



Soil & Plant Considerations in Bioretentions in Fairfax County, Virginia

Urban Waters National Training Workshop
EPA Headquarters, Washington DC

Department of Public Works and Environmental Services
Working for You!



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Today's Focus

- 2016 Bioretention Evaluation
- Lessons Learned in Fairfax County: Post Construction Maintenance



2016 Bioretention Evaluation

- Develop protocols to assess the structural & non-structural elements that determine the performance of a bioretention early in its lifespan
- 90 total facilities
 - Phase I – 63 facilities entered into inventory 1999-2009
 - Phase II – 27 facilities entered into inventory 2010-2014
- ❖ Take-Away: Inadequate performance mostly a construction related issue-not a maintenance problem



2016 Bioretention Evaluation

- Physical Survey
 - Ponding area - 67% less than design ponding depth
 - Soil media
 - Soil media depth - 49% missing filter media depth of 6" to 2'
 - Infiltration rate – 55% had some level of impairment
 - Media particle size distribution (sand, silt, clay)- significant variations
 - No significant correlation found between clay and sand content and infiltration rates

*Results from Phase I evaluation only



2016 Bioretention Evaluation

- Good News!
 - Developed 3rd party inspection checklists
 - Agreement to perform evaluations on new bioretentions each year as they enter inventory
 - Recent evaluations show **improvement in constructability** over earlier bioretentions

3rd Party Construction Inspection Checklist and Certification: Bioretention DEQ Spec. No. 9 & PFM 6-1307

Project Name: _____ Construction Firm: _____
 Co. Plan Number: _____ 3rd Party Inspection Firm: _____
 Site Address: _____ 3rd Party Inspector's Name: _____
 Latitude / Longitude: _____ 'N _____ 'W Contact Info / Phone Number: _____
 BMP ID Number as shown on plan and general location on the site: _____

- A certification is required for all SWM/BMP facilities under PFM 6-1300 et. seq.
- A Virginia licensed professional engineer or licensed professional meeting the exemption requirements of the Code of Virginia §54.1-401 must sign the certification at the end of this checklist.

Instructions:

- Check each item as complete, or write in "N/A" for those items that are not applicable.
- Fill in blanks for requested information on dimensions, materials, etc.
- Provide one or more photos for applicable items; checkboxes indicate items that require photos.

Pre-Installation Meeting and Site Preparation

CHECK	PHOTO	DESCRIPTION	DATE OF INSPECTION / COMMENTS
<input type="checkbox"/>		Pre-Installation Meeting with - contractor designated to install the facility - 3rd party inspector (or designee) A review of checklist and tentative schedule for interim inspections and sign-offs has been discussed	
<input type="checkbox"/>		Bioretention area has not been impacted during construction, or has been remediated prior to installation. Circle one: Not Impacted Remediated	
<input type="checkbox"/>		Impervious cover draining to the BMP have been constructed and area is free of equipment, vehicles and material storage	
<input type="checkbox"/>		Pervious areas of contributing drainage area have been stabilized with adequate vegetation.	
<input type="checkbox"/>	<input type="checkbox"/>	Stormwater diverted around the bioretention area and perimeter E&S controls to protect the BMP during construction have been installed.	
<input type="checkbox"/>		Drainage area slopes toward the bioretention facility.	

Excavation

CHECK	PHOTO	DESCRIPTION	DATE OF INSPECTION / COMMENTS
<input type="checkbox"/>		Size & horizontal location conforms to approved plans. Area of Excavation _____	
<input type="checkbox"/>		If the area has previously been used as sediment trap verify that the bottom of the proposed stone reservoir is lower than the bottom elevation of the existing trap.	
<input type="checkbox"/>		Level 2 bioretention: Excavation bottom was scarified prior to placement of stone.	
<input type="checkbox"/>	<input type="checkbox"/>	Subgrade surface free of rocks, roots, and large voids. (Voids may be refilled with base aggregate to create a level surface for the placement of aggregates and underdrain.)	
<input type="checkbox"/>		No groundwater seepage or standing water is present. Any standing water is dewatered to an acceptable dewatering device, and the design consultant has been notified.	



2016 Bioretention Evaluation

- Plant Survey
 - Survival rate of original plantings
 - Plant species that survived best
 - Dominant voluntary plants
- Weeds- Are they Bad?
 - Provide cover, protect from erosion
 - Nutrient uptake

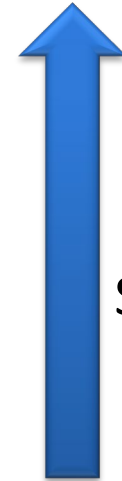
*Results from Phase I evaluation only




2016 Bioretention Evaluation – Shrub Performance

Common Name	Botanical Name	# of BRs Plant located in	Total # Installed	Survival Rate
Red paniced dogwood	Cornus racemosa	1	8	100%
Serviceberry	Amelanchier arborea	8	20	85%
Sweetbay magnolia	Magnolia virginiana	6	10	70%
Ninebark	Physocarpus opulifolius	1	12	67%
Highbush blueberry	Vaccinium corymbosum	1	12	50%
Witch hazel	Hamamelis virginiana	5	38	47%
Southern arrowwood	Viburnum dentatum	4	79	38%
Winterberry	Ilex verticillata	5	47	30%
Brilliant red chokeberry	Aronia arbutifolia	3	20	25%
Red osier dogwood	Cornus sericea	8	82	20%
Inkberry	Ilex glabra	15	130	18%
Sweet pepperbush	Clethra alnifolia	5	42	14%
Brookside alder	Alnus serrulata	1	8	0%
American beautyberry	Callicarpa americana	1	6	0%
New Jersey tea	Ceanotus Americanus	2	18	0%
Sugar hackberry	Celtis laevigata	1	2	0%
Buttonbush	Cephalanthus occidentalis	2	12	0%
Silky dogwood	Cornus amonmum	1	5	0%
Black huckleberry	Gaylussacia baccata	2	12	0%
Wild hydrangea	Hydrangea arbores	2	12	0%

Highest
%
Survival



Lowest
%
Survival



2016 Bioretention Evaluation – Frequently Found Perennials

Common Name	Botanical Name	# of BRs
Beebalm (unknown specific)	Monarda	7
Partridge Pea	Chamaecrista fasciculata	7
Black eyed susan	Rudbeckia hirta	6
Virginia creeper	Parthenocissus quinquefolia	5
Iris	Iris Versicolor	4
Bluejoint	Andropogon garardi	3
Butterflyweed	Asclepias tuberosa	3
Common Milkweed	Asclepias syriaca	3
Indiangrass	Sorghastrum nutans	3
Ox eye sunflower	Heliopsis helianthoides	3
Pickereel Weed	Pontederia cordata	3

- Inconsistencies between field survey and original plans
- Hard to differentiate between seed mixes and plugs



2016 Bioretention Evaluation – Frequent Weeds

Common Name	Scientific Name	Invasive or Native		# of BRs
Smartweed	Polygonum hydropiperoides	Non-native*		29
Common Ragweed	Ambrosia artemisiifolia		Native	24
Horsenettle	Solanum carolinense		Native	20
Buckhorn Plantain	Plantago lanceolata	Non-native		18
Horseweed	Conyza canadensis		Native	18
Creeping Oxalis	Oxalis corniculata		Native	17
Dandelion	Taraxacum officinale	Non-native*		17
false nutsedge	Cyperus strigosus		Native	15
3-seeded mercury	Acalypha rhomboidea		Native	15
Wild Morning Glory	Calystegia sepium	Non-native*		15
Northern Crabgrass	Digitaria ischaemum	Non-native		14
Common Pokeweed	Phytolacca americana		Native	13
Common Vetch	Vicia sativa	Non-native		13
Oriental ladies thumb	Persicaria longisetia	Non-native		13
Dogbane	Apocynum		Native	11
Prickly Lettuce	Lactuca serriola	Non-native		11
Chinese Lespedeza	Lespedeza Cuneata	Non-native		10
Porcelainberry	Ampelopsis brevipedunculata	Non-native		10
Virginia Pepperweed	Lepidium virginicum		Native	10

Weeds considered prolific and listed if estimated 40 plants or more were at a site.

*Found in disturbed areas tend to be the non-native spp. varieties.



2016 Bioretention Evaluation – Frequent Weeds

Common Name	Botanical Name	Invasive or Native		# of BRs
Yellow foxtail	Setaria pumila	Non-native		9
Japanese Stiltgrass	Microstegium vimineum	Non-native		8
Paper Mulberry	Broussonetia papyrifera	Non-native		8
Red Clover	Trifolium pratense	Non-native		8
Barnyard Grass	Echinochloa	Non-native		7
Common Plantain	Plantago major	Non-native		7
Dock	Rumex	Non-native		7
White Heather Aster	Symphyotrichum ericoides		Native	7
Lambs Quarters	Chenopodium album	Non-native*		6
Blackberry Vine	Rubus L.	Non-native*		6
Common Blue Violet	Viola papilionacea		Native	5
Fireweed	Erechtites hieracifolia		Native	5
Queen Anne's lace	Daucus carota	Non-native		5
Spotted Spurge	Euphorbia maculata		Native	5
White Clover	Trifolium repens	Non-native		5
Rice flat sedge	Cyperus iria	Non-native		4
Trailing Bush Clover	Lespedeza procumbens		Native	4
Indian Grass	Sorghastrum nutans		Native	3
Jimson weed	Datura stramonium	Non-native		3
Johnson grass	Sorghum halepense	Non-native		3

Weeds considered prolific and listed if estimated 40 plants or more were at a site.

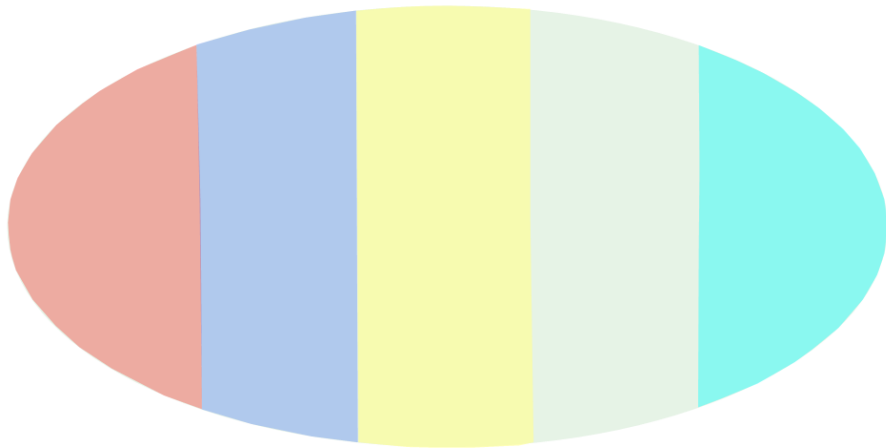
*Found in disturbed areas tend to be the non-native spp. varieties.



Lessons Learned: Post-construction Maintenance

Levels of Service

- Simplify planting palettes



-  Rudbeckia Fulgida var. Fulgida Black-Eyed Susan
-  Asclepias Tuberosa Butterfly Milkweed
-  Juncus Effusus Soft Rush
-  Iris Versicolor Blue Flag
-  Asclepias Incarnata Swamp Milkweed



Lessons Learned: Post-construction Maintenance

Levels of Service

- Consequences of simplified planting plan
- What is the alternative?
- Reseeding?
- Limited interplanting?



Lessons Learned: Post-construction Maintenance

Cost & Efficiency

- Partially determines Level of Service
 - FY17 Annual **average** cost/facility = \$1600 (4x/year)
 - \$270K – BRs only
 - FY18 – 5x/yr
- What is the value of the optics?
- Only get credit for function



Lessons Learned: Post-construction Maintenance

Cost & Efficiency

- From neighborhood resident, “We hope that the current condition may be maintained and that there will now be consistent and periodic grass cutting, including more when needed this year before winter, in order to avoid the wildlife look that we have now, fortunately, lost. Thanks for your efforts. **The Park now looks as good as the asphalt.**”



Additional Information

For additional information, please contact

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