Maintaining Stormwater Systems

A Guidebook for Private Owners and Operators in Northern Virginia

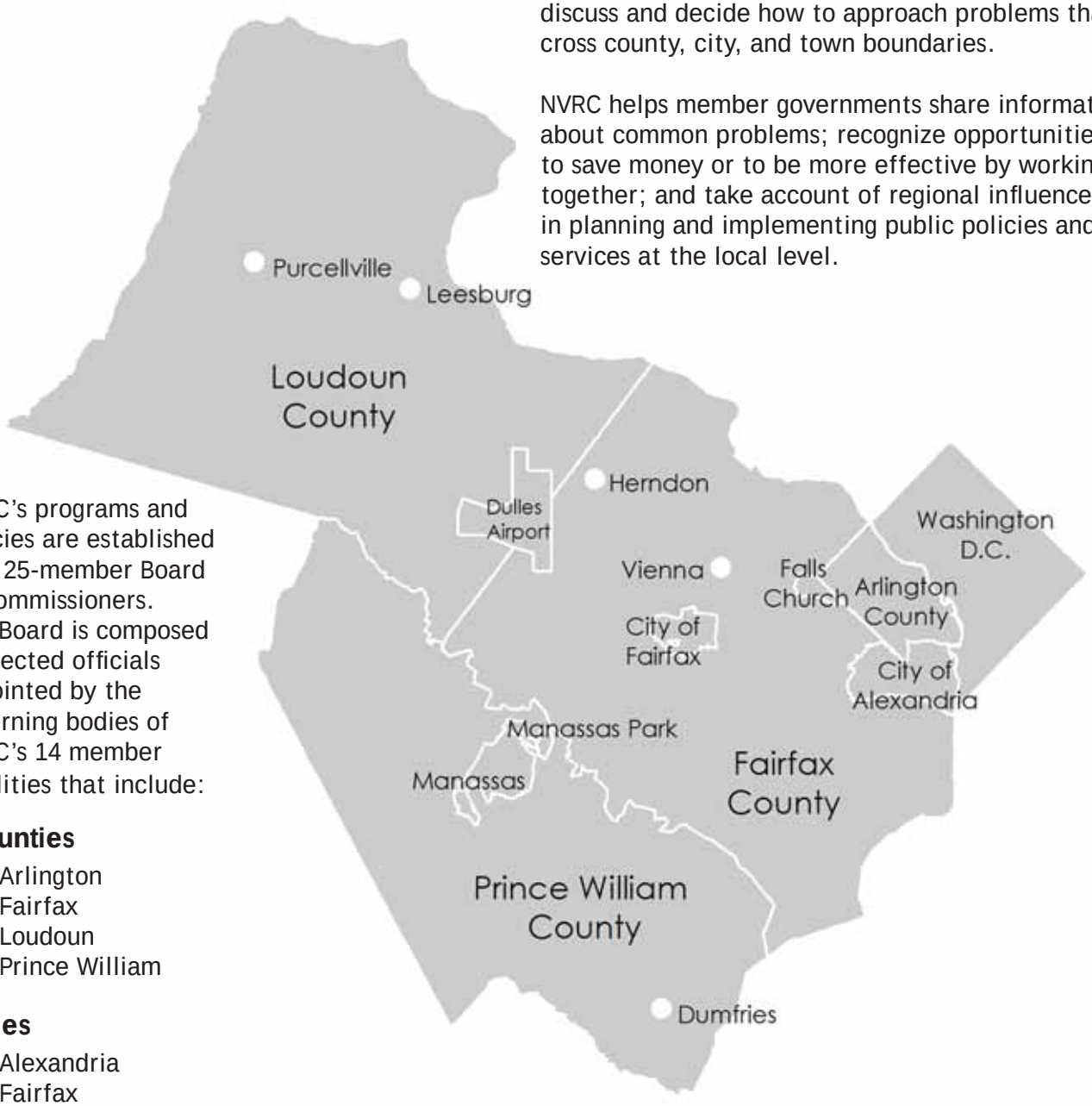
Northern Virginia Regional Commission

JANUARY 2007

The Northern Virginia Regional Commission (NVRC) is a regional council of local governments in Northern Virginia.

NVRC serves as a neutral forum where representatives of the member governments can discuss and decide how to approach problems that cross county, city, and town boundaries.

NVRC helps member governments share information about common problems; recognize opportunities to save money or to be more effective by working together; and take account of regional influences in planning and implementing public policies and services at the local level.



NVRC's programs and policies are established by a 25-member Board of Commissioners. The Board is composed of elected officials appointed by the governing bodies of NVRC's 14 member localities that include:

Counties

- Arlington
- Fairfax
- Loudoun
- Prince William

Cities

- Alexandria
- Fairfax
- Falls Church
- Manassas
- Manassas Park

Towns

- Dumfries
- Herndon
- Leesburg
- Purcellville
- Vienna

THIS GUIDEBOOK IS *a resource on maintaining stormwater management facilities. However, it is not a set of rules and regulations or a manual that provides guidance on how to design or build a stormwater management facility.*

For specific information regarding regulations, contact your local government agency.

Contents

The Stormwater Story

While Webster's New Millennium Dictionary describes stormwater as "an abnormal amount of surface water due to a heavy rain or snowstorm," stormwater can be a valuable resource if properly managed.

Rainfall and snow melt keep gardens green, streams and rivers full, and wells from running dry. However, stormwater problems can occur when there is too much of a good thing, or when excessive pollution and changes in land use prevent natural infiltration and filtering processes from taking place.

Stormwater Challenges

Once rain reaches the ground, what happens next depends largely on land cover type. Rain falling in a forest is slowed, filtered, and absorbed as it makes its way into the ground or to the nearest stream, river, or reservoir. In contrast, hard, impervious surfaces such as roof tops and roads send stormwater rushing to the nearest ditch, culvert, storm drain, and stream.

This stormwater picks up pollutants, such as heavy metals, gas, oil, nutrients, and sediment, along the way. Uncontrolled stormwater erodes stream banks, causes flooding, and carries nutrients and sediment downstream. An excess of nutrients contributes to the expansion of oxygen-depleted "dead zones" in local waterways, the Potomac River, and the Chesapeake Bay.

Stormwater Solutions

To improve the quality and reduce the quantity of stormwater runoff, before it enters natural waterways, stormwater **Best Management Practices**, or **BMPs**, are prevalent throughout Northern Virginia's residential and commercial areas.

BMPs range from structural facilities, such as ponds, bioretention areas, and underground vaults to non-structural practices, such as street-sweeping and educational efforts.

Simple Things Residents Can Do

There are several simple things residents can do to ensure stormwater facilities function properly and the downstream aquatic environment is protected.

- Pick up after pets, always. Place their waste in the trash or flush it down the toilet.
- Place motor oil, paint and antifreeze in separate sturdy containers and recycle them at a local disposal facility.
  Never pour them down the storm drain.
- Compost yard waste or bag it for municipal collection.
- Recycle or put litter in the trash.
- Fertilize in the fall, if at all, to reduce algal blooms.
- Call 9-1-1 if there is a visible oil spill or other liquid spill into a waterway.

The Stormwater Story

Over time, the approaches to managing stormwater have adapted to a variety of different challenges. The techniques used to control stormwater evolved from ditches and pipes that remove water quickly and reduce flooding to an intricate system of practices that retain water and improve its quality.

Short History of Stormwater "Solutions"

Pre-1900s - *Run It All in Ditches*
Everything (stormwater, kitchen waste, wastewater) drained to the nearest stream.

Early-1900s - *Run It All in Pipes*
All waste efficiently got to the stream through the same pipe. But, downstream neighbors became ill due to upstream-generated waste. It was then recognized that sewage and stormwater require different levels of water quality treatment.

From 1940s - *Run It in Separate Stormwater Pipes*
A system of catch basins and pipes was developed to get stormwater to the nearest stream.

Early-1970s - *Keep It From Stormwater Pipes*
Stormwater was detained in ponds. This approach worked in theory but not in practice, as too many detention ponds releasing water at a controlled rate at the same time caused downstream flooding and an increase in the frequency and duration of runoff events.

1970-80s - *Well, Just Don't Cause Flooding*
Stormwater Master Plans were developed. However, very few plans were actually completed as designed, and stormwater runoff was identified as a major pollution source.

Late-1980s - *Oh, and Don't Pollute Either*
Best Management Practices or ways to improve the quality of stormwater runoff were implemented. However, the lack of good data on **BMP** efficiency or comprehensive monitoring programs were problematic.

Early-1990s - *It's the Ecology*
Use of biological criteria and bioassessment protocols became a common parameter for determining the type of stormwater management practice. But there were still questions about which parameters actually contribute to solutions to runoff problems.

Late-1990s - *Water is Water is Watershed*
Planning was conducted according to where the water flows, a watershed approach. However, people didn't relate to watersheds, and the watershed approach may be too large in scale to have an impact at the site level or to be meaningful to residents, which is where political change begins.

Present - *Green and Bear It*
A range of approaches is considered to address basic issues and institutional practices associated with the way in which land is used or developed: green infrastructure, conservation development, low impact development (LID), better site design, etc. This paradigm returns to small-scale distributed approaches that will succeed if supported and enforced by local governments.

Adapted from Land and Water, May-June 2004, Andy Reese of Amec Earth and Environmental

Future - *A Vision of Comprehensive Stormwater Management*
Mimicking pre-development runoff characteristics will become increasingly important as regulations continue to encourage using watershed planning for expanded nutrient control and streambank preservation. Monitoring the effectiveness of green technologies at improving the quality and decreasing the quantity of stormwater runoff leads to improved designs and performance criteria. Stormwater is viewed as a resource as opposed to a waste product.

Key Points to Remember When Reading this Guidebook

A thorough inspection and maintenance program for any stormwater management facility will save time and money in the long term.

Identify Facility Characteristics and Maintenance Needs	Understand how the facility works and its specific maintenance needs. While this Guidebook includes general information on the maintenance needs of common stormwater management facilities, valuable information may also be gained by consulting with the local government.
Check the Maintenance Agreement	If there is a stormwater management facility maintenance agreement with the local government, consult it often to ensure that specific obligations are met.
Perform Routine Inspections	The frequency of required inspections may be found in the maintenance agreement, the technical guide provided by the manufacturer, or on the facility's design specifications. In some local jurisdictions, all inspections are conducted by staff, while maintenance is typically the responsibility of the owner.
Define Maintenance Tasks, Personnel, and Equipment	Defining maintenance tasks and who will undertake these tasks - along with establishing a regular inspection program - is the core of a successful stormwater management facility maintenance program.
Identify Costs and Allocate Resources	While routine maintenance costs can typically be predicted for an annual budget, some maintenance tasks will require infrequent but considerable expense. Non-routine expenses need to be identified, and a long-term fund allocation plan needs to be developed.
Involve the Community, if possible	Pollution treated by the stormwater management facility may be generated from surrounding yards, streets, and businesses. Implementing a pollution prevention program and educating neighbors on the purpose of the stormwater management facility is a cost-effective way to prolong its life and to protect water quality.
Establish a Record Keeping Procedure	Establishing a record keeping procedure will help to define chronic maintenance problems and aid in future budget preparation. A periodic examination of maintenance practices will assist in identifying persistent problems early.

Identify Facilities and Maintenance Needs

There are many types of stormwater management facilities, which are introduced over pages 5 through 16. Taking a moment to understand what kind of stormwater management facility you have and how it works, will help you to better plan for its maintenance needs.

If you do not recognize any of these facilities, call your local government.

Dry Pond

Wet Pond

Infiltration Trench

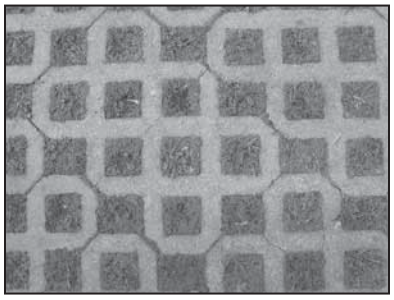
Sand Filter

Bioretention Facility

Vegetated Swale

Underground Detention

Vegetated Rooftop



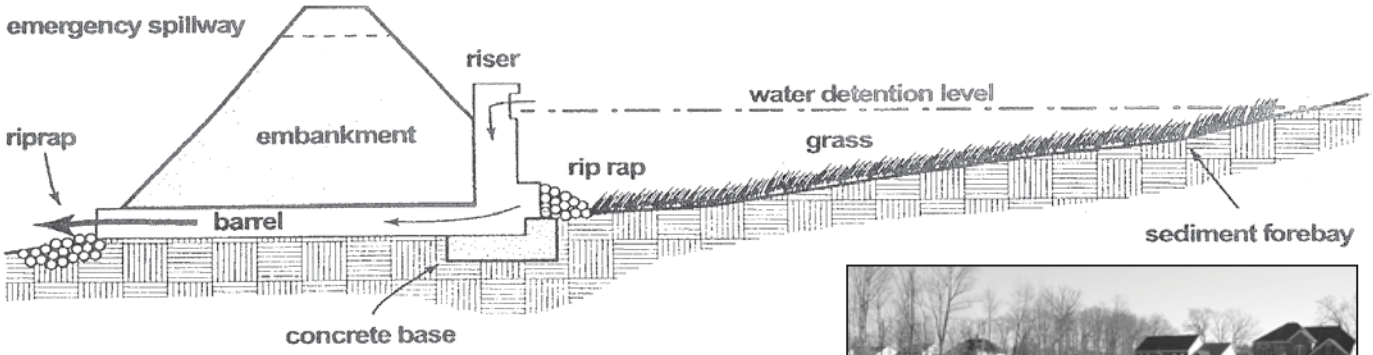
Permeable Paving Material

Manufactured BMP System

Non-Structural BMP

Extended Detention Basin - "Dry Pond"

Dry ponds retain water for a specified period of time (usually 48 hours) after a storm. Water is impounded temporarily to allow many of the pollutants time to settle to the bottom. The impounded water is discharged through an outlet that provides for prolonged release.



Dry ponds are the most common stormwater management facilities in Northern Virginia. Most do not contain a permanent pool of water and no water should remain if it is functioning properly.

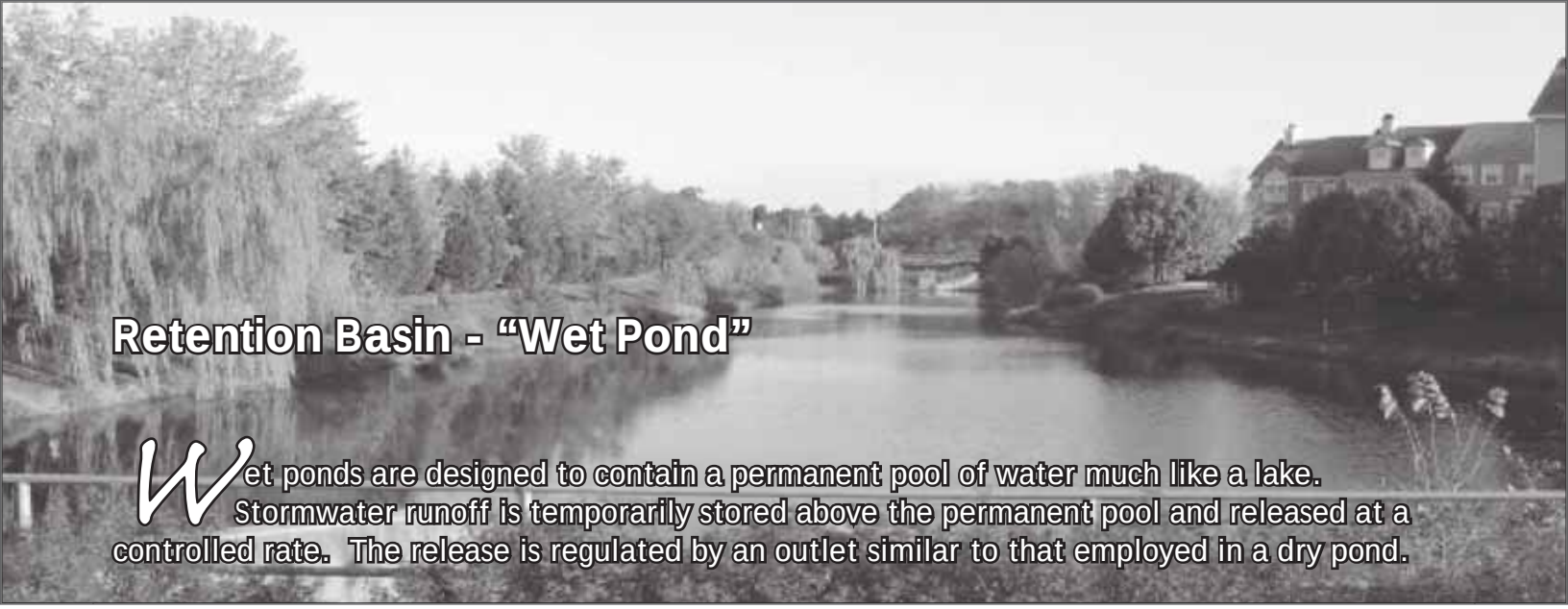
Consult a local government representative to determine whether standing water is by design or a sign that maintenance is required.

Dry ponds are commonly found in residential and commercial areas throughout Northern Virginia.

Extended detention wetland basins, or two-stage detention ponds, incorporate a shallow marsh or wetland to increase pollutant removal.

MAINTENANCE IS REQUIRED WHEN:

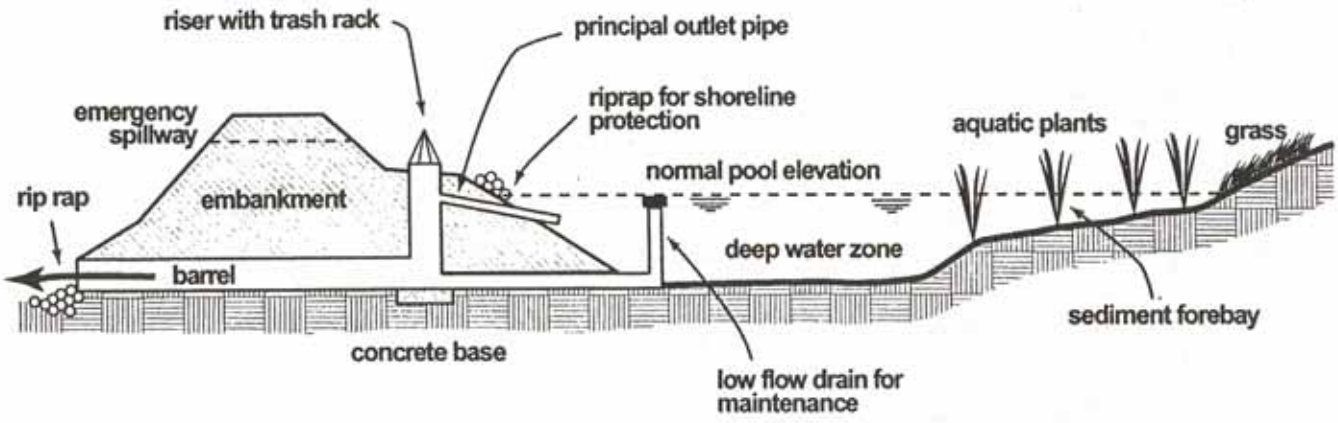
- Standing water is visible in inappropriate areas 72 hours after a rain event.
- Insects and/or odor become problems.
- Wetland vegetation emerges (unless the facility is specifically designed with a marsh or wetland area).
- There is visible damage to the embankment (such as sinkholes) or to the mechanical components.
- Animal burrows or trees present on embankment or near riser.
- Low flow orifice, forebay, or concrete trickle ditches blocked by trash, debris, or sediment.



Retention Basin - "Wet Pond"

Wet ponds are designed to contain a permanent pool of water much like a lake. Stormwater runoff is temporarily stored above the permanent pool and released at a controlled rate. The release is regulated by an outlet similar to that employed in a dry pond.

The advantages of a wet pond over a dry pond are higher pollutant removal and less chance that pollutants will be resuspended during a storm. However, wet ponds also pose a higher safety liability than other



MAINTENANCE IS REQUIRED WHEN:

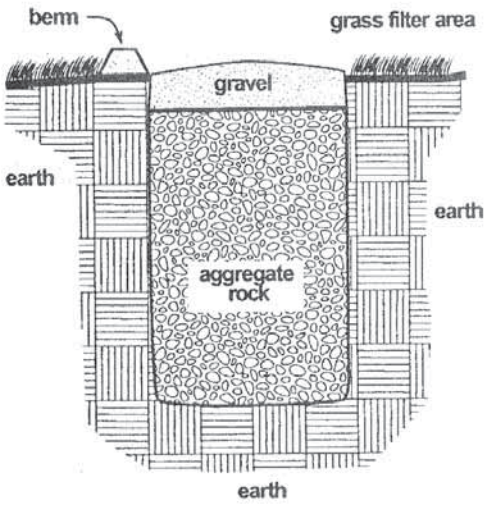
- There are visible signs of sediment accumulation.
- Insects and/or odor become problems.
- Algae blooms occur in the summer months or the ponded areas become dominated by a single aquatic plant.
- There is visible damage to the embankment or to the mechanical components.
- There are visible seeps on the downstream dam face.
- Woody vegetation is growing on the dam.
- Beavers are present in the plunge pool.

NOTE: If your wet pond is protected by perimeter fencing, periodic inspections of its integrity should be conducted.

Wet ponds and their surrounding vegetated buffers may also serve as an aesthetic or recreational amenity, as well as habitat for some wildlife.

Infiltration Trench

Infiltration trenches are gravel-filled excavations that temporarily store stormwater and allow it to sink into the underlying soil.



Infiltration trenches are classified in two ways:

In dispersed input facilities, runoff from impervious surfaces is directed over a gently sloping grass area before it reaches the facility, to remove large particles that otherwise might cause clogging.

In concentrated input facilities, runoff is transferred to the trench directly from curb inlets, gutters, and pipes.

The purpose of an infiltration trench is to retain water.

MAINTENANCE IS REQUIRED WHEN:

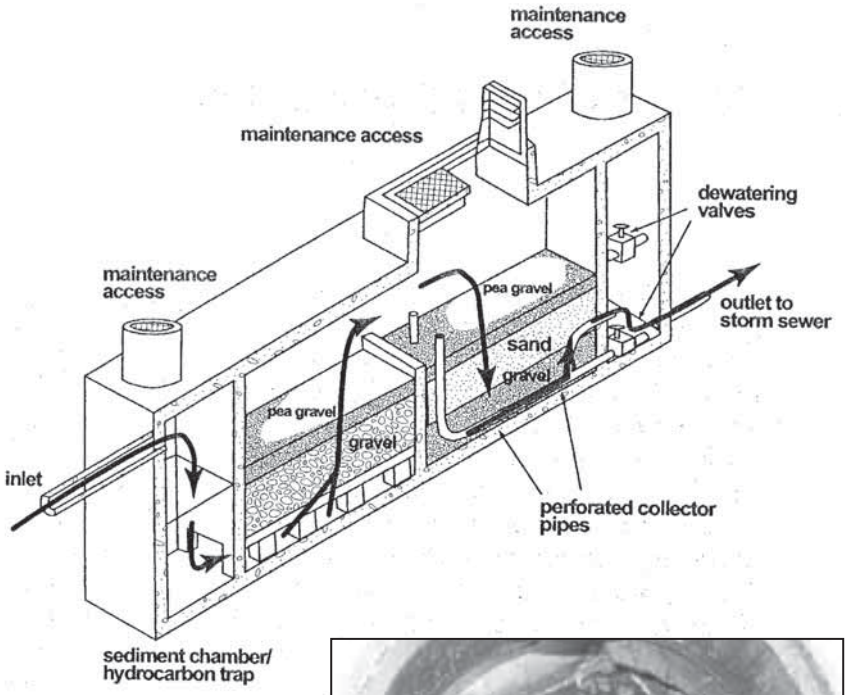
- Standing water is visible in the observation well 48 hours after a rain event.
- Insects and/or odor become problems.
- Wetland vegetation emerges.
- There is visible damage to the embankment (such as sinkholes) or to the mechanical components.
- Trash, leaves, and other debris are visible on the gravel surface.
- Runoff flows across, rather than into, the facility.

Sand Filtration System - "Sand Filter"

Sand filtration systems are used to treat runoff from highly impervious settings (commercial/office complexes and high density residential areas). To save space, sand filters are usually constructed inside a concrete shell and placed underground.

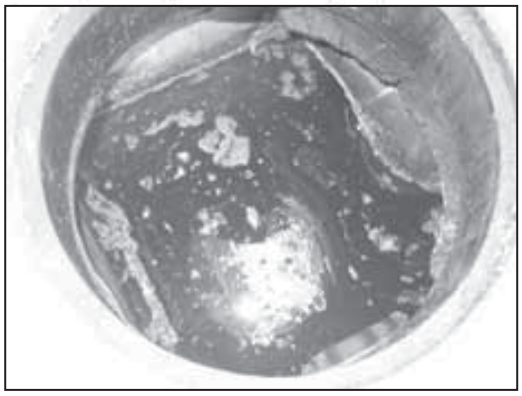
Sand filters consist of a series of chambers that remove heavy sediment, floatable debris, and oil, before slowly filtering stormwater through a layer of sand (and sometimes a sand/peat mix) where additional pollutants are removed when they become trapped between sand particles and other filter media. In some filters, microbes help remove metal and nutrient pollutants through biochemical conversion.

From the surface, some sand filters look like a series of manholes.



MAINTENANCE IS REQUIRED WHEN:

- The facility has reached its capacity for sediment accumulation, see the device's owners manual for specific amounts.
- Standing water is noticeable in the sediment and/or filter chambers.
- Excessive amounts of oil and trash are visible in the sediment chamber.
- Regular maintenance time interval has passed.



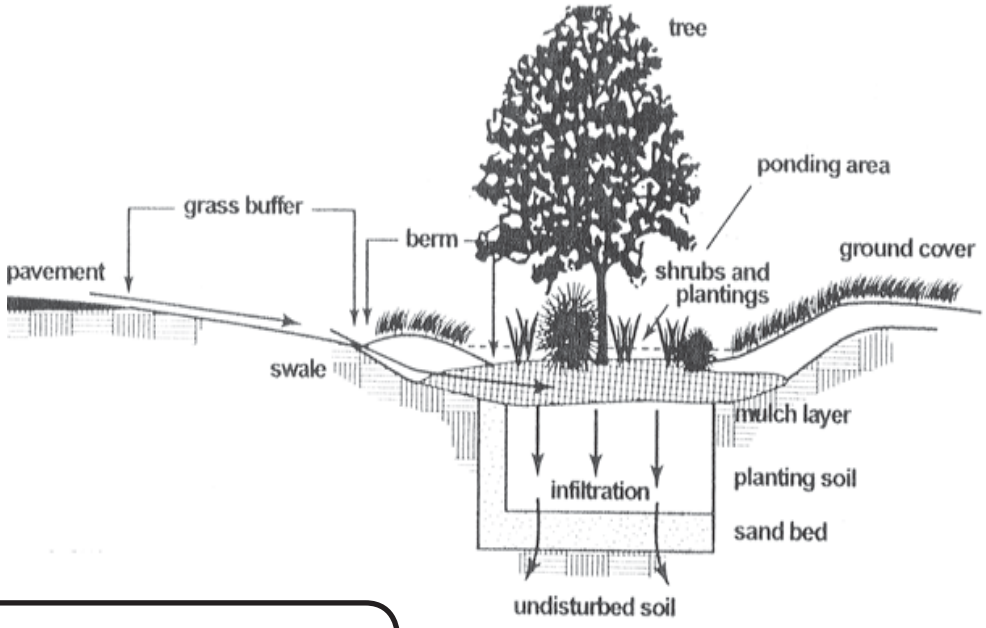
Sand filters are commonly used in areas where stormwater runoff has a high concentration of oil and grease.

Bioretention Facility - "Rain Garden"

Bioretention facilities, or "rain gardens" are vegetated basins designed to mimic the conditions found in a mature forest floor. Configured to act as a sink and underlain with specific layers of soil, sand, and organic mulch, runoff is trapped and treated by vegetation and microbes.

The facility is planted with specific types of vegetation that can withstand both wet and dry weather extremes. Reference information for the *Plants for Bioretention Basins* list prepared by Fairfax County, may be found in the *Stormwater Resources Guide* on page 34.

In areas where the local soils do not support infiltration, a bioretention facility may be underlain with layers of sand or gravel and an underdrain that carries treated water to the storm drain network.



MAINTENANCE IS REQUIRED WHEN:

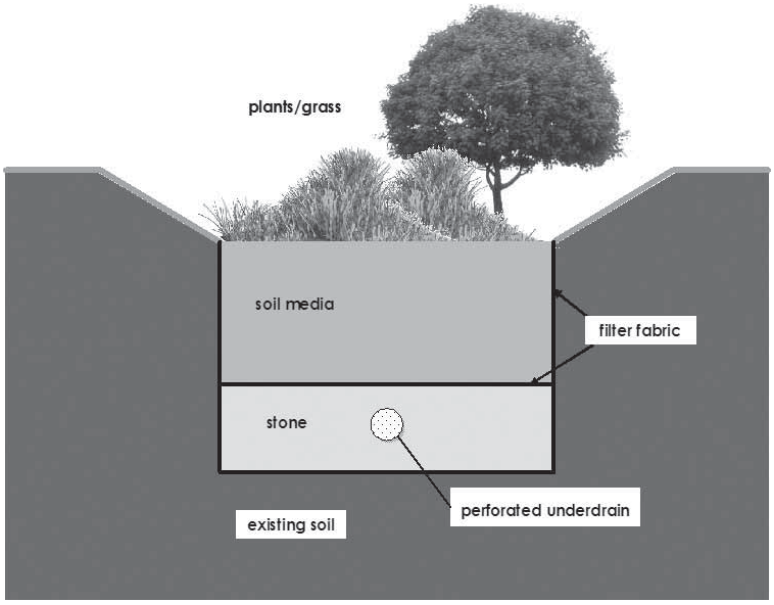
- Standing water is visible in the basin 72 hours after a rain event.
- Insects and/or odor become problems.
- Vegetation is wilting, discolored, or dying.
- Erosion is visible within the basin, on the **berms**, or on the slopes.
- Settling has occurred along the **berm**, if present.
- The overflow riser or grate is covered by debris.

Bioretention facilities intercept stormwater runoff and use plants and soil layers to remove pollutants.

Vegetated Swale

Vegetated swales may be seen along many of Virginia's roadways, although they are not always designed to treat stormwater.

Typically, vegetated swales are concave, earthen conveyance systems designed to simply transfer runoff. Today they are constructed to serve a water quality purpose, trapping particulate matter in the vegetative groundcover and allowing stormwater to soak into the soil.



Vegetated swales serve a water quality purpose by trapping particulate matter in the vegetative groundcover.

Vegetated swales are often located along roadways, parking lots, and other impervious areas.

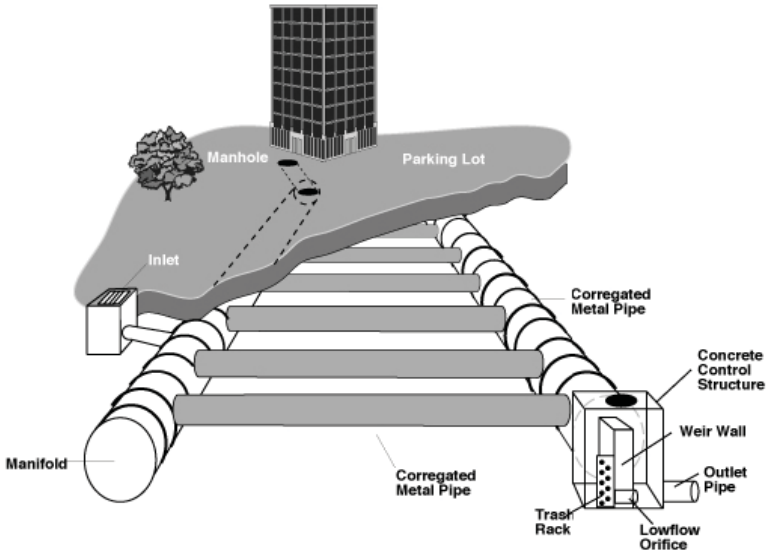
MAINTENANCE IS REQUIRED WHEN:

- Vegetation is bare in spots or appears unstable.
- Significant sediment has accumulated behind check dams*, if present.
- Erosion is visible in the bottom of the swale.
- Trash, grass clippings, leafy, and/or woody debris have accumulated.
- Standing water is visible after 48 hours.

check dams are small* ***berms* *built across a facility to slow water and create small areas of ponding.*

Underground Detention

Underground detention consists of large underground pipes that provide storage and water quantity control through detention and/or extended detention of stormwater runoff.



Underground detention is often used in space-limited areas, such as parking lots, roadways, and paved areas in commercial, industrial, or residential developments, where adequate land for a surface **BMP** facility is not available.

Subsurface detention facilities are commonly associated with other manufactured pretreatment facilities to improve water quality before the stormwater is released into natural waters. For more information about manufactured BMPs, see page 17.

MAINTENANCE IS REQUIRED WHEN:

- Significant amounts of trash and/or sediment has accumulated in the vaults or tanks.
- There is visible damage to the inlets or outlets.

Trash and sediment can quickly accumulate in underground detention facilities, requiring frequent clean outs, by professionals.

NOTE: Since underground detention systems are enclosed subsurface structures, they are considered confined spaces and have specific safety requirements by the Occupational Safety and Health Administration (OSHA) that should be heeded when inspecting or maintaining your system.

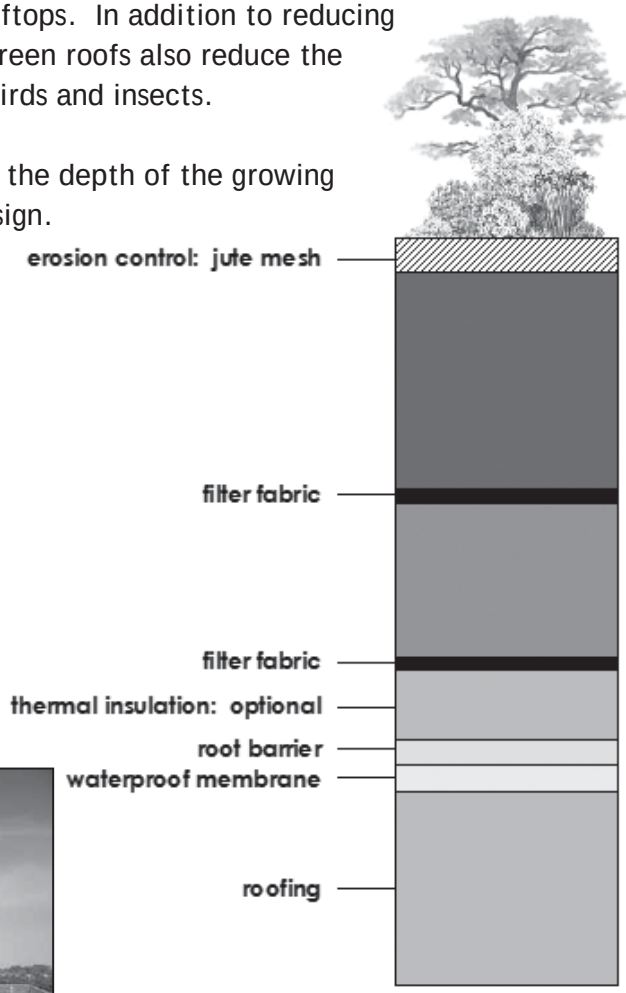
Vegetated Rooftop - "Green Roof"

While vegetated rooftops, commonly known as "green roofs" have been used extensively in Europe for centuries, they are becoming popular stormwater management tools in urban areas throughout the United States.

Green roofs intercept stormwater and slow its flow off of rooftops. In addition to reducing the amount of stormwater runoff and improving its quality, green roofs also reduce the effect of city "heat islands" and provide micro-habitats for birds and insects.

Green roofs are classified as extensive or intensive, based on the depth of the growing medium and the types of vegetation and amenities in the design.

Extensive green roofs employ succulent low-growing plant species, such as sedums.



MAINTENANCE IS REQUIRED WHEN:

- Leaks occur.
- Unwanted vegetation appears
- Vegetation shows signs of stress.

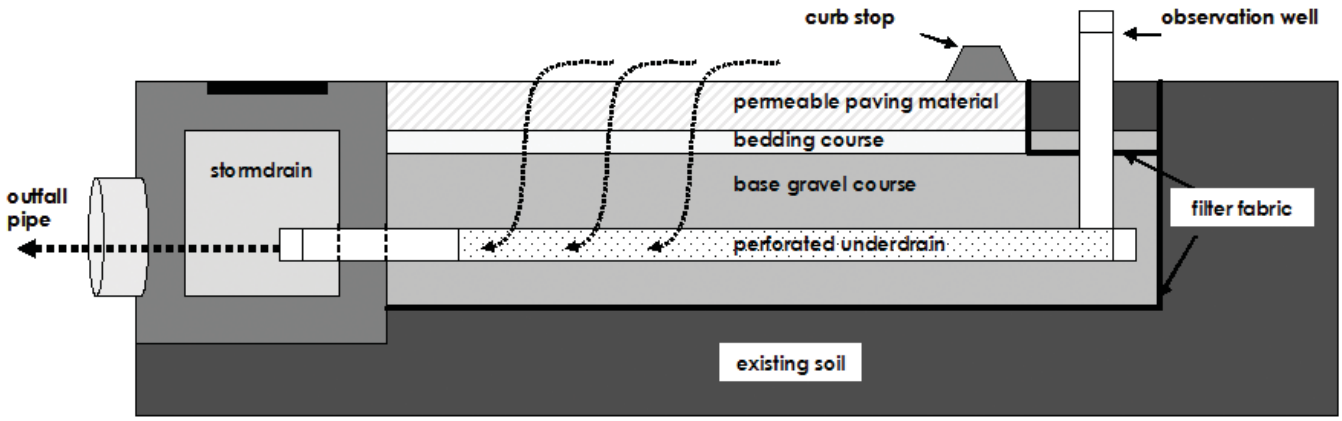
Intensive green roofs, applied on sturdier roofing systems, can accommodate paths, perennial plants, and other amenities.

NOTE: A detailed structural analysis of the existing building is required to ensure it can adequately support the weight of a vegetated rooftop, before one can be constructed.

Permeable Paving Material

Permeable paving materials consist of bricks, gravel, or other permeable materials that provide structure and stability yet allow water to infiltrate through to the ground's surface. They can be used in place of traditional asphalt in parking areas, sidewalks, and low traffic vehicular corridors.

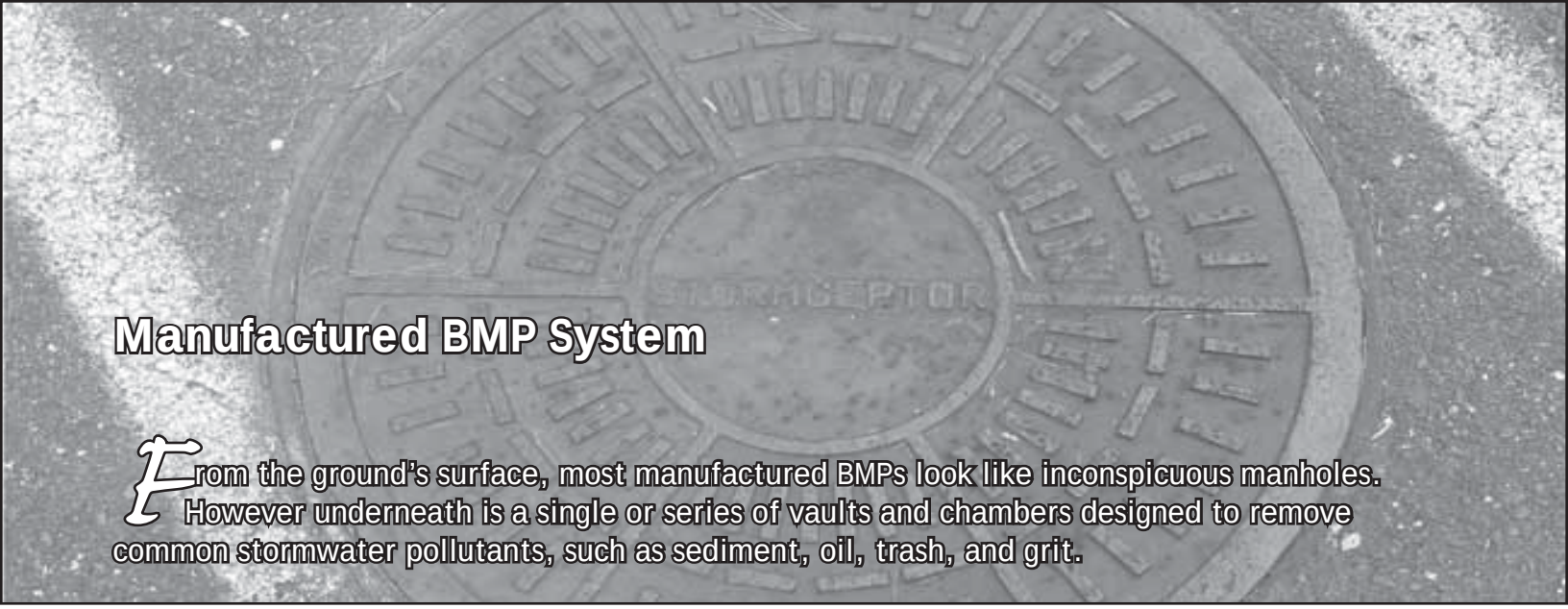
Permeable paving materials appear in a variety of different forms. Brick pavers are commonly used in parking lots and other areas that may receive frequent use. Whereas paving systems that are cellular in nature and allow for vegetation to grow through them are commonly used in place of traditional concrete or asphalt, in low traffic areas.



MAINTENANCE IS REQUIRED WHEN:

- Puddling or ponding water is visible on the surface 48 hours after a rain event.
- Significant amounts of sediment have accumulated between the pavers.

Permeable paving materials are often used along streets, driveways, parking lots, sidewalks, paths, and other low traffic volume areas.



Manufactured BMP System

From the ground's surface, most manufactured BMPs look like inconspicuous manholes. However underneath is a single or series of vaults and chambers designed to remove common stormwater pollutants, such as sediment, oil, trash, and grit.

Manufactured BMP facilities use gravitational, hydrodynamic, absorption, biochemical, and/or filter techniques to remove pollutants.

They are regularly used in urban and ultra-urban areas for water quality enhancement, where space for large facilities, such as wet ponds, is not available. Since they are often the same size as a typical stormwater inlet, manufactured BMPs are a common retrofit option.

Manufactured BMPs are used solely for water quality enhancement in areas where space for surface BMPs is not available.

left: Stormceptor™
right: Filterra™

Examples of Manufactured BMP Systems:

- Aqua-Swirl™
- BaySaver™
- Downstream Defender™
- Filtrexx SiltSoxx™
- Stormceptor™
- StormFilter™
- Vortechs™

MAINTENANCE IS REQUIRED WHEN:

- Sediment accumulation in the sediment chamber is over the manufacturer's recommended depth.
- Floating oil layer has reached an appreciable volume.
- Obstructions from trash or debris are visible in the inlet or outlet (vent).

NOTE: Consult the BMP's manufacturer or the operations manual.

For a comprehensive list and comparison of manufactured BMPs, visit:
www.epa.gov/region01/assistance/ceitts/stormwater/techs.html

Non-Structural Best Management Practices

Non-structural BMPs do not have a physical structure and are designed to eliminate or limit the amount of pollutants entering the stormwater system from the surrounding environment.

Non-structural BMPs involve educational efforts, management strategies, and planning alternatives and are often associated with the way land is used and managed. Limiting the frequency of fertilizer applications and reaching out to the community about how to reduce their contributions to stormwater pollution are just two examples that may be considered as non-structural BMPs.

Implementing these practices can have a long-lasting effect on the health of the local environment and can significantly reduce maintenance costs for structural BMPs.

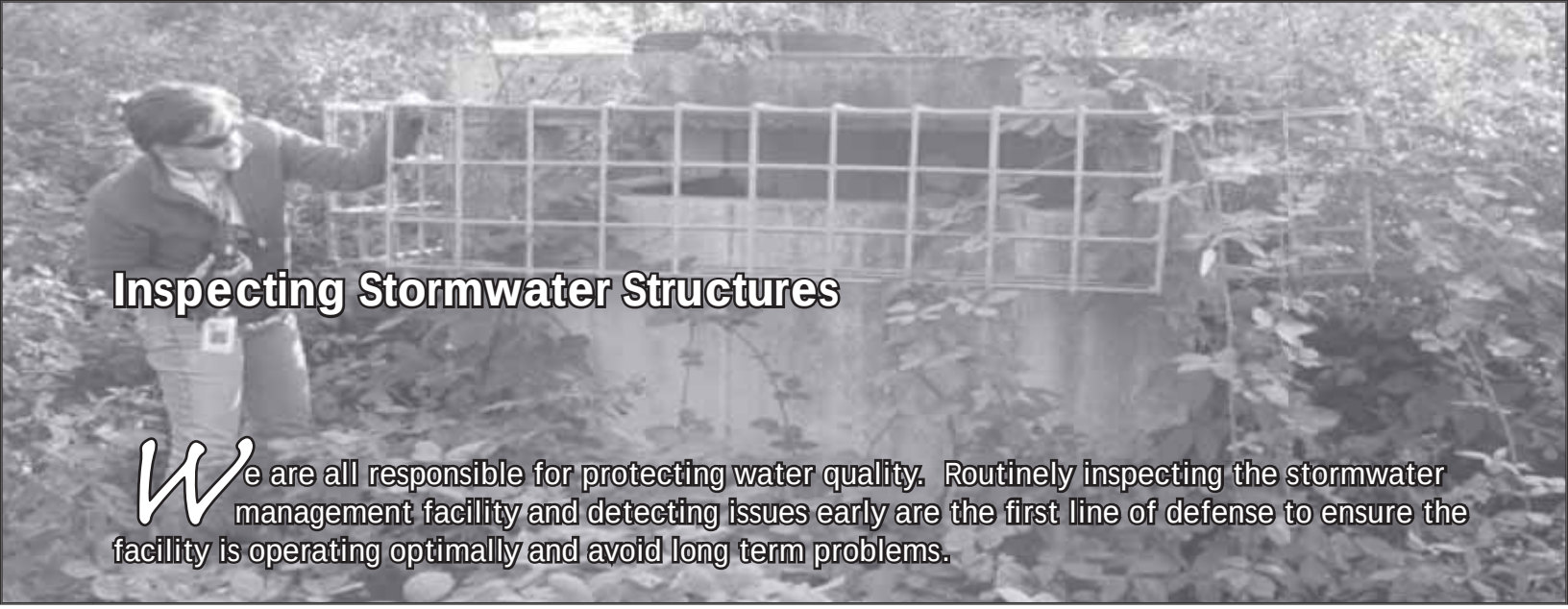
Examples of Non-Structural BMPs

- Trash Pick-Ups
- Storm Drain Marking
- Educational or Informative Articles
- Biological Stream Monitoring
- Tree Plantings
- Street Sweeping
- Lawn and Garden Management Workshops
- Invasive Plant Removals
- Carwashing Stations

Conduct tours of gardens that are not only aesthetically pleasing, but also improve the local environment and water quality.

Erect disposal stations, with bags and a trash can, encourages the proper disposal of dog waste and reduces the amount of bacteria entering nearby waterways.

Host workshops on proper lawn care and gardening techniques to help reduce the amount of fertilizer and excess nutrients from entering the stormwater facility.



Inspecting Stormwater Structures

We are all responsible for protecting water quality. Routinely inspecting the stormwater management facility and detecting issues early are the first line of defense to ensure the facility is operating optimally and avoid long term problems.

Who is Responsible for Inspections and Maintenance?

Many Northern Virginia local governments will maintain stormwater management facilities in residential areas under specific conditions. However, if a community or business is subject to a **BMP** maintenance agreement, that community or business is responsible for the maintenance of their **BMP**.

It is important to check the maintenance agreement to identify specific legal obligations. In the event that the maintenance agreement is unable to be located, consult a local government contact to determine who is responsible for conducting inspections and/or maintenance. Ask local government staff about the conditions of this agreement. Contacts can be found in the *Stormwater Resource Guide* on page 34.

STORM WATER DETENTION AGREEMENT

THIS AGREEMENT, made and entered into this_____ day of _____, 19____, by and between _____ (hereinafter called the "Landowner") and the Board of Supervisors of Fairfax County, Virginia (hereinafter called the "County");

WITNESSETH, that

WHEREAS, the Landowner is the owner of certain real property, more particularly described as _____ as recorded by deed in the land records of Fairfax County, Virginia, in Deed Book _____ at Page _____ (hereinafter called the "Property"); and

WHEREAS, the Landowner is proceeding to build on and develop the property; and

Developing an Inspection Strategy

Depending on the specific stormwater facility, inspection requirements vary from jurisdiction to jurisdiction.

Some sand filtration systems require monthly or seasonal inspections while other **BMPs** can be inspected on an annual basis. Some localities conduct inspections of all facilities, while others require that the responsible party arrange for an inspection and send the results to the jurisdiction inspection manager for confirmation. **The local government should be contacted to determine specific requirements and for assistance in selecting a qualified inspector.**

It is unlikely that a lawn care or landscaping company has the knowledge or experience to perform a proper, comprehensive BMP inspection. A professional (engineer, landscape architect, surveyor, etc.), or someone who has had appropriate training, should be hired to perform inspections. Since there is no "**BMP** inspection" listing in the telephone book, call a local government for advice on hiring a skilled professional.

A maintenance agreement legally binds the facility owner and/or responsible party with performing maintenance on the BMP.

Sample Self Inspection Checklist

STRUCTURAL INTEGRITY

Yes No N/A
Does the facility show signs of settling, cracking, bulging, misalignment, or other structural deterioration?

Yes No N/A
Do embankments, emergency spillways, side slopes, or inlet/outlet structures show signs of excessive erosion or slumping?

Yes No N/A
Is the outlet pipe damaged or otherwise not functioning properly?

Yes No N/A
Do impoundment and inlet areas show erosion, low spots, or lack of stabilization?

Yes No N/A
Are trees or saplings present on the embankment?

Yes No N/A
Are animal burrows present?

Yes No N/A
Are contributing areas unstabilized with evidence of erosion?

Yes No N/A
Do grassed areas require mowing and/or are clippings building up?

WORKING CONDITIONS

Yes No N/A
Does the depth of sediment or other factors suggest a loss of storage volume?

Yes No N/A
Is there standing water in inappropriate areas, such as on filters or cartridges after a dry period?

Yes No N/A
Is there an accumulation of floating debris and/or trash?

OTHER INSPECTION ITEMS

Yes No N/A
Is there evidence of encroachments or improper use of impounded areas?

Yes No N/A
Are there signs of vandalism?

Yes No N/A
Do the fence, gate, lock, or other safety devices need repair?

Yes No N/A
Is there excessive algae growth, or has one type of vegetation taken over the facility?

Yes No N/A
Is there evidence of oil, grease, or other automotive fluids entering and clogging the facility?

Yes No N/A
In rain gardens, is there evidence of soil erosion, does mulch cover the entire area, are specified number and types of plants still in place, or is there evidence of disease or plant stress from inadequate or too much watering?

OTHER OBSERVATIONS

_____

_____

_____

_____

A yes answer to any of these items should result in corrective action or a call to a professional inspector.

NOTE: The intent of the checklist is to provide a general sense of the areas of concern and issues that should be considered when inspecting a stormwater facility. A local government contact may provide a more comprehensive checklist for a specific type of facility.

Planning for BMP Maintenance Costs

Routine maintenance costs can usually be predicted for an annual budget and may range from four percent of original capital construction costs per year for a dry pond to nine percent of original capital costs per year for an infiltration trench.

A general rule of thumb is that annual maintenance costs may run from $100 per acre for minor maintenance, such as mowing, to $500 per acre for more intensive maintenance including weed control, debris removal, etc.

Non-routine maintenance costs, however, can be substantial over the long run, especially when considering the possibility of eventual BMP replacement. To lessen the immediate financial impact of non-routine costs, it is advised that a BMP maintenance fund, with annual contributions, be established.

As an example, for dry ponds, which need to have sediment removed once every two to ten years, ten to 50 percent of anticipated dredging costs should be collected annually. In addition, the average dry pond has a life expectancy of 20 to 50 years. A separate fund that collects two to five percent a year should be established for replacement. Anticipated interest may be used to offset the effects of inflation.

Estimating and Planning for Non-routine Costs for BMPs

Costs for non-routine maintenance of BMPs are highly specific and will vary depending upon:

- the type, size, and depth of the facility;
- the volume of the sediment trapped in the BMP;
- the accessibility of the BMP; and
- whether or not on-site disposal of the sediment is possible.

Type of BMP	Sediment Removal Frequency	Facility Life Span*
Wet Pond	5 to 15 years	20 to 50 years
Dry Pond	2 to 10 years	20 to 50 years
Infiltration Trench	Monthly or as needed	10 years
Sand Filter	Every 6 months or as required	20 to 50 years
Bioretention System	5 to 10 years	10 to 25 years
Vegetated Swale	As needed	10 to 25 years
Underground Detention	Annually or as needed	10 to 30 years
Vegetated Rooftop	Every 5 years	25 years
Permeable Paving Materials	3 to 4 times per year	25 years
Manufactured BMP	Annually or as required	20 to 100 years

*Assumes the facility is maintained on a regular basis.

Wet and Dry Pond Sediment Removal

The technique used to remove sediment from a wet or dry pond is very site-specific. The information below provides an estimate of costs associated with the dredging process.

- Mobilization and Demobilization of Machinery

Associated Costs: $1,000 to $10,000

Large wet ponds or regional facilities will often require a waterborne operation during which an excavator or a crane must be mounted to a floating barge and moved into position. For smaller ponds, larger ponds that can be drained or dredged from the shore, and extended detention basins, a perimeter or dry operation will usually suffice. In this case, a backhoe, truck equipment, or crane may be used to scoop out the sediment. Additional costs for the construction and restoration of access roads for trucks and heavy equipment may be accrued.

- Dredging

Associated Costs: $10 per cubic yard to $20 per cubic yard

The cost of dredging a BMP depends on the volume of sediment removed. The cost (expressed by cubic yard) is largely influenced by the depth of the water and the distance between the excavation area and the "staging area" where sediment is transferred to trucks for removal. Another consideration is whether equipment can easily access the BMP bottom. The following equation can be used to estimate the volume of sediment in cubic yards.

Equation to Estimate the Volume of Sediment in a BMP (in cubic yards)

surface area _____ (acres) **x** depth of sediment _____ (feet) **x** 43,560 **=** _____ cubic feet

cubic feet _____ **/** 27 **=** _____ **cubic yards**

- Disposal

Associated Costs: $5 per cubic yard - on-site to $47 per cubic yard - off-site

The primary determinant of disposal costs is whether on-site disposal is an option. If on-site disposal is not available, then locating a landfill or large area to apply the spoils, such as a farm may prove challenging and transportation costs may increase considerably. Dredged materials will require special disposal if found to contain hazardous materials.

Additional costs that vary per jurisdiction, should be considered for permitting fees, grading plans, and erosion and sediment controls.

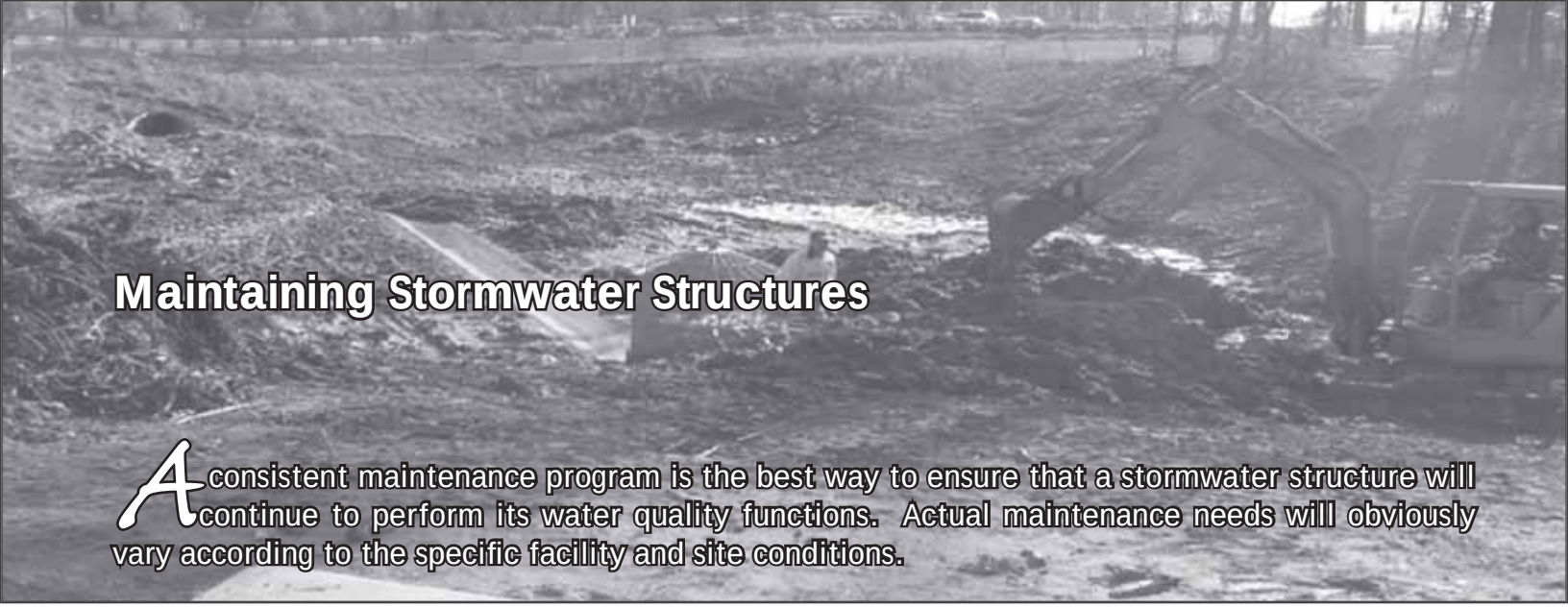
Adding the likely costs of the sediment removal components establishes a range in which an owner can expect to pay for sediment/pollutant removal. For a facility with a small surface area (0.25 acres) overall costs can range from $4,000 to $10,000+. For a large facility (10 acres) overall costs can range from $170,000 to $550,000+.

Planning for BMP Maintenance Costs

	Maintenance	Annual Associated Cost
Vegetated Facilities		
Bioretention Facility	Removal of sediments and replacement of some level of soil is required periodically. Mulch should be replaced annually, or as needed.	Between $1,500 and $2,000, depending upon the size and complexity of the facility.
Vegetated Rooftop	Repair leaks, as necessary. Replenish soil and plants, annually. If drought is a concern, installing an irrigation system or supplemental watering will be necessary.	Between $500 and $7000, depending upon the size of the facility and the amount of soil/planting area that needs to be replenished.
Vegetated Swale	Remove sediments, replace check dams (usually made of earth, riprap, or wood), reseed or sod (if grassed) or replace dead plants, every two years.	If located on a highway right-of-way, maintenance may be covered through state maintenance. Call the Virginia Department of Transportation at 703-383-VDOT to find out if the swale is on state property.
Infiltration Facilities		
Infiltration Trench	Remove the top six to 12 inches of gravel and to replace the filter cloth sediment barrier.	Between $1,500 and $2,000, depending on the size of the facility.
Permeable Paving Material	Vacuum sediments from surface, twice a year.	Between $500 and $1,000, depending on the size of the facility.
Underground Facilities		
Sand Filter	Remove the top filter cloth and remove/ replace the filter gravel, when a semi-annual inspection reveals that it is necessary. Pump and refill the carbon trap every six months. Remove and replace the filter cloth and gravel every three to five years.	Between $3,000 to $10,000, depending on the type and size of the sand filter and the amount of impervious surface draining to it.
Underground Detention	Vacuum accumulated sediment and debris, twice a year.	Between $1,000 and $1,500 depending on the size and complexity of the facility.
Manufactured BMP	Vacuum accumulated sediment, oil, and debris, every six months, or as required.	$500+, depending on the type, size, and location of the facility and the amount of sediment, oil, and debris that has accumulated.

If an oil sheen is present in the facility, it should be removed by a qualified oil recycler, which increases costs. Other expenses, such as removal of trash and hydrocarbons from water traps may also be required. The owner should consult a local government representative to determine an appropriate funding level.

Removing sediment from stormwater facilities can be a considerable expense. Look for opportunities to reduce the amount of sediment entering the pond from the surrounding drainage area.



Maintaining Stormwater Structures

A consistent maintenance program is the best way to ensure that a stormwater structure will continue to perform its water quality functions. Actual maintenance needs will obviously vary according to the specific facility and site conditions.

Factors Affecting the Type and Frequency of Maintenance Required

Visibility of the Facility/Aesthetics

The needs and preferences of the surrounding community will determine to a large extent the amount of maintenance required for aesthetic purposes.

Landscaping

Maintenance needs will vary considerably depending upon the types of vegetation used in landscaping. Rain gardens, dry ponds, and vegetated rooftops in particular will require special attention to vegetation management.

Upstream Conditions

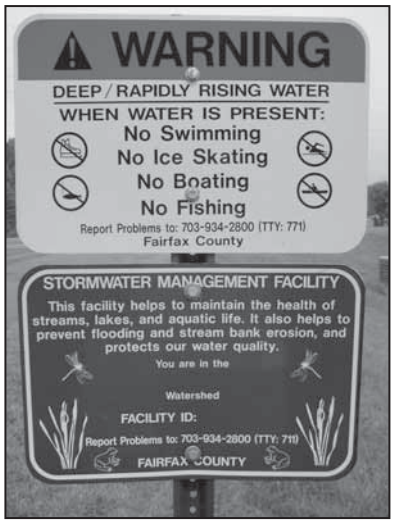
The condition of the surrounding watershed will significantly impact the amount of sediment and other pollutants the facility must manage. For example, erosion problems and high traffic areas upstream can dramatically increase the amount of sediment accumulation.

Safety

Since **BMPs** often involve the storage or impoundment of water, the safety of nearby residents or customers must be considered. This includes maintaining appropriate fencing and signs. Confined space training is required before entering underground facilities.

Need for Professional Judgement

BMPs are water treatment facilities. While some maintenance can be conducted by a non-professional, the advice of a professional should be consulted regularly.



Signs increase awareness of stormwater and explain the benefits of the BMP.

Financing

The costs associated with non-routine **BMP** maintenance tasks can be considerable. A fund should be established to provide for the costs of long-term maintenance needs such as sediment removal.

Maintaining Stormwater Structures

Routine maintenance will keep a **BMP** functioning properly and will pay off in the long run by preventing unneccesary repairs. Preventing pollutants from reaching the **BMP** will result in lower maintenance costs and cleaner water.

Common Routine Maintenance Needs for Most BMPs

Regular Inspections	Vegetation Management	Embankment & Outlet Stabilization	Debris & Litter Control	Mechanical Components Maintenance
Insect Control	Access Maintenance	Overall Pond Maintenance	Sediment/ Pollutant Removal	Components Replacement

Regular Inspections

Local governments require a specific schedule of inspections for a **BMP**. In many instances, an annual or semi-annual inspection, depending on the facility, is required. It will also be necessary to conduct an inspection after a large storm event during which the **BMP**'s capacity was surpassed.

Some **BMPs**, such as sand filters, may require more frequent inspections. Additional information on who needs to carry out inspections is provided under *Inspecting Stormwater Structures* on page 17.

Vegetation Management

Most **BMPs** rely on vegetation to filter sediment from stormwater before it reaches the **BMP**. Vegetation also serves to prevent erosion of the banks and stabilize the bottom of the facility. While turf grass is the most common groundcover, many **BMPs** are being retrofitted or designed with woody vegetation and wetland plants to increase pollutant removal.

- **Mowing.** Most grass is hardiest if it is maintained as an upland meadow, therefore mow no shorter than six to eight inches. Grass on embankments should be cut at least twice during the growing seasons and once during the summer.
- **Pest and Weed Control.** To reduce the amount of pollutants reaching the **BMP**, avoid overfertilization and excessive pesticide use.
- **Removing Sediment Build-Up.** Since the vegetation surrounding the **BMP** is designed to trap sediment, it is likely to become laden with sediment.
- **Stabilize Eroded Areas or Bare Spots.** Bare spots should be vigorously raked, backfilled if needed, covered with top soil, and seeded.
- **Unwanted Vegetation.** Some vegetation is destructive to a **BMP**. Keeping dams and bottom areas free of deep-rooted vegetation is critical as roots may destabilize the structure. Consistent mowing and monitoring will control any unwanted vegetation.
- **No Mow Zones.** For wet ponds, a ten foot vegetated buffer, around the perimeter of the facility (exclusive of the dam embankment) may be established to filter pollutants from adjacent properties and to help prevent shoreline erosion.

Embankment and Outlet Stabilization

A stable embankment is important to ensure that erosion does not contribute to water quality problems and that embankments are not breached - resulting in downstream flooding. Maintaining a healthy vegetative cover and preventing the growth of deep-rooted (woody) vegetation on embankment areas is an important component to stabilization.

Animal burrows will also deteriorate the structural integrity of an embankment. Muskrats and groundhogs in particular will burrow tunnels up to six inches in diameter. Efforts should be made to control excessive animal burrowing and existing burrows should be filled as soon as possible. Outlet structures are particularly prone to undercutting and erosion. Unchecked, a small problem can easily result in the need to replace the entire structure. A professional engineer should be consulted if

sink holes, cracking, wet areas around the outlet pipe, displacement, or rusting of the pipe are observed.

Debris and Litter Control

Regular removal of debris and litter can be expected to help in the following areas:

- reduce the chance of clogging outlet structures and trash racks;
- prevent damage to vegetated structures;
- reduce mosquito breeding habitats;
- maintain facility appearance; and,
- reduce conditions for excessive algal growth.

Special attention should be given to the removal of floating debris which can clog inlets, outlets, and low-flow orifices. If trash or dumping is particularly problematic, outreach to the local community can help (see *Involving the Whole Community*, page 27).

Mechanical Components Maintenance

Some **BMPs** have mechanical components that need periodic attention - valves, sluice gates, pumps, **anti-vortex devices**, fence gates, locks, and access hatches should be functional at all times. This type of routine maintenance is best left to a professional.

Insect Control

A healthy ecosystems actually promotes biological controls of mosquitoes. However, mosquito and other insect breeding grounds can be created by standing water. Though perceived as a significant nuisance, mosquitoes are not as big a problem as is often thought, and there are ways to address the issue.

The best technique is to ensure that stagnant pools of water do not develop. For **BMPs** that have a permanent pool of water, this means the prompt removal of floatable debris. It may also be possible in larger wet ponds to stock fish that feed on mosquito larvae. The Department of Game and Inland Fisheries can provide additional information on this management option (see *BMP Resource Guide*, page 34).

The development of a mosquito problem, particularly in dry ponds, infiltration trenches, and rain gardens, is usually an early indication that there is a maintenance problem, such as clogging. In such cases, the infiltration capacity of the **BMP** needs to be increased or sediment needs to be removed.

Access Maintenance

Most **BMPs** are designed so that heavy equipment can safely and easily reach the facility for non-routine maintenance. Routine maintenance of access areas is particularly important since one never knows when emergency access will be needed. Maintenance includes removal of woody vegetation, upkeep of gravel areas, fences, and locks.

Overall Pond Maintenance

An often overlooked aspect of maintenance, especially for wet ponds, is the need to ensure a healthy aquatic ecosystem. A healthy ecosystem should require little maintenance. An indicator of an unhealthy system is excessive algal growth or the proliferation of a single species of plant in the permanent pool of a wet pond. This may be caused by excess nutrients from fertilization practices (of a landscape company or surrounding neighbors), or by excess sediment.

Steps should be taken to reduce excess nutrients at their source and to encourage the growth of native aquatic and semi-aquatic vegetation in and around the permanent pool. The Department of Game and Inland Fisheries can provide additional information on overall pond maintenance practices (see *BMP Resource Guide*, page 34).

Maintaining Stormwater Structures

The non-routine maintenance of a **BMP**, while infrequent, can be a major undertaking and should always be performed by a professional. While tasks will vary by facility, they typically include sediment/pollutant removal and replacement of the facility's structural components.

Sediment/Pollutant Removal

Since the primary purpose of a **BMP** is to remove sediment and other pollutants (which are usually attached to sediment) from stormwater, sediment will accumulate in a **BMP** and need to be removed. Facilities vary dramatically so there are no universal "rules of thumb" to guide responsible parties in sediment removal requirements.

For instance, dry ponds should be cleared of sediment once a significant portion of the **BMP** volume (25-50 percent) has been filled. For wet ponds, a minimum water depth of approximately three feet is desirable.

Sediment and pollutants will need to be discarded. The best solution is to have an onsite area or a site adjacent to the facility (outside a floodplain) set aside for sediment. When sediment is stored near the facility, it is important to adhere to Virginia's Erosion and Sediment Control requirements for stabilization to protect the stockpile against erosion. If on-site disposal is not an option, transportation and landfill tipping fees can greatly increase sediment removal costs. Once the sediment is removed, the facility should be quickly restabilized, either through revegetation or, in the case of a sand filter, replacement of sand and other filter media.

Finally, wet sediment is more difficult and expensive to remove than dry sediment. In some cases, the entire facility can be drained and allowed to dry so that heavy equipment can remove sediment from the bottom. In other cases, it may be necessary to remove sediment from the shoreline or by hydraulic dredging from the surface. A permit may be required for removal and proper disposal of sediment. Contact your local government for assistance.

Stormwater Management Facility Component Replacement

Eventually, like most infrastructure, actual facility components will need to be replaced. Components may include:

- inflow and outflow pipes;
- trash racks and **anti-vortex devices**;
- valves, orifices, and aerators;
- concrete structures (such as the casing for a sand filter, or riser structures in ponds);
- pumps and switches;
- manhole covers and access hatches*;
- earthworks (such as embankments and side slopes); and,
- mulch and vegetation.

While most stormwater management facilities may last up to 100 years with proper maintenance, a community or business should plan long in advance for replacing these facilities.

**Many BMPs are located in parking lots. When the parking lot is repaved, ensure that the access areas are not covered.*

Who Should Carry Out Maintenance

In determining who should carry out maintenance activities, safety, cost, and effectiveness need to be balanced. Some activities can be undertaken effectively by a facility owner. Some examples of tasks that are appropriate for a facility owner may include landscaping and revegetating bare areas, education, and litter removal.

While engaging a community or business in routine maintenance is a great way to educate people about the facility's purpose, it is strongly recommended that a professional landscaping company be hired for more difficult work. Trained personnel may be able to identify problems in their early stages of development when it is most cost-effective to make repairs. Additionally, mowing and handling a wheelbarrow can be dangerous on sloping embankments. Filling eroded areas, and soil disturbing activities, such as resodding and replanting vegetation, are also tasks that a professional landscaping firm can manage.

Working with Lawn Care Companies

Communicate to a lawn care company that the stormwater management facility is a water treatment system that requires special attention. While most companies have the ability to perform special maintenance, many will not unless specifically asked.

Contact a company manager to discuss how their services can be tailored to help meet the stormwater management facility's maintenance objectives.

Tips for Working with Lawn Care Companies

COMMUNICATE that the facility is a water quality protection facility.

PROVIDE specific instructions on mowing and fertilization practices. For example, mowing at a higher level and perhaps not as frequently is preferred. Ask that heavy equipment be avoided where possible and particularly in vegetated areas.

INFORM land owners and landscape companies of the need to keep sediment from accumulating and the need to keep the facility clear of grass clippings.

REQUIRE that the company follows an integrated pest management (IPM) plan to minimize the application of pesticides and fertilizers.

An IPM plan can include the:

- use of pesticides only as needed and only on trouble spots;
- use of alternatives to pest controls or no pesticides; and/or,
- policy of not applying chemicals when rainfall is in the forecast.

If the company cannot oblige, consider switching to a lawn care company that will.

Who Should Carry Out Maintenance

Involving the Community

It is a common misconception that curbside storm drains go to a water treatment plant. In actuality, they lead to a stormwater facility or directly to a stream!

Educating and involving the community is a cost-effective way to prolong the life of the facility, prevent pollution, and make a difference in improving the local environment. Activities can range from organizing a clean-up day to developing a community-wide education program.

Numerous local organizations provide supplies, resources, and technical support to businesses and communities interested in developing a public education program or hosting an event.

A community activity, such as a cleanup or tree planting, will help increase appreciation for a facility and maintenance.

Questions to Ask When Developing a Public Education Program for a Community

What pollution problem(s) need to be addressed?
Determining the type of pollution that is causing an issue with a stormwater management facility can help with planning community activities to remediate the problem.

What activity or activities are responsible for pollution?
Locating possible sources of pollution are helpful in targeting educational messages, planning activities, and determining solutions.

Who can help implement a community education program?
Rallying the community together can make an activity much more successful. One suggestion is to involve an existing active group that is looking for opportunities to complete community service or volunteer hours.

A storm drain marking project will increase awareness that storm drains lead to streams.

How will the message reach the targeted community?
Publicizing the event or educational message using existing or new outlets, including websites, list serves, and newsletters, should be explored.

What alternatives to pollution generating activities should be encouraged?
Implementing solutions and providing alternatives for pollution prevention will greatly assist in reducing the amount of pollution entering a stormwater management facility and local streams.

Tips to Lessen Maintenance Costs

If properly cared for, a stormwater management facility can work effectively for years without major maintenance costs. Neglected, it can potentially be a continual financial drain.

Businesses and homeowner associations can minimize costs and the potential liability of those responsible for the facility's maintenance by promoting and following these simple rules:

DO!!

☑ DO keep properties, streets, and gutters free of trash, debris, and lawn clippings.

☑ DO provide information to those who maintain their own automobiles on where to recycle oil and antifreeze.

☑ DO encourage residents to take dirty vehicles to a commercial carwash or select a location where soapy water will infiltrate into the ground and not enter a storm drain.

☑ DO put a pan underneath your car if it is leaking to catch the fluids until it is repaired. Spread an absorbent material, such as kitty litter, to soak up drippings and dispose of it properly.

☑ DO educate residents on where to properly dispose of hazardous wastes, including oil and latex paint.

☑ DO plan lawn care to minimize the use of chemicals and pesticides. Sweep paved surfaces of fertilizers and put the clippings back on the lawn.

☑ DO limit the amount of impervious surfaces. For patios, walkways, and landscaping, consider porous pavements such as bricks, interlocking blocks, or gravel.

☑ DO plant native trees, shrubs, and groundcovers to help the water soak into the ground. Replace turf with native plants. Select species that need little or no fertilizer or pest control and are adapted to specific site conditions.

☑ DO sweep up and dispose of sand and ice melting chemical residues in the winter. This will protect grass and other plants, as well as reduce the amount entering the storm drain network.

DO NOT!!

☒ DO NOT dump used motor oil, antifreeze or other oil and grease into storm inlets. This is a criminal offense and will greatly increase BMP maintenance costs.

☒ DO NOT dump grass clippings, leaves, soil, or trash of any kind into the stormwater facility or a storm inlet. Leaves and grass clippings release bacteria, oxygen consuming materials and nutrients. They will also clog the facility's components.

☒ DO NOT dispose of pet wastes in the storm system, including grassy areas near a facility. Animal wastes contain disease-causing bacteria and release oxygen consuming materials.

☒ DO NOT wash dirty vehicles on streets or driveways. Whatever comes off the car ends up in the stormwater facility or directly in streams.

☒ DO NOT overfertilize the lawn. Whatever washes off the lawn or impervious areas (such as driveways or sidewalks) drains into the stormwater facility and shortens its life-span.

☒ DO NOT leave bare areas unstabilized. Erosion from bare soil results in sediments that can quickly clog a stormwater facility.

☒ DO NOT dispose of left over paint or hazardous materials into the storm drain. These materials can kill vegetation and aquatic life. Dumping into the storm drain system is also a criminal offense.

SEDIMENT REMOVAL AND DISPOSAL

Impact on Facility Performance

The purpose of a stormwater treatment facility is to remove pollutants, including suspended solids, by capturing sediment. Sediment can include dirt, leaves, and litter. These materials can restrict or clog a facility. Timely removal of sediment will improve infiltration rates, water quality, and help prevent clogging and flooding.

Type of Facility This Applies To	Remove Sediment When
Vegetated Vegetated Rooftops, Bioretention Facilities, Ponds, Constructed Wetland Forebays, Swales, and Vegetated Filters	• Sediment depth is damaging or killing vegetation; or, • Sediment is preventing the facility from draining in the time designed (usually 48 - 72 hours).
Underground Manufactured Facilities, Sand Filters, Underground Detention	• At least once a year, or when • The basin is half-full of sediment, whichever comes first.
Infiltration Permeable Paving Materials (Grasscrete, permeable pavers, gravel), Infiltration Trenches	• Sediment is preventing the facility from draining in the time required (usually 48 hours).

What to Do

For small facilities, sediment can be removed by hand. Large facilities and underground facilities will need to be cleaned with heavy equipment by trained professionals. For example, a vacuum truck may need to be used for confined spaces.

- Remove sediment during dry months when it is easiest to remove because it weighs less and creates fewer secondary environmental impacts, such as wet sediment running off the site.

Vegetated Facilities:

- Use rakes and shovels to dig out accumulated sediment.
- Avoid damage to existing vegetation. If sediment is deep, some plants may need to be removed to excavate sediment.
- Reseed, replant, and mulch disturbed area to prevent erosion.
- Excavate sand and gravel and clean or replace.

Underground Facilities:

- Use a vacuum truck to remove sediment from the vaults or chambers.

Infiltration Facilities:

- Infiltration Trenches: Excavate sand or gravel and clean or replace.
- Permeable Paving Materials: Remove accumulated sediment from the surface with a dry broom, vacuum system, or other hand tools. A vacuum truck or street sweeping equipment may also be used, with professional assistance.

A vacuum truck may be required to remove sediment from stormwater facilities located underground.

How To Reduce Sediment Accumulation in the Facility

- Minimize external sources of sediment, such as eroding soil upstream of the facility.
- Sweep surrounding paved areas on the property regularly.

VEGETATION MANAGEMENT
Importance to Facility Performance

Plants play an important role in stormwater facilities. They absorb water, improve infiltration rates of soil, prevent erosion by stabilizing soil, cool water, and capture pollutants. Plants create habitat for birds and other wildlife and provide aesthetic value to a property. Proper maintenance of vegetation improves the appearance and performance of the facility.

Type of Facility	Facility Needs Maintenance When
Vegetated Vegetated Rooftops, Bioretention Facilities, Ponds, Swales, and Vegetated Filters	• Areas of exposed, bare soil. • Vegetation is buried by sediment. • Vegetation appears unhealthy or has died. • Nuisance and invasive plants are present. • Vegetation is compromising the facility's structure by blocking inlets or outlets, or roots are intruding into the component of the facility. • Dropped leaves and other debris are contributing to sediment accumulation or are blocking inlets or outlets.

What to Do

Maintenance activities can easily be incorporated into existing site landscape maintenance contracts. Vegetation can be maintained with a formal or more natural appearance depending on your preference.

General maintenance:
- Remove dropped leaves, dead plants, grass and other plant clippings. Plant debris adds nutrient pollution as it breaks down and can clog facility piping and reduce infiltration.
- Avoid using fertilizers, herbicides, or pesticides in the facility. These products add to the pollution problems the facilities are designed to remedy.
- Use mulch to inhibit weed growth, retain moisture, and add nutrients. Replenish when needed. Ensure mulch does not inhibit water flow.
- Irrigate all new plantings as needed for the first two years.

Caring for desired vegetation:
- Plant in late-fall or early-spring so plant roots can establish during the cool, rainy seasons, before summer.
- Amend and aerate compacted soils before replanting by adding compost to increase nutrients and enhance soil texture.
- Protect young plantings from herbivory from deer and waterfowl.

Mowing:
- Grass facilities are designed for routine mowing. Mow at least twice a year.
- Grass should be mowed to keep it 4 - 9 inches tall. Grass that is at least 4 inches tall capture more pollutants and is hardier.

Nuisance and unwanted vegetation:
- Remove nuisance and invasive vegetation, such as English Ivy, before it goes to seed in the spring. Conduct additional weeding in the fall. Check the *Stormwater Resource Guide* on page 35 for a guidebook to invasive plants in the Chesapeake Bay Watershed.
- Immediately remove vegetation that is clogging or impeding flow into the facility.
- Remove potentially large and deep-rooted trees or bushes when they might impede the flow path or compromise facility structures.
- Provide erosion control on any soil exposed by vegetation removal.

EROSION, BANK FAILURE, AND CHANNEL FORMATION

Importance to Facility Performance

Stormwater flowing through a facility can cause erosion. Erosion can increase sediment build up, clog outlets, reduce water quality benefits, add to pollution, and cause facility components to fail. Eroded channels create an easy path for water to travel down reducing the ability of the facility to filter pollutants and infiltrate water.

Type of Facility	Facility Needs Maintenance When
Vegetated Vegetated Rooftops, Bioretention Facilities, Ponds, Swales, and Vegetated Filters	• The formation of flow restricting channels occurs in the bottom of the facility, around inlet pipes and curb cuts, or at overflows. • Undercutting, scouring, and slumping occur along banks and **berms**. • Channels and undercutting occur through check dams*. **check dams are small* **berms** *built across a swale or channel to slow water and create small areas of ponding.*

What to Do

Any area with erosion more than two inches deep needs maintenance.

- Fill the eroded area with soil, compact it lightly, and cover with mulch, compost, seed, sod, or other erosion prevention materials.
- Plant banks with deep or heavily rooted plants to permanently stabilize soil.
- Plant the bottom of the facility with grass or grass-like plants to slow water and stabilize soil.
- Install or repair structures designed to dissipate energy and spread flow, such as splash blocks on downspouts, or riprap around inlet pipes and curb cuts.
- If erosion continues to be a problem, consult a professional to determine the cause and the solution.

POLLUTION YOU CAN SEE OR SMELL

Importance to Facility Performance

Stormwater facilities often collect a variety of trash and debris. Trash and debris, especially floating debris, can clog pipes or treatment media. It can also cause odors through decay or by collecting spilled or dumped materials. Stormwater facilities are designed to help prevent pollutants from entering rivers and streams. Any visible water quality pollutants may wash out of the facility spreading the pollution problem.

Type of Facility	Facility Needs Maintenance When
All Types of Facilities	Any unusual or unpleasant smells from sources such as: • Natural plant decay • Dying plants trapped under sediment. • A spill or a leak (e.g., gasoline or sewage). Visible pollution such as: • Sheens and discoloration • Turbid (cloudy) water • Other pollution on the surface of the water.

What to Do

Check monthly for trash and debris and look for opportunities to minimize the pollutant source.

- Regularly remove trash and plant debris.
- Remove accumulated sediment (see “Sediment Removal” in this guidebook).
- Make sure inlets and outlets are not clogged.
- Identify the source of trash, debris, or pollutant, such as a spill, leak, or illicit discharge.
- If there is evidence of a spill or leak, call 9-1-1. Use trained professionals for any cleanup or remediation.

Troubleshooting Guide

PONDING WATER

Importance to Facility Performance

Most facilities are designed to drain in a certain amount of time. This varies from two to 48 hours depending on the type of facility. Ponding water is usually a sign that the facility's filter or outlet is clogged or it is not infiltrating properly.

Type of Facility	Facility Needs Maintenance When
Vegetated Vegetated Rooftops, Bioretention Facilities, Ponds, Swales, and Vegetated Filters **Underground** Manufactured Facilities and Sand Filters **Infiltration** Permeable Paving Materials	• Clogging of overflows or outlets with debris, trash, or other obstructions. • Fine sediments filtering into the soil or other filtration media (like sand or gravel) that can prevent proper infiltration. • Water that has remained ponded for more than 72 hours. • Evidence of seepage at toe of slope on embankment (wet and dry ponds).

What to Do

Any area with erosion more than two inches deep needs maintenance.

- For surface facilities, first try raking the top few inches of soil to break up clogged sections and restore water flow.
- Clean out overflows and outlets with hand tools, if possible. Difficult or hard to access blockages may require professional contractors.
- Identify sources of sediment and debris and prevent them from entering the facility.
- Make sure the facility has adequate vegetation. Vegetation absorbs water and roots help keep soil loose so it can infiltrate water.
- Make sure there is a sufficient amount of mulch in vegetated facilities. This will also help to absorb excess water.

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Stormwater Lingo - A Glossary of Commonly Used Terms

A

Access Systems
Measures and devices that provide access to facility components by maintenance personnel and equipment.

Aeration
The process of introducing air space into soil.

Anti-Vortex Device
A device that promotes the settling of pollutants by preventing a whirlpool from occurring at the outlet device.

B

Berm
An elongated elevated ridge of material that is used to hold or direct stormwater.

Best Management Practice - BMP
A facility designed to reduce the impacts on local streams from pollutants and increased stormwater caused by development.

Bypass System
A system which allows maintenance by temporarily diverting stormwater or allowing it to flow through a facility during heavy rain events.

D

Dam/Embankment
The wall or structural fill that impounds runoff in the facility.

Dredge
The process of physically removing sediment from the bottom of a pond.

E

Emergency Outlet/Spillway
The structure that safely conveys overflows from the facility.

Emergent Plants
An aquatic plant that is rooted in sediment but whose leaves are at or above the water surface.

F

Filter Fabric/Geomembrane
A webbed fabric which serves to filter pollutants or to hold a filter medium such as gravel or sand in place.

I

Impervious Cover
Any hard surface that prevents water from infiltrating into the soil.

Integrate Pest Management Plan - IPM
A plan that minimizes the application of pesticides and fertilizers on vegetated or grassed areas.

L

Low Impact Development - LID
An integrated stormwater management design strategy to replicate pre-development hydrology. LID techniques promote storage, infiltration, and groundwater recharge.

P

Perimeter
The outward boundary of the BMP.

Principal Outlet
The structure that controls and conveys the facility's outflow.

Pump System
Electrical/mechanical components, including pipework, used to convey discharge under pressure.

R

Riprap
A layer or mound of large stones placed to prevent erosion.

Riparian
Habitat occurring along the banks of a water body.

Riser/Outlet
A vertical pipe extending from the bottom of a BMP that is used to control the rate of stormwater discharge.

S

Side Slopes
Slopes at dams, embankments, spillways, and the facility perimeter.

Swale
An elongated depression in the land used to channel runoff.

Stormwater Management - SWM
A system of structural and non-structural practices used to control the water quantity and water quality of stormwater runoff.

T

Trash Rack
Device placed upstream of the principle outlet or drain to intercept debris.

Trickle Ditch/Low Flow System
Measures that convey low and dry weather inflows to the principle outlet without detention.

V

Vegetative Cover
Vegetation used to stabilize surfaces and/or provide stormwater treatment.

Stormwater Resource Guide

Local Government Agencies - Information on facilities, maintenance agreements, and responsibilities.

Arlington County	Water, Sewers, and Streets Division	703-228-6485 www.arlingtonva.us
City of Alexandria	Transportation and Environmental Services	703-838-4334 www.alexandriava.gov
Town of Dumfries	Public Works	703-221-3400 www.dumfriesvirginia.org
Fauquier County	Community Development	540-347-8660 www.fauquiercounty.gov
Town of Leesburg	Engineering and Public Works	703-771-2790 www.leesburgva.org
Fairfax County	Maintenance and Stormwater Management Division	703-934-2800 www.fairfaxcounty.gov
City of Fairfax	Public Works, Stormwater Supervisor	703-385-7980 www.fairfaxva.gov
City of Falls Church	Public Works	703-248-5080 www.ci.falls-church.va.us
Town of Herndon	Public Works	703-435-6853 www.herndon-va.gov
Loudoun County	Building and Development	703-777-0397 www.co.loudoun.va.us
City of Manassas	Public Works	703-257-8378 www.manassascity.org
City of Manassas Park	Public Works	703-335-8820 www.cityofmanassaspark.us
Prince William County	Environmental Services	703-792-7070 www.co.prince-william.va.us
Town of Vienna	Public Works	703-255-6381 www.ci.vienna.va.us

Soil and Water Conservation Districts (SWCD) - Information on erosion and sediment control.

John Marshall SWCD	Fauquier County	540-347-3120 www.co.fauquier.va.us/government/departments/jmswcd
Loudoun SWCD	Loudoun County	703-771-8395 www.loudoun.vaswcd.org
Northern Virginia SWCD	Fairfax County	703-324-1460 www.fairfaxcounty.gov/nvswcd
Prince William SWCD	Prince William County	703-594-3621 www.pwswcd.org

Virginia Cooperative Extension Offices - Information on vegetation and landscape management and soil testing laboratories.

Arlington County	703-228-6400 www.offices.ext.vt.edu/arlington
City of Alexandria	703-519-3325 www.offices.ext.vt.edu/alexandria
Fairfax County	703-324-8556 www.offices.ext.vt.edu/fairfax
Fauquier County	540-341-7950 www.offices.ext.vt.edu/fauquier
Loudoun County	703-777-0373 www.offices.ext.vt.edu/loudoun
Prince William County	703-594-3621 www.offices.ext.vt.edu/prince.william

Additional Contacts

Northern Virginia Regional Commission	703-642-4625 www.novaregion.org
Prince Georges County, Maryland	301-883-5935 www.goprincegeorgescounty.com
Virginia Department of Game and Inland Fisheries	804-367-1000 www.dgif.state.va.us
Virginia Department of Transportation	703-383-VDOT www.virginiadot.org

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www.novaregion.org/bmp.htm

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www.epa.gov/region01/assistance/ceitts/stormwater/techs.html

Northern Virginia Regional Commission
3060 Williams Drive, Suite 510
Fairfax, VA 22035
www.novaregion.org

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