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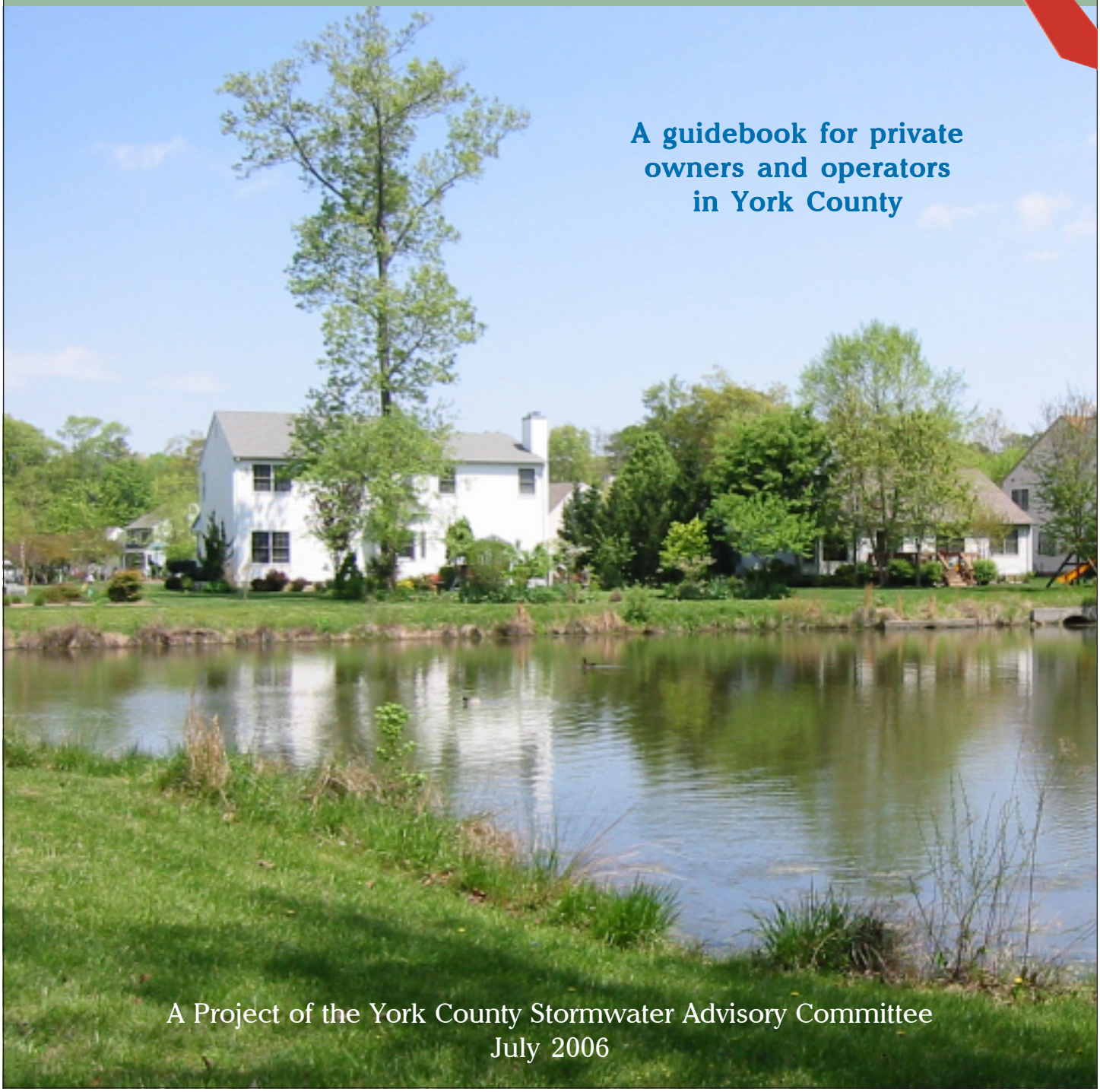
Maintaining Your Stormwater Lakes and Ponds



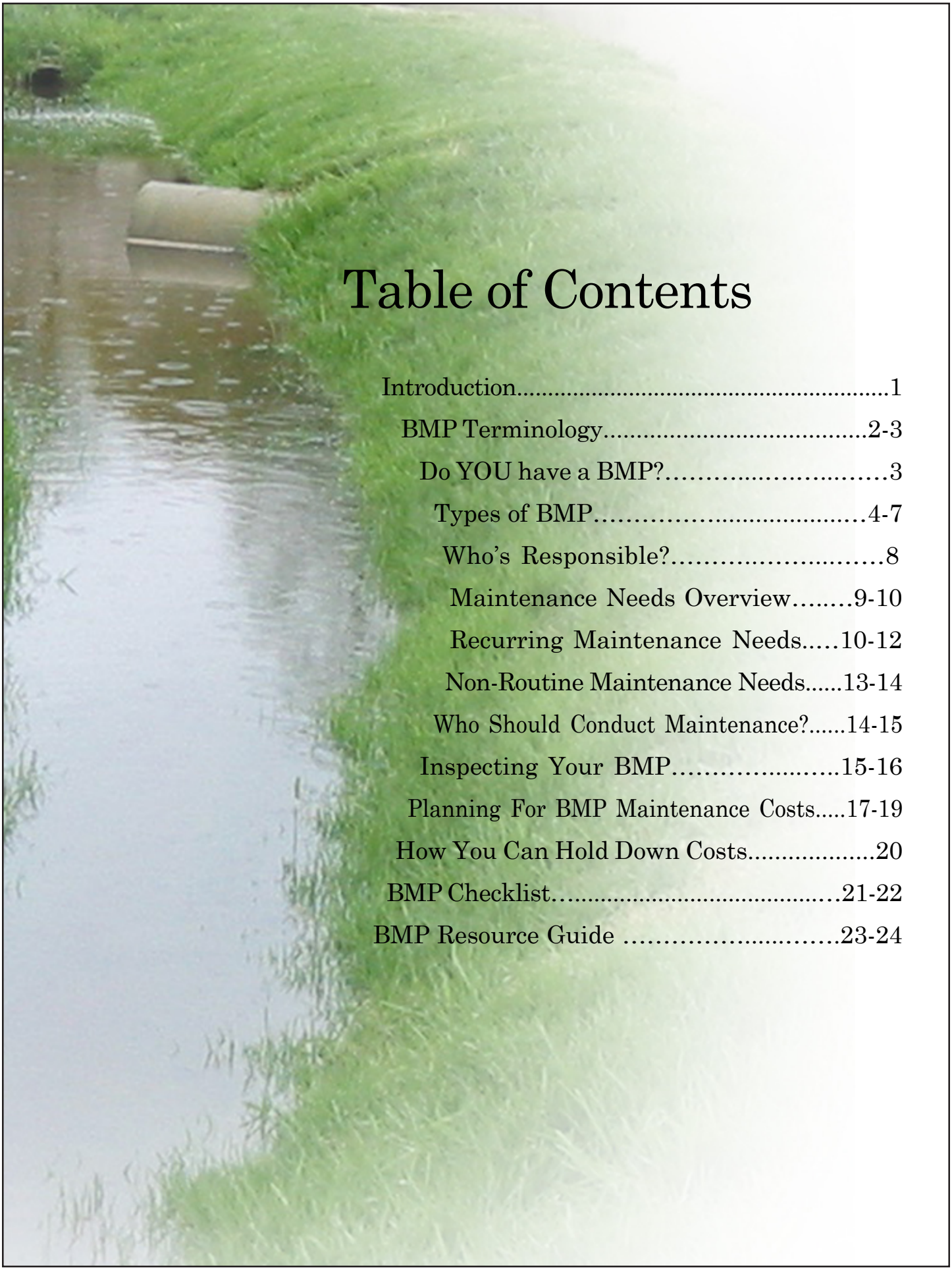
A guidebook for private owners and operators in York County

A Project of the York County Stormwater Advisory Committee
July 2006

What Is a BMP?

BMPs, or Best Management Practices, are facilities designed to reduce the impacts of pollutants and increased stormwater on local streams caused by development. They are an essential part of the region's efforts to restore aquatic habitats in many local rivers and the Chesapeake Bay. However, BMPs may fail prematurely if not properly maintained. Once a BMP fails, it will no longer perform the intended functions and repair or replacement can be very expensive.

Whether you are an individual property owner, a homeowner's association representative, or a residential/commercial property manager, this Guidebook outlines basic maintenance and planning tasks that will help keep your BMP functioning properly.



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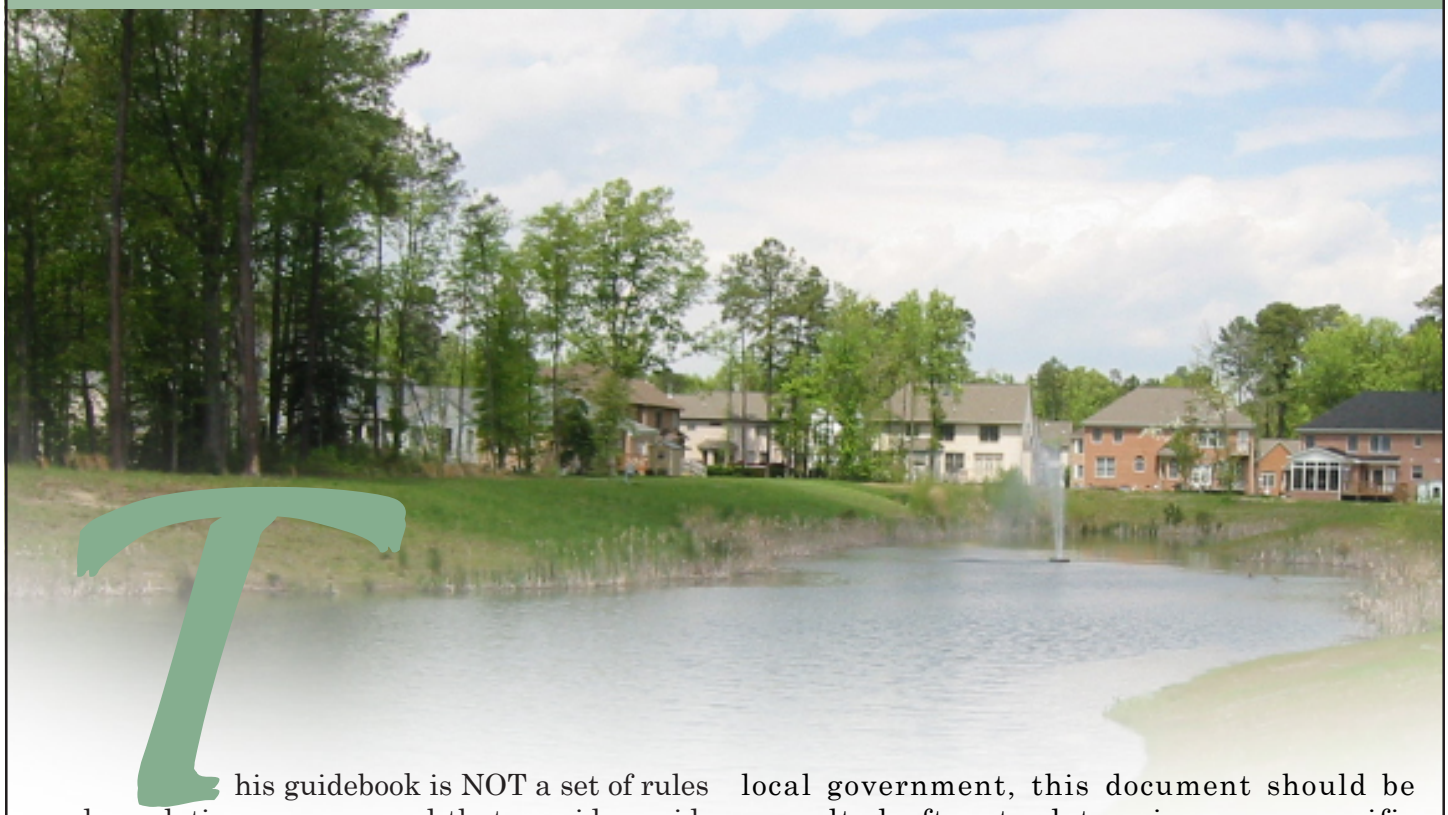
Introduction



This guidebook is NOT a set of rules and regulations or a manual that provides guidance on how to design or build a BMP. Rather, it is a guide to an effective BMP maintenance program that will save you money and time in the long run. Key points to remember as you read through this Guidebook:

Identify Facility Characteristics and Maintenance Needs. Understand how your facility works and its specific maintenance needs. While this Guidebook includes general information on the maintenance needs of common BMPs, valuable information can also be gained by consulting with your local government and other sources provided in the BMP Resources Guide on pages 23-24.

Identify Costs and Allocate Resources. While routine maintenance costs can typically be predicted for an annual budget, some BMP maintenance tasks will require infrequent but considerable expenses. Non-routine expenses should be identified, and a long-term fund allocation plan needs to be developed.

Check Your Maintenance Agreement. If you have a BMP maintenance agreement with your local government, this document should be consulted often to determine your specific obligations. If not, do you have a maintenance agreement with a local lake maintenance company? If so, check the scope of work as listed in the contract.

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 help identify potential problems early.

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 BMP maintenance program.

Involve the Community. Pollutants treated by your BMP are generated from surrounding yards, streets, and businesses. Implementing a pollution prevention program and educating neighbors on the purpose of the BMP is a cost effective way to prolong its life and to protect water quality.

BMP Terminology

Like many technical professions, the world of BMP maintenance has a language all its own. The following is a glossary of common BMP terms.

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

Aeration. The process of introducing air and increasing oxygen in the water of a BMP to improve the aquatic ecosystem.

Algae. A small plant that grows naturally in most lakes, rivers and ponds. Nutrients like phosphorus and nitrogen can make algae grow faster.

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

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

Bioretention Basin. A water quality BMP designed to filter the water quality volume through an engineered planting bed, consisting of a vegetated surface layer, planting soil and sand bed. Also called rain gardens.

BMP. Best Management Practice.

Bypass System. A system that allows maintenance by temporarily diverting stormwater.

Catch Basin. An inlet chamber usually built at the curb line of a street or low area, for collection of surface runoff and admission into a storm sewer system.

Check dam. Small dam constructed in a channel or ditch to decrease the flow velocity, minimize erosion and promote the deposition of sediment.

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

Detention Pond/Basin. A BMP which provides temporary storage of stormwater runoff and discharges it through a hydraulic outlet to a downstream conveyance system. Normally dry during non-rainfall periods. Also known as a dry pond.

Erosion. The wearing away of the land surface by water, wind and ice. Or the process of detachment and transportation of soil materials by erosive agents.

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.

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

Fountains. A decorative water feature that does not improve water quality because they use a low volume of water at high pressure.

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

Inlet. The pipe that carries stormwater to a BMP.

Invert. The lowest flow line elevation in any component of a storm water system including basins, channels, catch basins and other stormwater structures.

Outfall. A pipe or drainage structure that discharges stormwater directly into a stream, river or waterway.

Perimeter. The outward boundary of the BMP.

pH. An expression of the intensity of the basic or acidic condition of a liquid. Natural waters usually have a pH range between 6.5 and 8.5.

Phosphorus. An element found in fertilizers and sediment runoff which can contribute to the process of over-enrichment of water bodies by nutrients often typified by the presence of algal blooms.

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

Pump System. Electrical/mechanical components including pipe work used to convey BMP discharge under pressure.

Retention Pond/Basin. A stormwater management facility which includes a permanent impoundment, or normal pool of water, for the purpose of enhancing water quality and, therefore, is normally wet, even during non-rainfall periods. Also known as a wet pond.

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

BMP Terminology (Cont.)

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

Sediment. Material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by water or wind. Sediment piles up in reservoirs, rivers, lakes and waterways, destroying wildlife habitat and clouding water so that sunlight cannot reach aquatic plants.

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

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

Storm Sewer. A system of pipes, separate from sanitary sewers, that only carries runoff from buildings and land surfaces.

Stormwater. Rainwater that runs over land.

SWM. Storm Water Management.

Trash Rack. Device placed upstream of the principal 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.

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

Do You Have A BMP?

Simple depressions, ponds, or ditches that you see every day may actually be engineered facilities designed to improve water quality and reduce flooding.

BMP, which is short for Best Management Practice, is the term used to describe a structure or facility that reduces the impacts of development on water quality and aquatic habitats.

Pollutants caused by urban development (called nonpoint source pollution) include sediment, nutrients, motor oil, lawn care products, and anything else that can wash from rooftops, driveways, parking lots, lawns, and streets during a storm event. In addition, urban stormwater drainage patterns, which do not allow stormwater to infiltrate into the ground, can often result in flooding.

BMPs operate by temporarily detaining or slowing stormwater, after which a number of pollutant removal mechanisms are employed (see types of BMPs for details). Some BMPs, such as sand filters, can be located completely underground, making their presence difficult to detect. However, most BMPs are located on the surface. The two most common BMPs in York County are dry ponds and wet ponds.

If you do have a BMP, you are not alone. A variety of laws, including the Virginia Chesapeake Bay Preservation Act, the Virginia Stormwater Management Act, and the federal Clean Water Act, encourage or require the

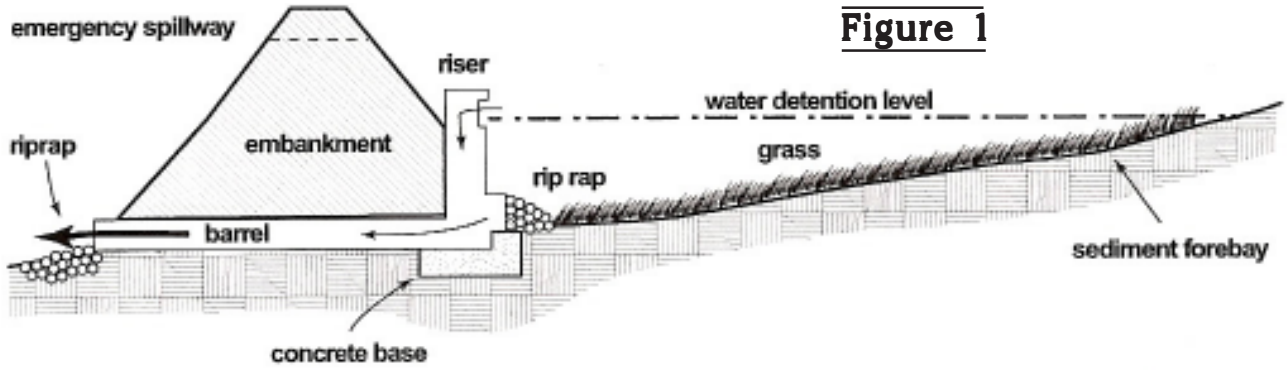


Figure 1

control of urban pollutants. As such, maintaining your BMP is an important part of York County's environmental protection efforts.

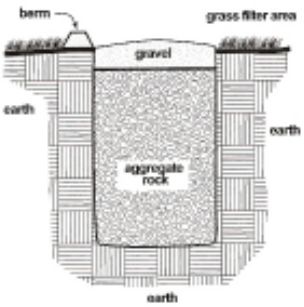
Types of BMPs

Although there are many types of BMPs in York County, the two most common types are the dry pond and the wet pond. Taking a moment to understand what kind of BMP you have and how it works will help you to better plan for its maintenance needs.

EXTENDED DETENTION BASINS "DRY PONDS" *(Fig. 1)*

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 to settle to the bottom. The impounded water is discharged through an outlet that provides for prolonged release. These are the most common BMPs in York County. Most dry ponds do not contain a permanent pool of water, and no water will remain if it is functioning properly. Some dry ponds, however, incorporate a shallow marsh or wetland to improve pollutant removal. These facilities are known as extended detention wetland basins or two stage detention ponds. **It is important to determine whether standing water is by design or a sign that maintenance is required.**

INFILTRATION TRENCHES



Infiltration trenches are gravel-filled excavations that temporarily store stormwater and allow it to sink into the underlying soil. Stormwater can enter the facility in one of two ways. In a dispersed input facility, water from impervious surfaces is directed over a gently sloping grassed area to remove large particles that otherwise might clog the facility. In a concentrated input facility, runoff is transferred to the trench directly from curb inlets, gutters, and pipes.

RETENTION BASINS — "WET PONDS" *(Fig. 2)*

Wet ponds contain a permanent pool of water much like a lake. The wet pond is designed to hold a permanent pool, above which stormwater

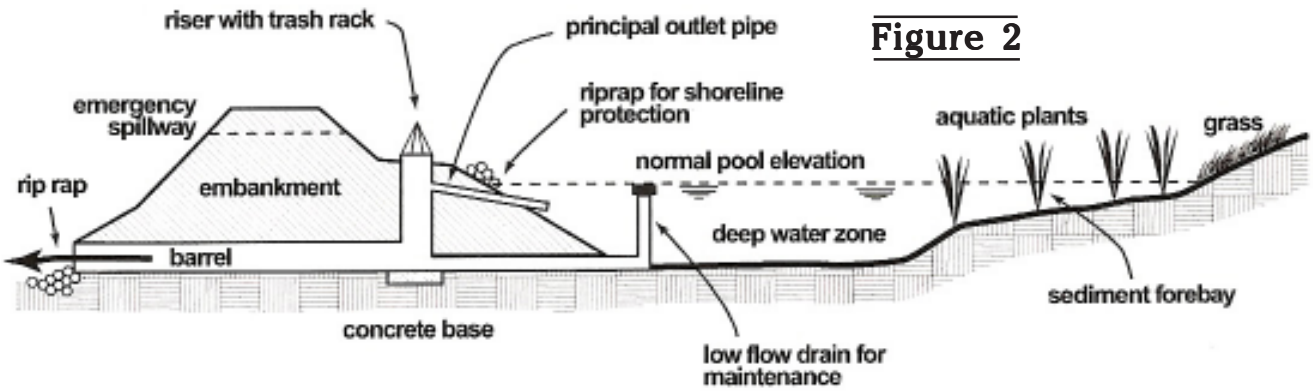


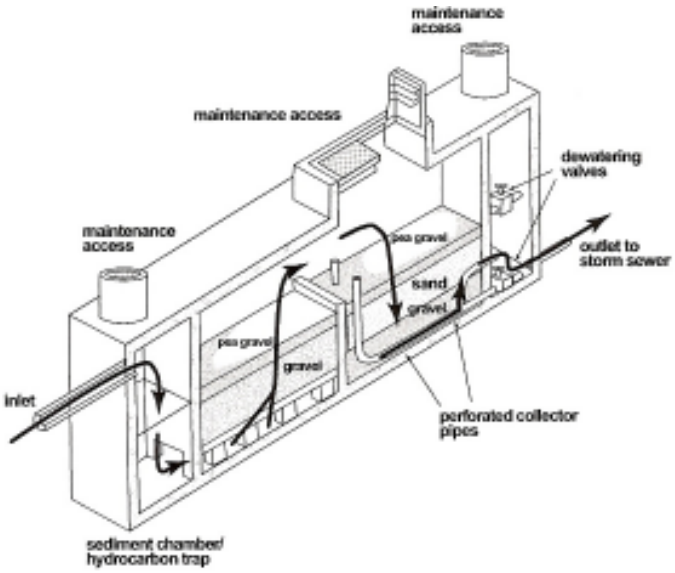
Figure 2

runoff is temporarily stored 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. Wet ponds can also serve as an aesthetic or recreational amenity as well as a habitat for some wildlife. However, wet ponds pose a higher safety liability than other BMPs.

CONSTRUCTED WETLANDS

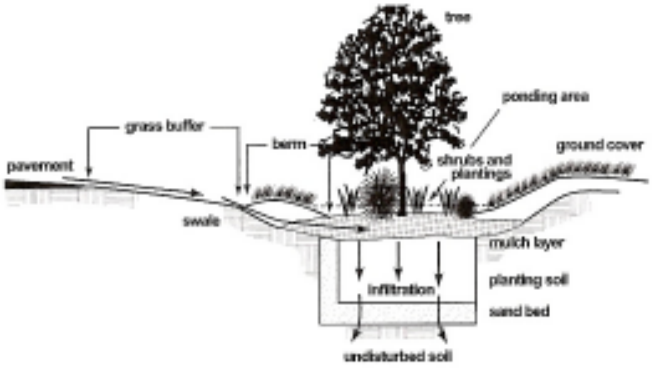
Constructed wetlands are constructed basins that have a permanent pool of water throughout the year (or at least throughout the wet season) and differ from wet ponds primarily in being shallower and having greater vegetation coverage. Wetlands are among the most effective stormwater practices in terms of pollutant removal and they also offer aesthetic value.

SAND FILTRATION SYSTEMS



Sand filtration systems (sand filters) 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 work by slowly filtering stormwater through a layer of sand (and sometimes a sand/peat mix) and pollutants are removed when they become trapped between sand particles and other filter media. In some filters, microbes help remove pollutants through bio-chemical conversion.

BIORETENTION FACILITIES "RAIN GARDENS"



Bioretention facilities, or "rain gardens," are basins designed to mimic the conditions found on 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, some of which are selected because of their ability to bind and convert pollutants to biomass. In areas where the local soils do not support infiltration, a bioretention facility may be underlain by a sand filtration, and underdrain that carries treated water to a storm drain.

GRASSED SWALES

Grassed swales can be seen along many of Virginia's roadways, although they are not always designed to treat stormwater. Typically, grassed swales are concave, earthen conveyance systems designed to simply transfer runoff. As a water quality device, a grassed swale is constructed to allow stormwater to soak into the soil, and particles are trapped by the ground cover – usually turf grass. Many swales are constructed with berms (small dams made of earth, rock, or wood) to create temporary ponds that prevent erosion and help promote infiltration of stormwater into the soil.

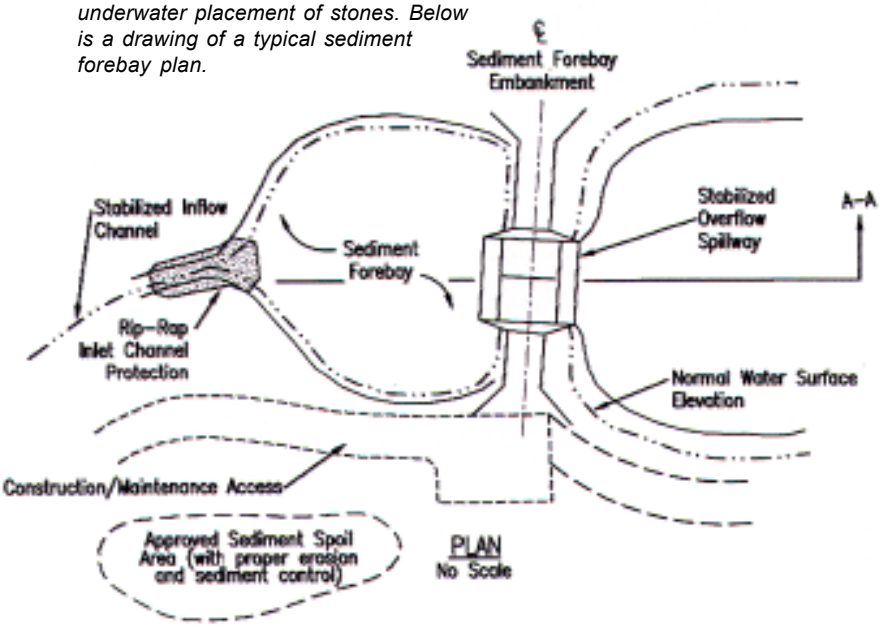
If you don't recognize any of these BMPs, call York County's Department of Environmental and Development Services (EDS) to find out what you have and whether it has special maintenance requirements.

SEDIMENT FOREBAY

A sediment forebay is a settling basin or plunge pool constructed at the incoming discharge points of a stormwater BMP. Its purpose is to allow sediment to settle from the incoming stormwater runoff before it is delivered to the balance of the BMP. A sediment forebay helps to isolate the sediment deposition in an accessible area, which facilitates BMP maintenance efforts.

Direct access to the forebay should be provided to simplify maintenance. Provision of a hardened access or staging pad adjacent to the forebay is also beneficial. Such an area helps protect the forebay and basin from excessive erosion resulting from

The sediment forebay shown above is known as a "Gabion basket" forebay, which provides structural support for underwater placement of stones. Below is a drawing of a typical sediment forebay plan.



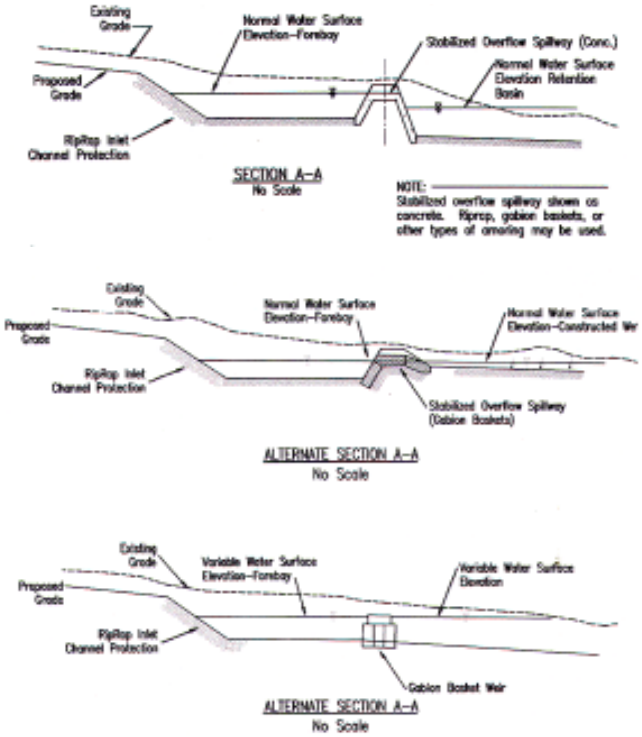
A traditional sediment forebay, such as the one above, encourages sediment to settle in one place, lowering maintenance costs. Below are drawings showing different ways the forebay can be configured.

operation of the heavy equipment used for maintenance. In addition, a fixed, vertical, sediment depth marker should be installed in each sediment forebay to measure the sediment deposition. The sediment depth marker will allow the owner to monitor the accumulation and anticipate maintenance needs.

Clean-out frequency will vary depending on the conditions of the upstream watershed and the given site.

In general, sediment should be removed from the forebay every three to five years, or when 6 to 12 inches have accumulated, whichever comes first. To clean the forebay, draining or pumping and a possible temporary partial drawdown of the pool area may be required.

To reduce the cost associated with hauling and disposing of dredged material, a designated spoil area should be approved and identified on the site during initial design and development of the project.



Who Is Responsible?

COUNTY OF YORK

STORMWATER MANAGEMENT/BMP
MAINTENANCE AGREEMENT

THIS AGREEMENT, made this day of_____, 20__, by and between_____, hereinafter referred to as the "developer," and the COUNTY OF YORK, Virginia, a political subdivision of the Commonwealth of Virginia, hereinafter referred to as the "County".

WITNESSETH:

WHEREAS, the developer is the owner of certain parcel of land located in the County bearing GPIN Number _____, hereinafter referred to as the "Property"; and

WHEREAS, the Property is being developed by the Developer into a project known and designated as_____, and has had prepared a site plan for the said development dated_____, 20__, hereinafter called the "Plan", which has been approved by the County, and is on file in the Utilities Division office for York County, and is incorporated herein by reference; and

WHEREAS, the County requires that on-site stormwater management/BMP facilities be constructed and adequately maintained by the Developer, its successors and assigns;

NOW, THEREFORE, for and in consideration of the foregoing premises, the mutual covenants contained herein, and the following terms and conditions, the parties hereto agree as follows:

1. The on-site stormwater management/BMP facilities shall be constructed by the Developer, its successors and assigns, in accordance with the plans and specifications identified in the Plan.

THE BOTTOM LINE: A maintenance agreement sets out your legal obligations.

We are all responsible for protecting water quality. But are you responsible for the maintenance and upkeep of your BMPs?

If you are a member of a homeowner association, you need to check your by-laws to determine if you are responsible for your BMP. If you are unsure who owns the BMP, contact the York County EDS to check property ownership. However, **if your community or business is subject to a BMP maintenance agreement, most likely you are the responsible party.** It is important to check your maintenance agreement to identify your specific legal obligations – although doing a little extra never hurts.

If you are not sure who is responsible for maintenance, are unable to locate your maintenance agreement, or have questions about what your maintenance agreement means, refer to the BMP Resource Guide at the back of this Guidebook.

Maintenance Needs Overview

UNTIMELY DEMISE: Of the ponds that fail in the first five years, over half of them fail due to lack of proper maintenance.

A consistent maintenance program is the best way to ensure that a BMP will continue to perform its water quality functions. In general, a maintenance program should contain the components listed below.

- Regular Inspections
- Vegetation Management - Cutting Grass
- Embankment and Outlet Stabilization (Keeping trees out)
- Debris and Litter Control
- Mechanical Components
- Insect Control
- Access Maintenance
- Overall Pond Maintenance
- Sediment/Pollutant Removal/Control
- Components Replacement
- Owner/User Education Program

Actual maintenance needs will obviously vary according to the specific facility and site conditions. The following are a few factors affecting type and frequency of maintenance that will be needed.

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

· **Landscaping.** Maintenance needs will vary considerably depending upon the types of vegetation used in landscaping. Rain gardens in particular will require special attention to vegetation management.

· **Upstream Conditions.** The condition of the watershed upstream of the facility can significantly impact the amount of sediment and other pollutants that a facility must manage. Erosion problems upstream can dramatically increase the

amount of sediment entering the facility. Upstream commercial and recreational areas may also result in an increased need for litter removal.

A BMP maintenance program should also consider the following:

- **Safety.** Since BMPs often involve the impoundment of water, the safety of nearby residents must be considered. This includes maintaining appropriate fencing and signage.

- **Need for Professional Judgment.** BMPs are water treatment facilities. While some maintenance can be undertaken by a non-professional the judgment of a professional, should be consulted regularly.

- **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. Some Homeowner Associations By-laws state a requirement to maintain funds for BMP repair. For higher costs, a financial manager should be consulted.

Recurring Maintenance Needs

Routine maintenance will keep your BMP functioning properly for a longer period of time and will pay off in the long run by preventing, delaying, or mitigating unnecessary repairs. The following is an overview of the common routine maintenance needs of most BMPs.

Regular Inspections

In many instances, an annual or semi-annual inspection, depending on the facility, is required. It will also be necessary to conduct an inspection any time that the BMP's capacity has been 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 Your BMP" on pages 15-16.

Vegetation Management

Most BMPs rely on vegetation to filter sediment from stormwater before it reaches the BMP and to prevent erosion of the banks and the bottom of the facility. Turf grass is the most common groundcover; many BMPs use woody vegetation (rain gardens) and wetland plants (wet ponds) to increase pollutant removal.

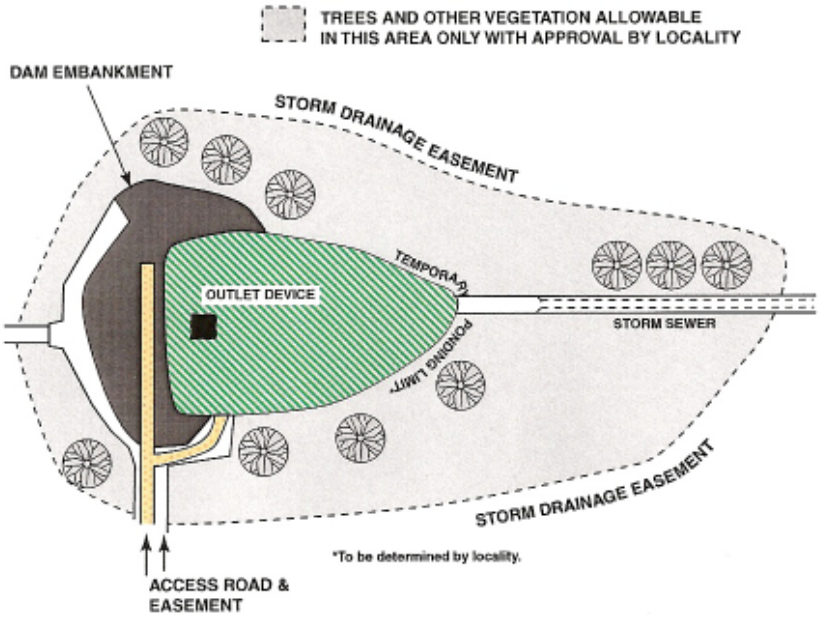
The following is a quick reference of ways to help your vegetation stay healthy.

- **Mowing.** Most grass is hardiest if it is maintained as an upland meadow, cut no shorter than 6 to 8 inches. If a more manicured look is desired, special attention to the health of the turf is needed. Grass should never be cut below 4 inches. Grass on embankments should be cut at least twice during both growing seasons and once during the summer. Guidance documents are available to help set your blade at the appropriate height for the specific turf grass. Contact the Virginia Cooperative Extension Office for further information (see "BMP Resource Guide," pages 23-24).

- **Routine Harvesting of Vegetation.** Routine harvesting of vegetation in constructed wetlands may increase nutrient removal and prevent the export of these constituents from dead and dying plants falling in the water. Vegetation harvesting in the summer is recommended.

- **Pest and Weed Control.** To reduce the amount of pollutants reaching the BMP, avoid overfertilization and excess pesticide use. Your local Virginia Cooperative Extension Office (see "BMP Resource Guide," pages 23-24) can provide additional information.

- **Removing Sediment Build-Up.** Because vegetation surrounding a BMP is designed to trap sediment, it is likely to become laden with sediment and bare spots may emerge. Bare areas should be vigorously raked, backfilled if needed and covered with topsoil. Disturbed areas should be seeded (a tall fescue grass seed



Vegetation Management

Vegetation management is critical in areas immediately surrounding almost all BMPs. The accompanying figure shows critical management areas for wet and dry ponds. Woody vegetation should be avoided in all areas except where they will not affect structural components or maintenance access. Always check with your local government before planting.

is recommended) and mulched. Excess material should be taken off-site and can be used as a mulch or soil supplement.

· **Unwanted Vegetation.** Some vegetation is destructive to a BMP. Keeping dam and bottom areas free of deep-rooted vegetation (trees and bushes) is critical because roots can destabilize the structure. Consistent mowing and monitoring will control any unwanted vegetation.

· **No Mow Zones.** For wet ponds, a 10-foot un-maintained 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 erosion.

· **Activities that have the potential to damage vegetation or compact the soil should be avoided.** What may seem like a harmless activity (sports activities, inappropriate landscaping, etc.) could take years off the life of your facility. **Before altering vegetation in a BMP, contact York County Department of Environmental and Developmental Services (EDS).**

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 of stabilization.

Animal burrows will also deteriorate the structural integrity of an embankment. Muskrats 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 sinkholes, cracking, wet areas around the outlet pipe, 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.

Not only are litter and debris unsightly, they can clog BMP components and create conditions perfect for insects.

- Prevent damage to vegetated areas.
- Reduce mosquito breeding habitats.
- Maintain facility appearance.
- Reduce conditions for excessive algae growth.

Special attention should be given to the removal of floating debris, which can clog inlet and outlet devices. If trash or dumping is particularly problematic, outreach to the local community can help.

Insect Control

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 control 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 maintain a stock of fish that feed on mosquito larvae. York County conducts aerial spraying and vehicle dispensed spraying to control mosquito infestation. Drainage maintenance crews also dispense larvacide "donuts" in specific areas to control mosquito breeding. The York County Mosquito Control Division can provide advice on the best option to use (See "BMP Resource Guide," pages 23-24).

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. 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 these areas is particularly important since one never knows when emergency access will be needed. Maintenance includes removal of woody vegetation and upkeep of gravel areas.

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 algae growth or the proliferation of a single species of plant in the permanent pool of a wet pond (see photo below). This may be caused by excess nutrients from fertilization practices or by excess sediment within the pond's drainage area or basin. Steps should be taken to reduce the nutrients at their source and to encourage the growth of more desirable aquatic and semi-aquatic vegetation in and around the permanent pool. Another indication of a unhealthy ecosystem is a low dissolved oxygen content. A method of improving oxygen levels is by aeration.

An invasion of a single aquatic species (such as water chestnut) indicates an unhealthy aquatic system.

Non-Routine Maintenance Needs

The non-routine maintenance needs of a BMP, while infrequent, can be major undertakings and should always be performed by a professional. While tasks will vary by facility, they typically include sediment/pollutant removal and replacement of BMP 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 naturally accumulate in a BMP and eventually need to be removed. Facilities vary so dramatically in terms of removal requirements that there are no fast "rules of thumb" to guide responsible parties. For instance, dry ponds should be cleared of sediment once a significant portion of the BMP volume (25-50%) has been filled. For wet ponds, a minimum water depth of approximately three to six 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 protect the stockpile against erosion. If onsite 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 reestablished, either through re-vegetation or, in the case of a sand filter, replacement of sand and other filter media if necessary.

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.

BMP Components Replacement

Eventually, as with most infrastructure, actual BMP components will need to be replaced. Components may include:

- Inflow and outflow devices
- Trash racks and anti-vortex devices
- Valves, orifices, and aerators
- Concrete structures (such as the casing for a sand filter)

- Pumps and switches
- Earthworks such as embankments and side slopes
- Mulches and vegetation

While most BMPs will last for a long time with proper maintenance, a community or business should plan long in advance for replacing these facilities.

Who Should Conduct 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 if desired. Maintenance tasks that are appropriate for a facility owner may include simple landscaping, education of those who are served by the facility, litter removal, and some routine maintenance.

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. 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 items that a professional landscaping firm might best manage. Trained personnel may be able to identify problems in their early stages of development when it is most cost effective to make repairs.

Working With Lawn Care Companies

Communicate to your lawn care company that your BMP is a water treatment system and 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 with BMP maintenance objectives.

- Communicate that the facility is a water quality protection device.
- Communicate specific instructions on mowing practices, for instance mowing at a higher level and perhaps not as frequently. Ask that heavy equipment be avoided where possible and particularly in vegetated pre-treatment areas.
- Communicate the need to keep sediment from building up in grassy areas and the need to keep the BMP facility clear of grass clippings (by the company and residents.)
- Ask whether the company follows an Integrated Pest Management (IPM) plan to minimize the application of pesticides and fertilizers. An IPM plan can include:
  - 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 there is heavy rainfall in the forecast.

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

Involving the Whole Community

Even if day-to-day maintenance is left to a professional, involving the entire community in certain BMP maintenance activities is a cost effective way to prolong the life span of the facility and to prevent pollution. Involving the community can take the form of BMP clean-up days or community education.

In many instances, people are not aware of the cumulative effects of small acts of pollution on local water quality. Others are not aware that their activities contribute to pollution at all. Through public education, people are made aware of how their actions impact water quality, and they become vested in protecting their environment. As your business or community considers developing a public education program, consider the following questions.

- What pollution problems need to be addressed? Is litter a problem? Does the BMP have an oil sheen, or has animal waste created problems?
- What activity or activities are responsible for pollution? Is the oil coming from automobile leakage? Do residents

Getting the community involved in BMP cleanup can be one of the most effective ways to maintain BMPs.

routinely repair automobiles on community streets?

- Who can help implement a community education program? Can a local Boy/Girl Scout troop, chamber of commerce, school, or environmental group be used?
- How will the message reach the targeted community? Possibilities include community meetings, bulletin boards, local newspapers, signage, assistance from the locality, pamphlets, field days, etc.
- How can alternatives to pollution generating activities be encouraged? Find out where used oil and antifreeze recycling stations are located, organize a hazardous household waste day, find out if public trashcans are an option.

Popular programs that the community may wish to consider include:

- Education on proper pet waste disposal, lawn and garden care, and automotive care; and,
- Finding and sharing information on recycling of used motor oil and antifreeze

A BMP maintenance day is another way to involve the community. Activities that are appropriate for communities to perform in such an event on a periodic basis include:

- Removal of debris and litter
- Seeding of bare spots
- Landscaping in areas other than the embankments (wildflowers, etc.)

Inspecting Your BMP

Inspecting your BMP allows you to detect problems early and to avoid long-term problems. It is also usually a requirement of your maintenance agreement. Inspection requirements vary from jurisdiction depending on the specific BMP. Some sand filtration systems require monthly inspections while other BMPs can be inspected on a yearly basis. Some localities provide inspections of all facilities while other require that the responsible party arrange for an inspection and send the results for confirmation. The York County EDS may be contacted to determine specific requirements.

It is unlikely that your lawn care or landscaping company has the know-how 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 your local landscaping or lake management companies for advice.

Self-Evaluation and When To Call A Professional

The development of problems may not coincide with a visit from an inspector – particularly if there are out of the ordinary circumstances. Communities and businesses are encouraged to perform frequent self-inspections. It is useful to have an original site plan on hand to help orient yourself. A self-inspection should be able to check for:

- Unexpected ponding
- Health of vegetation or growth of unwanted vegetation
- Obstructions of the inlet or outlet
- Excessive erosion or sedimentation
- Signs of dumping or pollutants other than sediment
- Cracking or settling of the BMP's structural components
- Wetness on the downstream side of the dam

- Low spots or sinkholes in bottom areas
- Deterioration of pipes
- Condition of the emergency spillway
- Condition of fences
- Shore erosion
- Stability of the side-slopes and downstream channel conditions
- Signs of vandalism

Inspections of underground systems such as sand filtration systems or infiltration trenches are obviously more difficult. A non-professional should never enter confined spaces meant for maintenance personnel. However, the facility owner should look for:

- Water remaining in the system longer than design draw down time;
- Obvious signs of excessive sediment build up or debris around the facility; and
- Signs of disturbance of manholes or damage to the structure caused by vehicles or settling.

Depending on the problem, either bring it to the attention of your landscape company or contact a professional BMP inspector.

Sample Self-Inspection Checklist

STRUCTURAL INTEGRITY			
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?	**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?	**Yes**	**No**	**N/A**
WORKING CONDITIONS			
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?	**Yes**	**No**	**N/A**
Is there an accumulation of floating debris and/or trash?	**Yes**	**No**	**N/A**
OTHER INSPECTION ITEMS			
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 garden BMPs, 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?	**Yes**	**No**	**N/A**

OTHER OBSERVATIONS_____

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

Planning For BMP Maintenance Costs

BMP maintenance costs can be divided into routine and non-routine. Routine costs can usually be predicted for an annual budget and will range from 4 percent of original capital costs per year for a dry pond to 9 percent of original capital costs per year for an infiltration trench. Annual maintenance costs per acre will vary considerably based on what is accomplished (mowing, weeding, fertilizing, reseeding, etc.), and how often.

Non-routine costs, however, can be considerable 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, 10 percent 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 2 percent to 5 percent a year should be established for replacement. Anticipated interest may be used to offset some of the effects of inflation. A financial manager should be consulted.

Estimating and Planning For Non-Routine Costs of BMP Maintenance

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. The primary non-routine costs are sediment/pollutant removal and BMP renovation/reconstruction.

The following sections provide information or sediment/pollution removal costs for (1) wet ponds and dry ponds, (2) sand filters, (3) infiltration trenches and rain gardens, and (4) grassed swales. General information is also presented on planning for BMP renovation/replacement.

Recurring Non-Routine BMP Maintenance

BMP	Sediment Removal Frequency	Facility Lifespan
Wet Pond	5 to 15 years	20 to 50 years
Dry Pond	2 to 10 years	20 to 50 years
Infiltration trench	As needed	10 years
Rain Garden	5+ years	Indefinite
Grassed Swale	As needed	Indefinite
Sand Filter	Every 6 months or as required	20 to 50 years

Wet and Dry Pond Pollutant Removal

In general, both wet and dry pond pollutant removal costs are similar unless otherwise noted. The costs reflected in the chart on the next page show the ranges of costs associated with sediment removal for various sized wet and dry ponds. Unfortunately, no dredging activities have occurred in York County as of the date of this publication so no accurate figures are available for this area. The information in the chart is from the Fairfax, VA area as of 1999.

- **Mobilization and Demobilization**. One of the larger fixed costs in dredging a BMP facility is mobilization and demobilization of the machinery. Large wet ponds will often require a waterborne operation during which an excavator or a crane must be mounted to a floating

barge and moved into position. The cost associated with such an operation could approach or exceed $10,000. 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. The costs of mobilizing and demobilizing for this type of operation could range from $1,000 to $7,000. Additional costs for the construction and restoration of access roads for trucks and heavy equipment may be required if not already provided.

- **Dredging.** The cost of dredging a BMP depends on the volume and composition of the sediment removed. The cost (expressed by cubic yard) is largely influenced by the depth of the water and distance between the excavation area and the "staging area" where sediment is transferred to trucks for removal. Based on February 2000 costs data published by the Northern Virginia Planning District Commission, the costs to dredge a wet pond is approximately $47/CY (e.g. dredging at $17/ CY + hauling/disposal at $30/CY). 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:

Surface area _____(acres) * depth of sediment_____(Feet) * 43,560 = _____ cubic feetCubic feet _____ / 27 = _____ cubic yards

Sample Wet and Dry Pond Sediment Removal Costs

	Surface Area	Surface Area	Surface Area	Surface Area
Surface area in Acres	0.25	1	2	10
Depth of Sediment to Dredge (in feet)	3	3	3	3
Cubic yards of Sediment (see formula)	1,210	4,840	9,680	48,400

Costs (based on above calculations)

Cost Range	Low	High	Low	High	Low	High	Low	High
Mobilization / Demobilization / Access Road	$1,000	$2,500	$3,000	$5,000	$5,000	$7,000	$5,000	$10,000
Dredging Cost *	$18,150	$24,200	$72,600	$96,800	$145,200	$193,600	$726,000	$968,000
Dredging cost per cubic yard	$15	$20	$15	$20	$15	$20	$15	$20
Disposal costs	$6,050	$56,870	$24,200	$227,480	$48,400	$454,960	$242,000	$2,274,800
Disposal cost per cubic yard	$5	$47	$5	$47	$5	$47	$5	$47

Total Cost **	Low	High	Low	High	Low	High	Low	High
	$25,200	$83,570	$99,800	$329,280	$198,600	$655,560	$973,000	$3,252,800

* **Dredging calculations assume a sediment accumulation of 3 feet.** Costs will vary according to sediment depth. Estimated costs also assume that the facility is drained and the silt is dewatered in place.

** The dollar figures used in this chart are rough estimates of potential costs. Because of varying issues such as dredging depth, sediment composition, pollutant levels, transportation distance, etc… accurate costs cannot be estimated without a detailed study of the actual site. It is likely that actual costs may be considerably higher in current dollars.

- **Disposal.** The primary determinant of disposal costs is whether on-site disposal is an option. If on-site disposal is not available, then landfill and transportation costs are an issue. Dumping at a landfill may cost an estimated $30 to $40 per cubic yard (fees may cover dumping costs, transportation depending on the dump location, mileage, and hourly charges, environmental fees, etc)

By adding the likely costs of these three components in a dredging activity (see chart), one can establish a rough estimate in which an owner can expect to pay for sediment/pollutant removal.

Infiltration Trench and Rain Garden Pollutant Removal Costs

Infiltration-dependent BMPs, including infiltration trenches and rain gardens, require maintenance based upon findings of frequent inspections. For a typical infiltration trench, the major cost will be to remove the top six to twelve inches of gravel and to replace the filter cloth sediment barrier. The cost of such an operation is generally between $1,500 to $2,000.

Because rain gardens rely on a special mixture of soils for their operation, non- routine removal of sediments and replacement of some level of soil will be required periodically. The cost associated with such an operation is generally from between $1,500 to $2,000 depending upon the size and complexity of the facility.

Because the cost of infiltration trench and rain garden maintenance will vary depending on the size and frequency of maintenance, the owner should consult a local government representative to determine an appropriate funding level.

Sand Filter Pollutant Removal Costs

The most common pollutant removal cost of a sand filter is to remove the top filter cloth (if applicable) and remove/replace the filter gravel. The cost, expressed as dollar per impervious acre (that is, parking lots, roadways, and rooftops draining to the facility), is generally $1,500 to $2,000. Most sand filters only serve a few acres of land. The frequency of filter maintenance largely depends on the type of BMP. A D.C. Sand Filter will require that carbon trap be pumped and refilled every six months ($500 to $700) and the filter cloth and the gravel be removed and replaced every 3 to 5 years ($1,500 to $2,000 per impervious acre served.) An Austin Sand Filter, which is more commonly used in residential areas, may only need to be cleaned when a semi-annual inspection reveals that it is necessary.

If an oil sheen is present in the facility, the owner will be required to have the oil removed by a qualified oil recycler. Other expenses, such as removal of trash and hydrocarbons from water traps, may also be required.

Again, the owner should consult a local government representative to determine an appropriate funding level.

Grassed Swale Pollutant Removal Costs

Unlike other BMPs, grassed swales will last an indefinite period of time given proper maintenance. The primary non-routine maintenance cost associated with grassed swales is to remove accumulated sediments, to replace check dams (often constructed of earth, riprap, or wood), and to reseed. Such an operation should need to be performed only once every two years. When the grassed swales are on road right-of-way, this type of activity may be covered through State maintenance. To find out if the swale is on State property, call the Virginia Department Transportation at (757) 253-4832.

Planning For the Reconstruction/ Renovation of Your BMP

Like all infrastructure, including highways, bridges, schools, etc., BMPs have a life span. For instance, most infiltration trenches will need to be completely renovated every 10 years. Most BMPs will last from 20 years to as many as 50 years if property maintained. However, BMP requirements have been in place long enough (since the 1970s and 1980s) for many business and communities to have to grapple with the cost of reconstruction and/or renovation.

The reconstruction or renovation costs of any BMP are highly site specific and will be more or less expensive, adjusting for inflation, than the original cost of construction depending on access issues and the items needing replacement.

How You Can Hold Down Costs

Properly cared for, a BMP can work effectively for years without major maintenance costs. Abused, it can potentially be a continual financial drain. Businesses and homeowners associations can minimize costs and the potential liability of those responsible for BMP maintenance by promoting the following simple rules.

DO!

- Keep properties, streets, and gutters free of trash, debris, and lawn clippings.
- Provide information to those who maintain their own automobiles on where to recycle oil and antifreeze.
- Encourage residents to take dirty vehicles to a commercial carwash or select a location where water does not enter a storm drain.
- Put a pan underneath your car if it is leaking to catch the fluids until it is repaired. Spread an absorbent such as cat litter to soak up drippings and dispose of properly.
- Educate residents on where to properly dispose of hazardous wastes, including oil and latex paints.
- Plan lawn care to minimize the use of chemicals and pesticides. Sweep paved surfaces and put the sweepings back on the lawn.
- Limit the amount of impervious surfaces. For patios, walkways, and landscaping, consider porous pavements such as bricks, interlocking blocks, or gravel.
- Incorporate native trees, shrubs, and groundcovers to help the water soak into the ground. Select species that need little fertilizer or pest control and are adapted to specific site conditions.
- Sweep up and dispose of ice melting chemical residues in the winter. This will protect grass and other landscaping plants.

DO NOT!

- Dump used motor oil, antifreeze, or other oil and grease into storm inlets. This is a criminal offense.
- Dump grass clippings, leaves, soil, or trash of any kind into a BMP or a storm inlet. Leaves and grass clippings release bacteria, oxygen consuming materials, and nutrients. They will also clog BMP components.

- Dispose of pet wastes in the storm system, including grassy areas near a BMP. Animal wastes contain disease causing bacteria and release oxygen consuming materials.
- Wash dirty vehicles on streets or driveways. Whatever comes off the car ends up in the BMP.
- Overfertilize the lawn. Whatever washes off the lawn or impervious areas (such as driveways or sidewalks) drains into the BMP and shortens its lifespan.
- Leave bare areas unstabilized. Erosion from bare soil results in sediments that can clog a BMP.
- Dispose of left over paint or hazardous materials into the storm drain. These materials can kill BMP vegetation and aquatic life. Dumping is also a criminal offense.

BMP Checklist

Wet and Dry Ponds

ROUTINE MAINTENANCE

- ✓ Remove accumulated debris and litter, especially around inlet areas.
- ✓ Mow routinely, with heights preferably not less than 6 to 8 inches.
- ✓ Remove woody vegetation from all dam and embankment areas.
- ✓ Stabilize/revegetate side and bottom areas.
- ✓ Stabilize/revegetate contributing areas to reduce incoming sediments.
- ✓ Implement a pollution prevention program.

TIPS FOR WHEN NON-ROUTINE MAINTENANCE IS REQUIRED

Dry Ponds

- Standing water is visible in inappropriate areas after 48 hours.
- Insects and/or odor become problems.
- Wetland vegetation emerges (unless the facility is specifically designed with a marsh or wetland area).
- Visible damage to the embankment (such as sinkholes) or mechanical components.

Wet Ponds

- Visible signs of sediment accumulation.
- Insects and/or odor become problems.
- Algae blooms occur in the summer months or ponded areas become dominated by a single aquatic plant.
- Visible damage to the embankment or mechanical components.

NON-ROUTINE MAINTENANCE

- ✓ Dethatch grass to remove accumulated sediments (less than every 2 years).
- ✓ Aerate compacted areas to promote infiltration (less than every 2 to 3 years).
- ✓ Remove accumulated sediment/pollutants (2 to 10 years for dry ponds; 5 to 15 years for wet ponds).
- ✓ Replace BMP components, reconstruct embankments and spillways (greater than 20 years if properly maintained).

Infiltration Trench

ROUTINE MAINTENANCE

- ✓ Remove accumulated debris and litter from trench area.
- ✓ Mow routinely around trench with heights preferably not less than 6 to 8 inches.
- ✓ Remove woody vegetation and stabilize/revegetate side areas.
- ✓ Stabilize/revegetate contributing areas to reduce incoming sediments.
- ✓ Implement a pollution prevention program.

TIPS FOR WHEN NON-ROUTINE MAINTENANCE IS REQUIRED

- Standing water is visible after 48 hours.
- Visible damage to the embankment or mechanical components.
- Apparent sealing of the top of the filter.

NON-ROUTINE MAINTENANCE

- ✓ Dethatch and aerate compacted grass areas (less than every 2 to 3 years).
- ✓ Remove and replace first 6 to 12 inches of gravel (as needed).
- ✓ Replace BMP (approx. every 10 years).

Grassed Swale

ROUTINE MAINTENANCE

- ✓ Remove accumulated debris and litter.
- ✓ Mow routinely, with heights preferably not less than 6 to 8 inches.
- ✓ Remove woody vegetation and stabilize and revegetate side and bottom areas.
- ✓ Stabilize and revegetate contributing areas to reduce incoming sediments.
- ✓ Implement a pollution prevention program.

TIPS FOR WHEN NON-ROUTINE MAINTENANCE IS REQUIRED

- Standing water is visible after 48 hours.
- Insects and/or odor become problems.
- Wetland vegetation emerges.
- Visible erosion or undercutting of swale banks.

NON-ROUTINE MAINTENANCE

- ✓ Remove accumulated sediment/pollutants (as needed).

BMP Checklist

Sand Filter

ROUTINE MAINTENANCE

- ✓ Limit confined space entry to professional maintenance personnel.
- ✓ Maintain appropriate safety precautions (locks and fences) and signage.
- ✓ Remove debris from inlet area.
- ✓ Ensure that contributing areas are not sources of debris or vehicle fluids.
- ✓ Keep any electrical components, such as pumps, in proper working order. Employ safe electrical practices and turn power off before maintenance.
- ✓ Stabilize/revegetate contributing areas to reduce incoming sediments.
- ✓ Implement a pollution prevention program.

TIPS FOR WHEN NON-ROUTINE MAINTENANCE IS REQUIRED

- There is a back-up of water in the filter.
- There is visible damage to mechanical components or concrete shell.
- Sink holes develop or sand deposition occurs.

NON-ROUTINE MAINTENANCE

- ✓ Remove accumulated sediment/pollutants.
- ✓ Replace sand and filter.
- ✓ Replace BMP components (greater than 20 years if properly maintained).

Rain Garden

TROUBLESHOOTING

- Look for signs that plants are too wet including wilting, yellowing, ringed spots on leaves, and a soft or rotting base.
- If erosion is occurring at drainage paths, stabilize the erosion.
- If plants are dying, it may be necessary to choose plants more tolerant of drier/wetter conditions.
- If water is not dissipating, the facility is not functioning properly.
- Do not walk or mow in ponding areas.
- Do not drag electrical equipment through wet areas.

INSPECTION FREQUENCY

- After or during each rainstorm, ensure that drainage paths are free from obstruction and that ponding dissipates. Water will pond longer in winter and early spring.

TIPS FOR WHEN NON-ROUTINE MAINTENANCE IS REQUIRED

- Standing water is consistently visible after one or two days.
- Invasive species take hold in the planting areas.
- There is visible damage to BMP components such as berms or bottom areas.

NON-ROUTINE MAINTENANCE

- Aerate soil profile to increase infiltration capacity (as needed).
- Remove accumulated sediment/pollutants (2 to 10 years or as needed).

SEASONAL CARE

Spring

- Prune deciduous trees and shrubs before leaves appear (usually early to mid-March).
- Prune flowering trees and shrubs after blossoming (usually early June).
- Divide ornamental grasses and perennials as soon as the soil becomes soft.

Summer

- During extended drought, water deeply in the morning every seven to ten days.
- Check trees and shrubs for signs of disease or insect pests. Plant diseases usually can be easily treated when detected early.
- Weed regularly, preferably by hand.

Fall

- Cut perennials back to the ground after the first frost and remove annuals.
- Plant new trees and shrubs as long as the soil temperature remains above 32 degrees.
- Mulch trees and shrubs to help condition the soil for spring and to protect roots.

Winter

- Cut back ornamental grasses and remove clippings. No other maintenance is generally required.

BMP Resource Guide

Local Government Agencies

York County Environmental & Development Services Department (EDS).....(757) 890-3750/3752
York County Mosquito Control .....(757) 890-3790
York County Waste Mgmt. Center .....(757) 890-3780
Virginia Cooperative Extension (York County Office) .....(757) 890-4940
Virginia Department of Transportation
North Office.....(757) 253-4832
South Office .....(757) 898-5151
HR Storm.....(757) 587-8676

Useful Websites

York County
http://www.yorkcounty.gov/
Click on "Local Government" then click on "Environmental and Development Services" or "Boards, Committees, Commissions."

York County Department of Environmental and Development Services
Http://www.yorkcounty.gov/eds/index.htm
Includes information on drainage and mosquito control.

York County Stormwater Drainage Advisory Committee
http://www.yorkcounty.gov/stormwater/index.htm
One stop shopping for all of the information that the Stormwater Drainage Advisory Committee provides: Points of contact by district, other websites related to stormwater issues, reporting procedures, necessary forms, committee goals/ objectives, meeting schedules, pickup schedules, printed booklets and handouts related to drainage and pollution etc.

Hampton Roads Storm (HR Storm)
http://www.hrstorm.org/
Provides educational programs, history, water conservation suggestions, information on household chemical collections and points of contact. It also contains a guide and information on drainage ponds and basins and Best Management Practices (BMPs).

Virginia Cooperative Extension (York County)
http://www.yorkcounty.gov/vce/index.html
Contains information on agricultural and natural resources.

Newport News Waterworks
http://www.newport-news.va.us/wwdept/
Provides the status of our water supply, information on water quality, and conservation.

US Environmental Protection Agency
http://www.epa.gov/
From home page, click on "Water" to find information on water quality, stormwater, groundwater, drinking water, surface water and others.

Environmental Protection Association (Australia)
http://www.epa.nsw.gov.au/stormwater/
Discusses stormwater drainage and water pollution issues. Flyers, posters and other useful information are available.

Chesapeake Bay Site
http://www.chesapeakebay.net/
Provides information on water quality, pollution, watersheds, bay restoration, instructional material and links to other websites.

National Association of Flood and Stormwater
http://www.nafsma.org/
Contains information about environmental issues/programs/laws and regulations.

Virginia Department of Environmental Quality
http://www.deq.state.va.us/
Contains information about environmental issues/programs/laws and regulations; and information on pollution reporting: DEQ Pollution Response Program (PREP). Website: http://www.deq.state.va.us/prep/

Norfolk District Army Corps of Engineers
http://www.nao.usace.army.mil/
Regional information about permits, public notices and projects.

Stormwater Magazine
http://www.forester.net/sw.html
A journal for surface water quality professionals, issued bi-monthly.

Virginia Department of Transportation
http://www.virginiadot.org
Contains information about VDOT programs, projects, state road information, current issues, contracts and other website links. Information on drainage can be found at http://www.virginiadot.org/infoservice/faq-ditching.asp.

The York County Stormwater Advisory Committee is grateful for Northern Virginia Planning Commission Division of Environmental Services' approval to source the contents of this pamphlet from their publication entitled, "Maintaining Your BMP: A Guidebook for Private Owners and Operators in Northern Virginia," February 2000.

The Stormwater Advisory Committee welcomes volunteers who wish to contribute their time to this very important endeavor for our County. If you are interested in a vacant position on the Committee, please contact your district representative to the Board of Supervisors, or go to the County website at www.yorkcounty.gov to apply to become a Committee member.

York County VIRGINIA

America's Future Since 1781

Department of Environmental and Development Services
York County Stormwater Advisory Committee
www.yorkcounty.gov/eds
(757) 890-3750