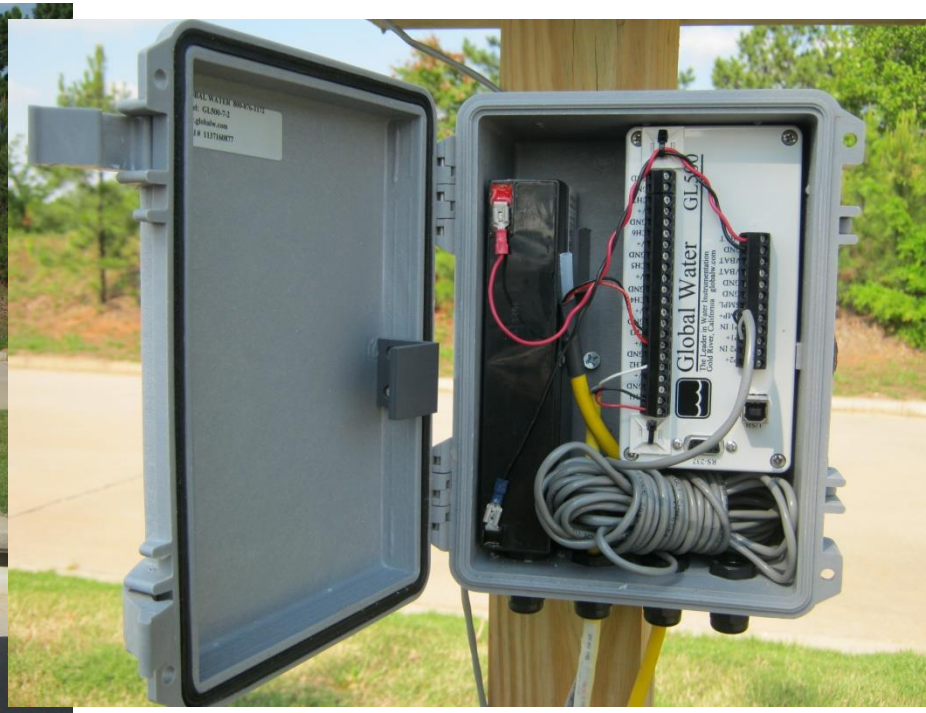
Final surface grading 3-5H:1V slopes.

Surface Treatment – cobble, *mulch, plants* and sod

Completed Project

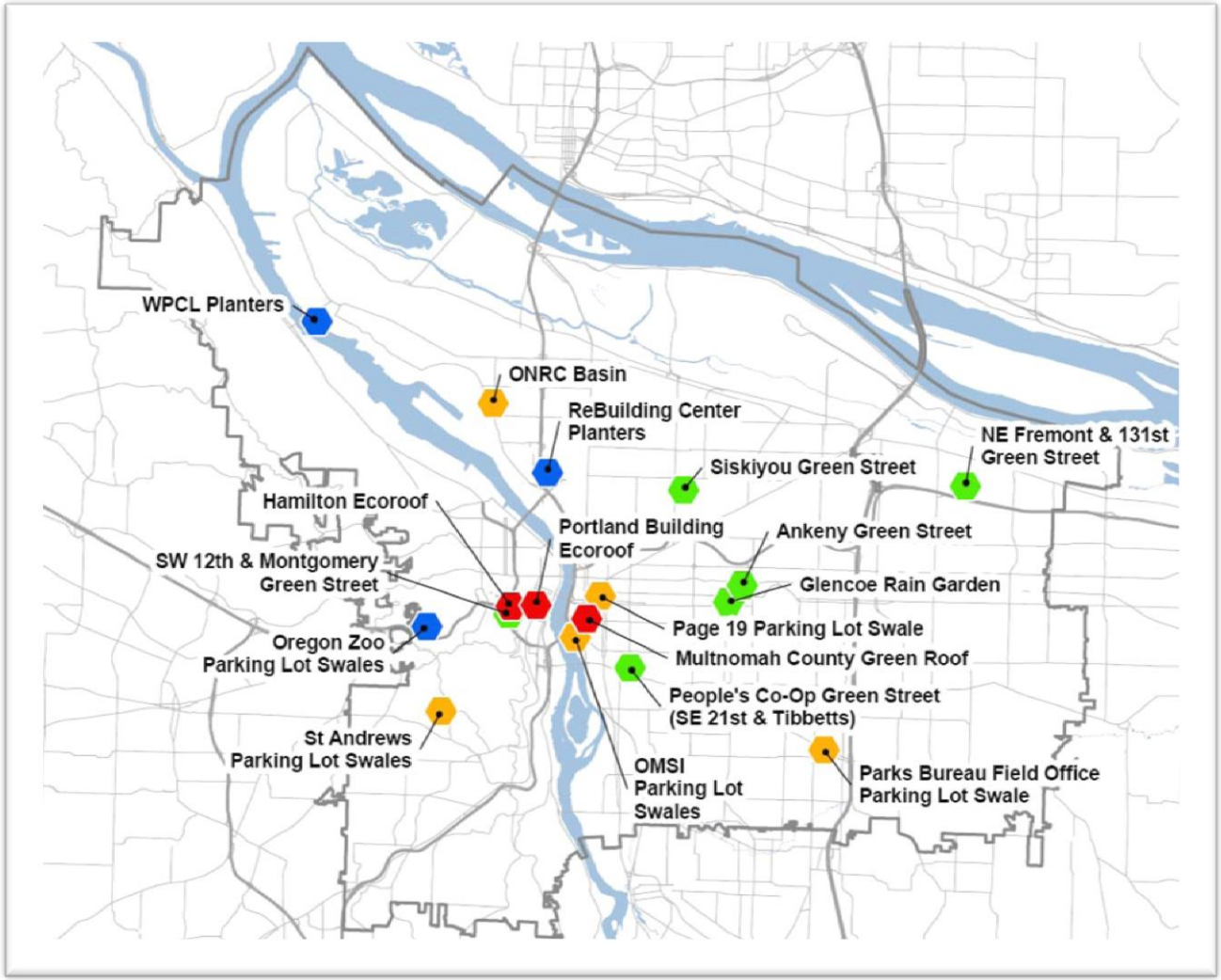
Frequent watering was initially required due to sandy soils.

Monitoring – WERF LID Study



LID Monitoring Studies in Portland

- Monitoring over 5 – 8 years.
- Monitored Facilities:
  - Ecoroofs
  - Green Streets
  - Vegetated Infiltration Basins
  - Flow-through Planters and Swales



Monitoring information and graphics per City of Portland Stormwater Management Facility Monitoring Report Summary December 2008

LID Monitoring Studies – Portland Results

Green Roofs

- Peak flow reduction 88-96%
- Volume retention variable
- Volume retention efficiency related to soil media used
- Zinc and copper removal variable

Bioretention

25-year peak flow reduction 80-100%

Volume retention > 80%

Consistent infiltration rates in soil

LID Monitoring Studies

Infiltration Basins

- Performance based on infiltration capacity
- Soil infiltration rates vary from 0.6 to 6.0 in/hr

Biodetention

25 year peak flow reduction 67-91%
Annual volume retention 21%
Volume retention efficiency related to geometry

Maximize Implementation of Non-Structural BMPs

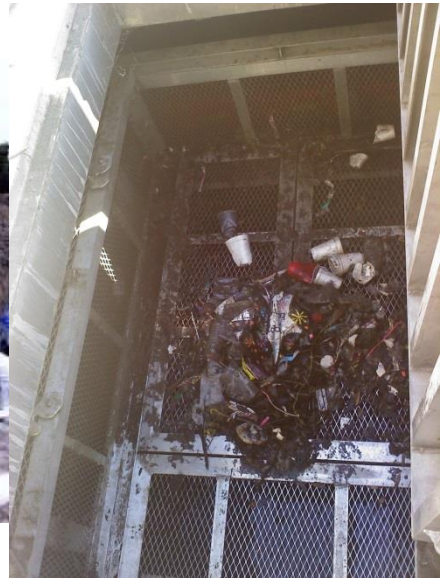
Nutrient Management
Street Sweeping
Catch Basin Cleanout
Material Storage

Typically cost effective pollutant load reduction

End of Pipe Stormwater Treatment

- Typically for gross solids and sediment removal but new medias effective for removing other pollutants
- Used extensively for removal of primary pollutants
- Minimal land required
- Relatively inexpensive
- Can be implemented relatively quickly

BC Design for CalTrans

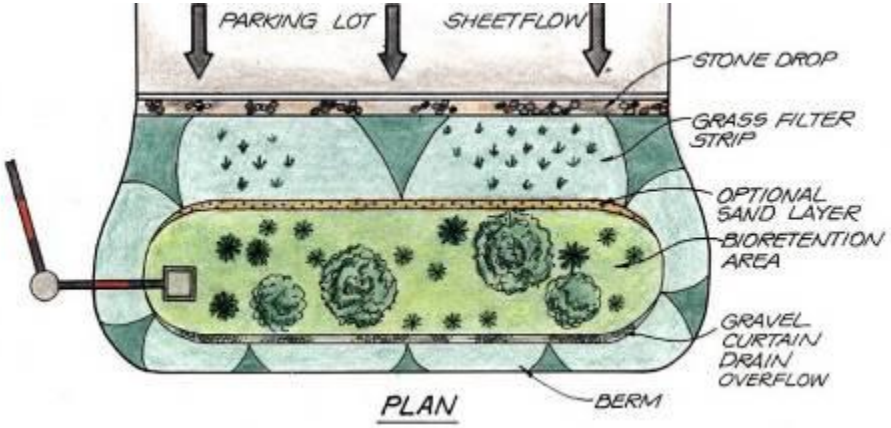


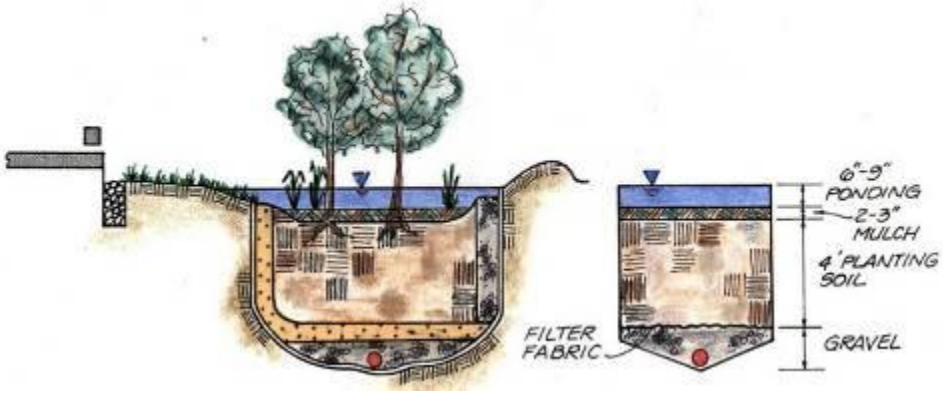
Baffle Box
CDS Unit
Vortechnics
Stormceptor
Many others

Lake Claiborne Restoration

- Removed 442,043 lbs/yr TSS/restored PPV
- Completed in 6 months
- $1.2M Construction Cost
- $3.68/lb TSS
- County average cost per pound is $10/lb TSS
- Homeowners happy
- Monitor for WQ and habitat improvements

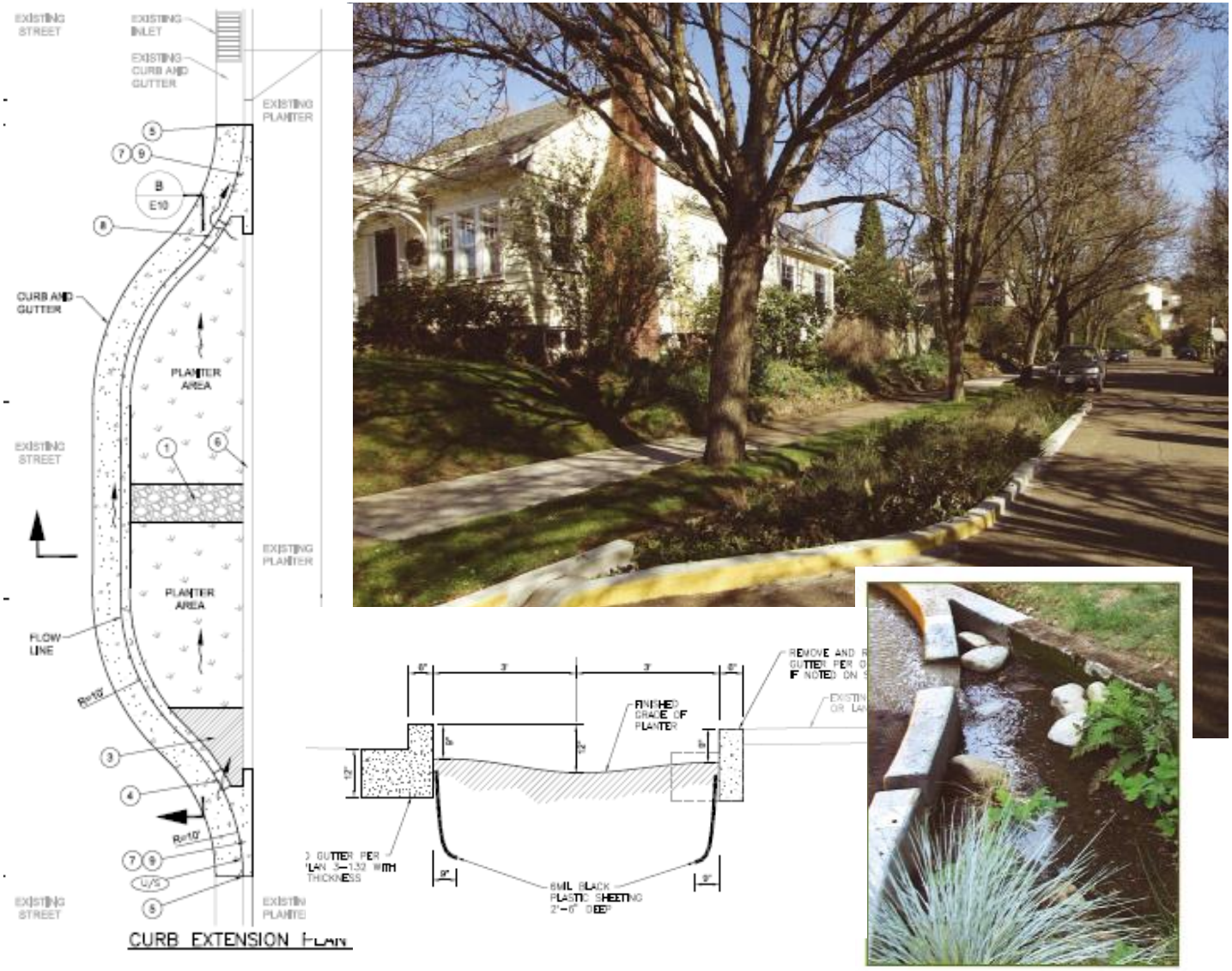
Bioretention Area (different than biofiltration)



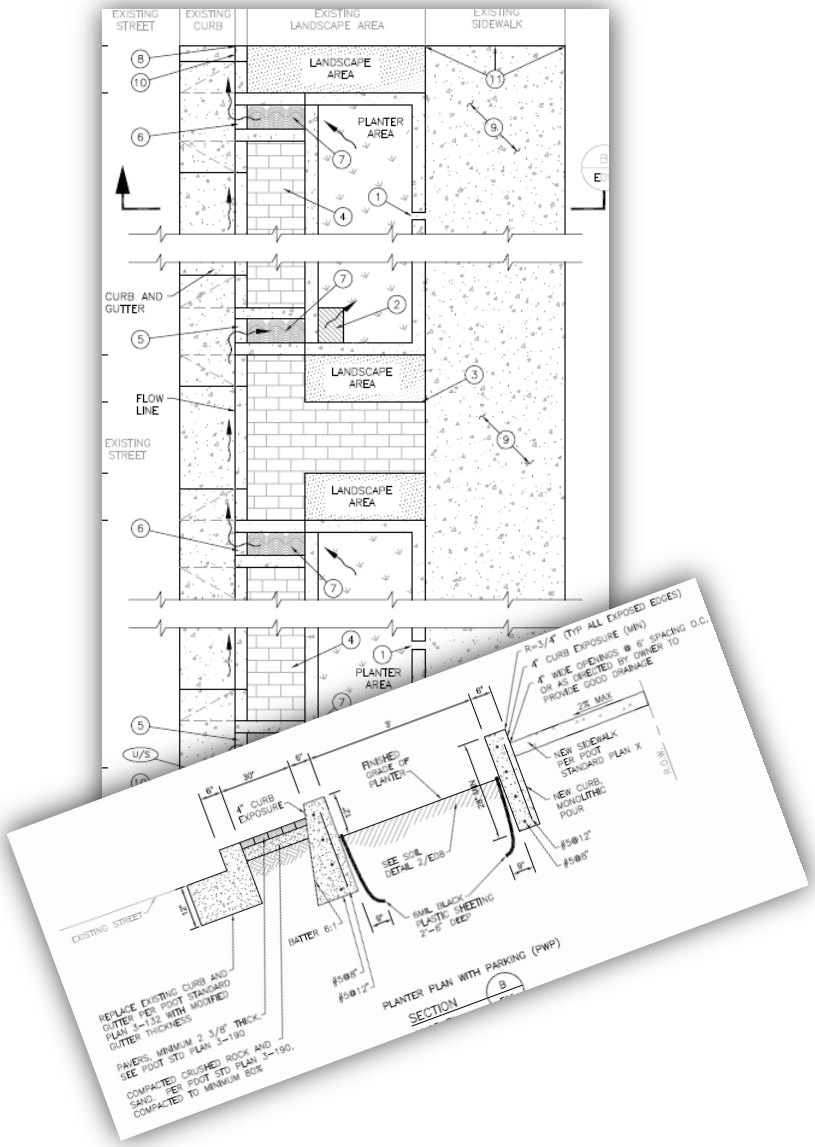


Research to improve TP and TN removal.
Aluminum precipitates for TP (4-5x).
Anaerobic zone for denitrification.

Curb Extension



Sidewalk Planter



Permeable Pavement/Pavers

Minimize run-on of stormwater and maintain vegetation on pervious contributing areas.

Largo Central Park

1200 acre watershed treated using 3 acre pond, floc pumped to SS
Construction cost = $1,000,000
Annual O&M cost = $50,000

Permeable Pavement O&M

- Pavement should be inspected to ensure it is clear of sediment and debris post-construction, annually, and after large storm events.
- Vacuum-sweep the permeable pavement surface annually.
- Dirt and sediment that is ground in repeatedly by tires can lead to clogging. Trucks or other heavy vehicles should be prevented from tracking or spilling dirt onto the pavement.
- Inspect for deterioration or spalling annually and rehabilitate the system per O&M guidelines.
- All construction or hazardous materials carriers should be prohibited from entering a permeable pavement lot.
- During winter, abrasives such as sand or cinders shall not be applied on or adjacent to the permeable pavement.
- Salt is not recommended for use as a de-icer on permeable pavement. Nontoxic, organic de-icers applied either as blended, magnesium chloride-based liquid products or as pretreated salt are preferable. De-icing materials should be used in moderation.

Traditional BMPs O&M

Management Practice	Annual Maintenance Cost (% of Construction Cost)	Maintenance Activity	Schedule
Ponds	3%-6%	Mowing of pond perimeter Cleaning and removal of debris after major storm events; (>2" rainfall) Harvesting vegetation when open water surface area <50% Repairing embankment and side slopes Repairing control structure	Mowing (as needed) Annual or as needed
		Removing accumulated sediment from forebays or sediment storage areas when 50% of the original volume has been lost	5-year cycle
		Removing accumulated sediment from main cells of pond once 50% of the original volume has been lost	20-year cycle
Dry Basins	~1%	See above	
Wetlands	~2%	See above	

Infiltration BMPs O&M

Infiltration Trench	5%-20%	Cleaning and removing debris after major storm events; (>2" rainfall) Mowing and maintaining upland vegetated areas Sediment cleanout Repairing or replacing stone aggregate Maintaining inlets and outlets	Annual or as needed
		Removing accumulated sediment from forebays or sediment storage areas when 50% of the original volume has been lost	4-year cycle
Infiltration Basin	1%-10%	Cleaning and removing debris after major storm events; (>2" rainfall) Mowing and maintaining upland vegetated areas Sediment cleanout	Mowing (as needed) Annual or as needed
		Removing accumulated sediment from forebays or sediment storage areas when 50% of the original volume has been lost	3- to 5-year cycle

Swales and Filter Strip O&M

Dry Swales, Grassed Channels, Biofilters	3%-6%	Mowing and removing litter/debris Stabilizing eroded side slopes and bottom Managing nutrient and pesticide use Dethatching swale bottom and removing thatching Discing or aerating swale bottom	Mowing (as needed) Annual or as needed
		Scraping swale bottom and removing sediment to restore original cross section and infiltration rate Seeding or sodding to restore ground cover (use proper erosion and sediment control)	5-year cycle
Filter Strips	$320/acre (maintained)	Mowing and removing litter/debris Managing nutrient and pesticide use Aerating soil on the filter strip Repairing eroded or sparse grass areas	Mowing (as needed) Annual or as needed

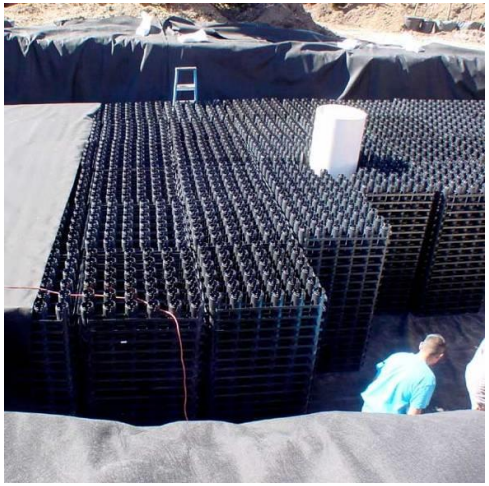
Bioretention and Permeable Pavement O&M

Bioretention	3%-6%	Removing litter/debris Removing sediment Repairing erosion areas Mulching of void areas Removing and replacing all dead and diseased vegetation Watering plant material	2-4x/yr or as needed
		Removing mulch and applying a new layer	Annual
Pervious Pavers/Pavement	$1,000/ac surface	Cleaning and removing debris after major storm events; (>2" rainfall) Vacuum/cleaning of surface Cleanout of sediment forebay	3-4x/yr or as needed
		Extensive cleaning/removal of fine sediment in openings	3- to 5-year cycle

Stormwater Reuse

Reduces runoff volume and pollutant load.

Higher concentrations of pollutants than rainwater but can be used for irrigation and gray water.



Must have sediment removal element prior to any underground storage with ability to remove sediment.

Thank you!

Brown AND Caldwell

essential ingredients®