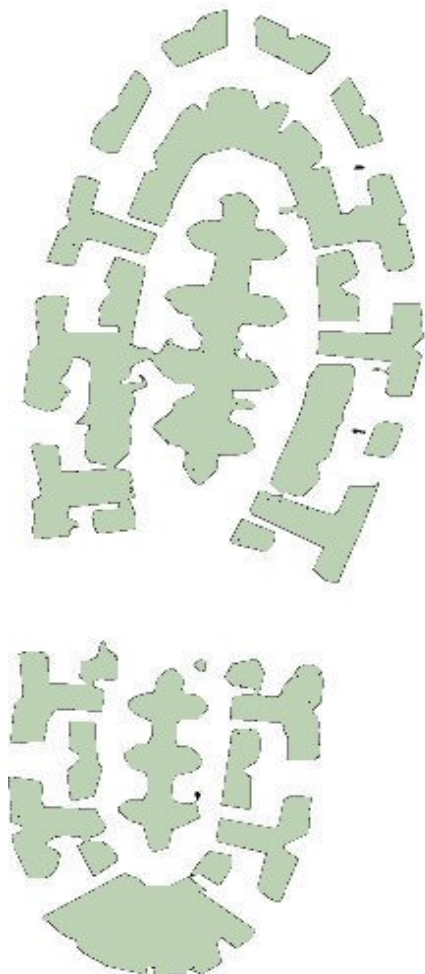


FIVE SIMPLE STEPS

TO MAINTAINING AND ENHANCING COMMUNITY OPEN SPACE AND STORMWATER MANAGEMENT AREAS

September 2004



Information gathered by the Delaware Department
of Natural Resources and Environmental Control,
Sediment and Stormwater Program

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FICTION AND FACT ABOUT NATURAL LANDSCAPES

Fiction: They attract rats.

Fact: Rats do not live in natural landscapes. They live in man-made structures and eat garbage.

Fiction: They breed mosquitoes.

Fact: Mosquitoes breed in shallow standing water (<3' deep). Natural landscapes absorb more water than conventional lawns, thereby reducing the amount of runoff and standing water. Natural landscapes also increase the populations of mosquito predators such as birds.

Fiction: They present a fire hazard.

Fact: Properly managed natural landscapes do not present more of a fire hazard than any other type of landscape.

Fiction: They increase pollen and hay fever.

Fact: All flowering plants produce pollen. The most offensive allergens are ragweeds, not plants that are used in environmentally-friendly landscaping.

Fiction: They have lower property values.

Fact: Property values are a function of public perception. As environmentally-friendly landscaping has become more accepted, it is seen as an asset.

Source:

Adapted from "To Mow or Crow" by Brett Rappaport in Wildflower, Spring 1996

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ABBREVIATIONS

BMPs	Best management practices
DNREC	Delaware Department of Natural Resources and Environmental Control
NPS	Nonpoint source pollution
ppm	parts per million

HOW TO USE THIS BOOKLET

This guide serves several purposes. It provides you with information and advice concerning three separate, but related, areas concerning your residential development. They are:

- 1) your community open space or common ground
- 2) the stormwater management facilities in your neighborhood
- 3) your private property.

We have attempted to make a clear distinction between those activities that you can carry out as residents, and those that require professional attention. A list of contacts has also been provided to help you with advice and technical assistance (Appendix A). Much of the information provided in this folder will be applicable for private property, in addition to the community's open space. The information provided herein does not conflict with the Sussex and Kent County Codes, as well as New Castle County's Unified Development Code.

Because it is the responsibility of the property owner to maintain stormwater management facilities, we have broken down such maintenance responsibilities into five simple steps. If it is determined that a professional should be consulted, we have also provided an insert that identifies those agencies and companies with expertise in this type of work.

The information contained within this guide is collected from various sources. Some of the information that has been provided is simply educational in nature. Take the time to read through this document and become familiar with the water quality issues. You may be surprised at how important these concepts are, and how easy it is to conduct your daily activities in ways that help protect our natural resources.

OVERVIEW OF NONPOINT SOURCE POLLUTION

Clean water is important to everyone in Delaware, and one of the keys to understanding water quality is to grasp the concept of a watershed. A watershed is the land area, much like a bowl, in which water is collected. Water flows downhill and forms small streams which flow into larger streams, lakes, rivers and eventually the ocean. The land area that contributes to this flow is called a watershed. We all live in a watershed, whether we are in Hockessin or Dewey Beach.

Everyday activities that take place in a watershed can affect water quality. Nonpoint source pollution (NPS) is runoff from rain, snow melt, car washing, irrigation or other sources that picks up contaminants as it washes across the land and deposits them into our waterways. Nonpoint source pollution is the cumulative result of our everyday actions and our local land use policies. The term *nonpoint* is used to distinguish this type of pollution from *point* source pollution, which comes from specific sources such as sewage treatment plants or industrial facilities. Over the last 20 to 30 years, Delaware has vastly improved water quality in regards to industrial pollution and sewer discharges. The Environmental Protection Agency has determined that NPS is now the single largest cause of the deterioration of our nation's water quality.

TYPES OF NONPOINT POLLUTANTS AND THEIR IMPACTS

Pollutant	Nonpoint Source	Impacts
Bacteria	Livestock, pet waste, septic systems, boat discharges	Introduces disease bearing organisms to surface water and ground water resulting in shellfish bed closures, swimming restrictions and contaminated drinking water
Nutrients (phosphates & nitrates)	Fertilizers, livestock, pet waste, septic systems, suburban & urban development, soil erosion	Promotes algae blooms and aquatic weed growth which can deplete oxygen, increase turbidity and alter habitat conditions
Sediment (soil)	Construction, earth disturbance, dredging, mining, agriculture, road maintenance, forest harvests	Increases surface water turbidity which reduces plant growth, food supplies, spawning habitat and cover for aquatic life, interferes with navigation and increases flooding risk
Toxics and Hazardous Substances	Landfills, junkyards, underground storage tanks, hazardous waste disposal, pesticides, herbicides, auto maintenance, highway runoff	Accumulates in sediment posing risks to aquatic life, contaminates ground and surface drinking water supplies, can accumulate in fish tissue threatening human health
Airborne Pollutants (acid rain, nutrients & metals)	Automobile and industrial emissions, dust from earth disturbing activities	Reduces pH in surface water, altering habitat & reducing natural diversity & productivity; may increase eutrophication, toxics accumulate in fish tissue; dust may intensify asthma and other respiratory ailments in humans

How Nonpoint Source Pollution Can be Controlled

The best way to control NPS pollution is to prevent it from the source. Everyone can easily recognize the causes of polluted runoff, therefore, everyone can work to prevent NPS pollution from becoming a problem. Examples of prevention can include actions at the local level, such as the creation of local ordinances to preclude development in environmentally sensitive areas, or actions from a homeowner's standpoint, such as recycling household items and cutting down on the use of fertilizers and pesticides.

Over the years, methods for managing or controlling polluted runoff have been developed. These methods are called Best Management Practices, or BMPs. They can be as simple as picking up pet waste, or as complicated as large structures such as wet ponds and filtration tanks. There are three major types of stormwater management facilities that keep pollutants out of our waterways:

- Those that prevent pollutants
- Those that trap pollutants
- Those that treat pollutants

How To Make a Difference

By making simple changes in our daily lives we can make a tremendous difference in the quality of Delaware's water and its aquatic resources. Here are just a few ways that you can help:

- Limit the amount of impenetrable surfaces in your landscape. Use permeable surfaces such as brick pavers, wood decks and concrete lattice to let water soak into the ground.
- Allow thick vegetation to grow along waterways to slow runoff and soak up pollutants. Plant trees, shrubs and ground covers that are native to the area (Appendix B; U.S. Fish and Wildlife Service 2001). They will absorb up to 14 times more water than a grass lawn and don't require mowing or fertilizer.
- Have your soil tested by the county extension office to determine the proper amount of fertilizer to use on your lawn.
- Use natural alternatives to pesticides.
- Dry sweep any paved areas (don't hose them down). Carefully dispose of the sweepings.
- Gutters and down spouts should drain onto vegetated or gravel-filled areas, not onto paved surfaces. Splash blocks also help reduce erosion.
- Compost grass clippings and leaves. Never allow them to wash into storm drains.
- Place litter, including cigarette butts, in trash receptacles.
- Properly dispose of household hazardous wastes. Contact your local solid waste management office for details on hazardous waste collection in your area.

- Recycle all used motor oil by taking it to a service station or local recycling center. Do not dump motor oil or hazardous wastes down the storm drain.
- Pet owners must pick up after their pets and dispose of the waste in the garbage or toilet.
- Wash your car on the grass so soapy water soaks into the ground.
- Get involved in the planning and zoning process in your community, where the decisions are made that shape the future of your community and the environment.

THE IMPORTANCE OF OPEN SPACE

It is widely agreed upon that open space in residential communities is a valuable amenity and should be managed to serve the needs of the people who live in the neighborhood. Open space provides residents with a range of benefits and opportunities that enhance the sense of community and environmental compatibility of a housing development. County codes typically contain requirements that open space be included in residential subdivisions of a certain size or population. General references are made to protect natural resources, but little guidance regarding ways to accomplish this goal is available to residents. Historically, open space has been managed for active outdoor recreation with ball fields and children's play equipment as the focal points. Areas adjacent to these amenities typically consist of mowed lawn and are not often used for any specific purpose.

Although active recreation areas include some grass, trees, and shrubs, they are usually of little habitat value and attract primarily common animal species and even pest species. With proper planning and a little effort up front, communities can make open space more environmentally friendly while expanding recreational opportunities. Passive recreational activities, such as hiking and bird watching, are especially compatible with habitat management and natural resource protection. Promoting passive recreation in your open space areas will help to preserve and even enhance natural resources, provide the opportunity for additional activities for residents, and save money on maintenance. The areas set aside for open space in residential subdivisions are often sufficient for both passive and some active recreation.

Managers of open space are encouraged to: install beneficial landscaping on new and existing public sites; adopt or amend local weed ordinances and development regulations to encourage natural landscaping; provide information about beneficial landscaping to residents, businesses, developers and civic organizations; identify natural areas within the community that need to be preserved or restored; and sponsor demonstration projects and reward creative efforts.

Environmentally-friendly Landscaping Basics

Traditional landscaping and current landscape maintenance practices, while frequently meeting human needs and aesthetics, often have harmful environmental impacts. The clearing of native woodlands and other natural habitats for urban/suburban growth and subsequent planting of grounds with vast lawns and manicured arrangements of exotic ornamental plants place a heavy toll on the environment and on human health. This type of a landscape requires extensive use of mechanical equipment, unnecessary consumption of our limited natural resources (water and fossil fuels), frequent application of fertilizers and pesticides, and the generation of significant quantities of solid waste. As a result, our surface and ground waters are being polluted; destructive flooding is more commonplace; our neighborhood's tranquility and air quality are compromised by noisy landscape equipment; and our landfills are being consumed by yard waste. Furthermore, the diversity of our ecosystems is suffering from the introduction of invasive landscape plants.

Proponents of beneficial landscaping view land occupied by urban and suburban development not so much as blight, but as an opportunity to mitigate the effects of development practices. We can learn to balance our needs with those of the environment. In addition to protecting and conserving our natural resources, this method of landscaping can also save considerable time and money through reduced maintenance requirements.

Beneficial landscaping is sometimes referred to as natural or native landscaping, although it is more than that. Beneficial landscaping contains a number of principles that revolve around balancing our needs and sense of beauty with wildlife conservation and water quality requirements in nature because they are interrelated. When incorporating beneficial landscaping, it is important to be sure to use native plants. Native plants (Appendix B) allow proper habitat for wildlife, and provide for a high food value. By adopting beneficial landscaping practices, wildlife isn't the only benefactor. Here's more:

- Safer, more enjoyable environments for our families
- Quieter neighborhoods (from reduced use of power equipment)
- Water conservation that benefits the homeowner and community
- Reduced flooding and costs for stormwater management
- Reduced landscape maintenance labor (more free time)
- Reduced landscape maintenance costs
- Less strain on municipal waste collection and water treatment
- Cleaner water bodies for fishing, swimming, and drinking
- Lower heating and cooling bills

For a copy of *Delaware Native Plants for Landscaping and Restoration*, please contact the Delaware Native Plant Society by visiting their website at <http://www.delawarenativeplants.org/>.

Flowers and trees provide wildlife with habitat while providing a more enjoyable environment for your family.



For lawn areas not in use, native grasses should be allowed to grow to heights of greater than 6 inches to help filter pollutants out of runoff before reaching the nearest waterway.

Environmentally-friendly Landscaping Techniques

Protect existing natural areas to the greatest extent possible (woodlands and wetlands, stream corridors and meadows).

Mulch, compost, or otherwise recycle yard wastes. Never dump yard wastes in open spaces, riparian areas, or other naturally vegetated habitats.

Select regionally native plants to form the backbone of the landscape. Select appropriate plants for each particular site (Appendix B). Each plant has its unique requirements and most sites have a variety of conditions. While there's not usually a problem with occasional use of exotic plants, native plants have evolved to local conditions over millions of years and form an integral part in the life cycles of the local wildlife. They also give an area its unique sense of place.

Reduce use of turf. Install woodland, meadow or other natural plantings. Where lawns are needed (such as play areas), follow BMPs available from your county's cooperative extension agent.

Reduce the use of pesticides and practice integrated pest management. Again, cooperative extension agents can help with natural alternatives to pesticides.

Compost and mulch onsite to eliminate solid waste. Generate a free Mulch A soil additive that can replace the need for most fertilizers.

Practice soil and water conservation. Stabilize slopes with natural plantings, mulch around plants, and install drought-tolerant species. Capture rainfall with a rain barrel, and use this to water your plants.

Reduce use of power landscaping equipment. Shrinking the size of the lawn and planting appropriate native species in less formal arrangements will reduce the need for extensive use of power equipment.

Use plantings to reduce heating and cooling needs. Deciduous trees planted appropriately along the south sides of buildings can reduce air conditioning costs by up to 20 percent. In winter, they allow the sun's rays to warm buildings. Coniferous trees planted to block prevailing NW winter winds can also reduce heating costs. Trees also significantly add to the value of your property.

Avoid use of invasive exotic species which out-compete native plants and result in declines in biodiversity. Examples include: Norway maples, kudzu, purple loosestrife, autumn olive, Japanese honeysuckle and multiflora rose (others listed in Appendix B). If these species appear, they should be eradicated.

Create additional wildlife habitat to partially compensate for land lost to urban/suburban sprawl. This is especially important along streams where the vegetation can filter runoff, aid in flood control, and provide wildlife corridors.

Managing Nutrients for Your Open Space

The overall goal of the Delaware Nutrient Management Act is to protect and improve water quality while maintaining profitable industries affected by nutrient management. Many areas of the state consist of relatively small lawns in urban and suburban areas, and fertilizing those lawns can have a significant cumulative impact (Delaware Nutrient Management Commission).

The Importance of Nutrient Management on Lawns

Improving the management of nutrients applied to lawns is important because:

- Properly fertilized lawns will have minimal losses of nutrients. Applying more nutrients than plants can use results in those excess nutrients being washed off the lawn into storm sewers, and eventually into surface waters.
- Properly fertilized lawns will exhibit healthy root growth. Applying fertilizer in the fall promotes root growth that improves lawn health.
- Properly fertilized lawns will require fewer pesticides. Healthy plants that have not been stressed by overfertilization are better able to resist attacks by insects and diseases (Delaware Nutrient Management Commission).

How Nutrient Management Affects the Environment

Many of today's water quality problems are caused by human activities on the land. By becoming aware of how our actions affect the environment, we can reduce pollution.

Take a minute to think about water and how it cycles, also known as the hydrologic cycle. All the water on earth exists in different forms and different places such as in the atmosphere; in icebergs; in oceans, lakes and ponds; in plants and animals; and in our soil. Water falls as rain, which either runs off hard surfaces or soaks into the porous soil. The water that runs off usually enters a body of water. The water that soaks into the soil becomes ground water which we use to water our lawns, crops, and trees. It all gradually seeps into our bays, rivers and other waterways. As you can see, this water cycle will wash pollutants from our land into our waterways and water supply.

The main nutrients that contribute to water pollution are nitrogen and phosphorus. Nitrogen (usually in the form of nitrate) is the nutrient that produces the greatest growth response in plants. If we put too much nitrate fertilizer on our lawns and landscaping, the excess nitrogen that is not taken up by plants will leach downward, entering the ground water supply that we use for drinking water. Nitrate contamination is most commonly caused by pet wastes, improperly designed or improperly installed septic tanks, and over-application of nitrogen fertilizers. Sandy, coarse soils common in southern Delaware are most susceptible to nitrate pollution, because they drain polluted ground water so freely.

Phosphorus is an important nutrient necessary for plant growth, but when excess phosphorus washes into our lakes and ponds, it causes rampant algae and weed growth. The overabundance of decaying algae depletes the water's oxygen supply, which can kill fish and desirable vegetation (Delaware Nutrient Management Commission).

General Fertilizer Tips

Follow these practices to help avoid nitrate and phosphate pollution of our surface and ground water.

- First, test your soil to determine the pH and fertilizer needs of your lawn. The ideal pH for turf is between 6.0 and 7.0. Delaware soils tend to be somewhat acidic, so regular applications of lime are often necessary.
- Keep fertilizers off sidewalks and driveways, so it does not wash into storm drains and gutters. Sweep up any spillage.
- Avoid over-watering. This will prevent water and nutrients from seeping below the root zone. It will also keep excess water from running off the surface into drains, gutters and streams.
- Never apply more fertilizer than is recommended for the areas of your property that is planted to turfgrass only. Just because a little is good, more is not better.
- Apply only the amount of nitrogen needed, at the optimum time.
- Use slow-release fertilizer during slow plant growth to provide nitrogen more gradually.
- Avoid late spring and summer fertilization except for application schedules that "spoon feed" nutrients throughout the growth season. Excess nutrients promote lush growth that makes it susceptible to disease, insects and drought.
- Never apply fertilizer to frozen ground.
- Remove plant debris, which contains phosphorus, from streets, gutters, sidewalks and driveways as quickly as possible so it does not run off with surface water. Use the debris as compost or mulch
- Control weeds in your lawn. Weeds reduce the quality of the turf and compete with desirable turf species for water.
- Cut the lawn no shorter than 2-1/2 to 3 inches during the summer. This mowing height is less stressful to turf than closer mowing, and longer turf shades the ground, conserving water. Don't cut more than 1/3 of the grass length, or plant health will decline.

When watering the lawn, use a slow watering technique, such as trickle irrigation or soaker hoses. Trickle irrigation is 90 percent efficient compared to sprinklers which are only 70 percent efficient. If you use sprinklers, be sure to place them so you do not water sidewalks, driveways and streets. Avoid watering on windy days. Set an alarm to remind you to turn off sprinklers when you have applied enough water. The best way to reduce lawn watering needs is to maintain a healthy, vigorous lawn. Healthy turf will bounce back from a summer drought with few, if any, problems (Delaware Nutrient Management Commission).

How to Take a Soil Sample

Soil tests will help you develop and maintain a more productive soil by providing information about the fertility of your soil. Information from a soil test will help you select the proper liming and fertilization program to obtain optimal growth of lawn, garden and ornamental plants. One of the most important steps in soil testing is collecting the sample. Soil test results can be no better than the sample submitted to the laboratory for analysis. A soil sample weighing about 1 pound is used to represent thousands of pounds of soil in the landscape or garden. Therefore, it is extremely important that soil samples be properly and carefully taken (Delaware Nutrient Management Commission).

Soil sample kits can be obtained from the University of Delaware Soil Testing Program, Department of Plant and Soil Science, at (302) 831-1392. Soil sample bags and other pertinent information are also available at your county Cooperative Extension Office. Each soil sample should represent only one soil condition (Delaware Nutrient Management Commission).

- Areas that have been treated differently should be sampled separately. Four samples should be taken; one each from the garden, the lawn, the ornamental shrubs in the landscape, and the azaleas. If the front and back lawns have been treated differently or if they are seeded with different grasses, take a separate sample from each.
- Take soil from a minimum of 10 random locations and mix together in a clean bucket.
- Areas where plants grow differently and/or the soil appears different should be sampled separately.
- Use clean sampling tools and containers.
- Never use tools or containers that have been used for mixing or applying fertilizer or limestone. A small amount of residue on containers can cause serious contamination of the sample.
- Remove any surface debris such as turf thatch or mulch. For lawns, sample to a depth of 4 inches.
- Use a trowel or sampling tube to collect soil samples. To use a trowel or spade, push the tool to the desired depth into the soil then push the handle forward with the trowel or spade still in the soil to make a wide opening. Cut a thin slice from the side of the opening that is of uniform thickness, about 1/4 inch thick and 2 inches wide, extending from the top

of the ground to the depth of the cut. Scrape away any grass thatch or mulch, and place the slice of soil into a clean bucket or other container. After the soil is taken, remove the shovel or spade and let the soil fall back in place. Soil samples should be carefully mixed and packaged.

- All cores taken for a given sample should be collected in a clean bucket and thoroughly mixed.
- Fill the soil sample bag to the indicated line with the mixed soil.
- Supply all the information asked for on the soil sample bag.

When to Test Soils

Soils can be tested any time during the year; however, be sure to sample well before planting or spring green-up. This is particularly important in areas where it is likely that lime will be needed. Lime reacts slowly and should be mixed with the soil several weeks before planting. Generally, fall is the best time to sample soils because landscapes and gardens are usually dry enough to till when sampling. If wet samples are collected, they should be air dried before being placed in the soil sample bag (Delaware Nutrient Management Commission).

How Often to Test Soils

Use the results of your soil test to determine how much lime and fertilizer your soil needs. Retest the soil the next year. Continue annual testing until results show medium or high fertility levels. After that, lawn and ornamental areas need to be sampled only every two to three years (Delaware Nutrient Management Commission).

THE IMPORTANCE OF STORMWATER MANAGEMENT

In a natural setting, rain falls on vegetation and is either captured by plants or infiltrated into the soil. Only a small portion of the water actually makes it to the stream or nearby waterbodies. When land is developed, however, vegetation is removed and impervious surfaces (impenetrable surfaces) such as buildings, roads, parking lots, and driveways are created. Most of the rain water is now unable to absorb into the ground, therefore, increasing the amount of water that we need to manage. The result is stormwater runoff. Stormwater runoff can sometimes result in flooding that can scour streambanks and cause erosion. As runoff washes across lawns, roads, and parking lots, it picks up sediment and pollutants such as fertilizers, pesticides, bacteria, and oil then deposit into our wetlands, creeks, lakes, and other waterways. As discussed earlier, these contaminants are called nonpoint source pollution because they do not originate from any distinct source or point, such as a factory or sewage treatment plant discharge pipe.



Stormwater Runoff
Harms Wildlife



Stormwater Runoff
Causes Flooding



Stormwater Runoff
Causes Pollution

Stormwater management is the science of preventing the adverse impacts of stormwater runoff. For new development in the last twenty to thirty years, this has often been accomplished by constructing stormwater management ponds (or basins) on the site. Initially, the focus was on managing the rate of runoff from a development to prevent flooding and erosion. More recently, ponds were modified to address water quality concerns in addition to quantity issues. The concept is simple; convey stormwater runoff to a containment area where nonpoint source pollutants (such as sediment) settle out before clean water is slowly released into the nearest waterway. These facilities are typically one of three types: dry ponds, wet ponds or infiltration basins. Recently, another category of stormwater management facility, called Green Technology, has become widely used. They are known for addressing water quality through more natural means.

Dry Ponds



Dry ponds are stormwater runoff containment areas that remain dry except after rain storms when runoff is conveyed to them. A device called an outlet structure is built into dry ponds to allow stormwater runoff from a recent storm to slowly drain into a nearby stream or waterway. It functions similar to that of a bathtub with a partially blocked drain. When water is flowing into it, the tub continues to fill up even though some water is getting out through the drain. In most cases, all of the water drains out of the pond after about 48 hours. During dry periods, the facility usually looks like a depressed area with grass growing on the bottom and side slopes.

With regular maintenance and the use of beneficial landscaping, the appearance, function, and habitat value of dry ponds can be improved. Planting trees and shrubs will encourage infiltration of water into the ground, increase water quality by trapping sediments, and create an improved visual appearance of the pond. In addition, the density of vegetation in a more “naturalized” pond helps to slow the stormwater velocity and cool the water temperature, which is important for aquatic life. Once again, trees, shrubs, and native grasses do not require frequent mowing, greatly reducing annual maintenance costs. Some common types of maintenance for dry ponds include mowing, unclogging the outlet structure, removing woody vegetation from the embankment, cleaning out low flow channels (if applicable), and maintaining forebays.

Wet Ponds



Wet ponds, also called stormwater ponds, typically appear to look just like a regular pond, with the exception that they are specially designed to manage stormwater and they have a fairly standardized design. Wet ponds should contain a permanent pool of water that is a minimum of three-feet deep. Although they function similar to a dry pond, their outlet structure is above the surface of the water, so the pond should stay full most of the time. For wet ponds, stormwater only discharges from the pond when the water level rises over the outlet as a result of runoff from a rainstorm. Prolonged storage of this water allows sediments to fall out of the water, improving the water quality. Eventually, the water level in the pond goes back to where it was before it rained.

Wet ponds can also be very attractive amenities for a community. Periodic maintenance of your wet pond is necessary for them to operate properly. Beneficial landscaping is especially effective in enhancing the pollutant removal capabilities and wildlife habitat value of wet ponds, while making them more aesthetically pleasing. Periodic maintenance of your wet pond is necessary for them to operate properly. A routine maintenance program can be designed to encourage wildlife-friendly native vegetation at much less cost to the community than an aggressive mowing or spraying program.

Structural enhancements to older ponds, both dry and wet, can also be done to enhance capability to improve water quality. Altering outlet structures, removing concrete low flow channels and adding sediment-collecting forebays are some examples. These types of enhancement, also known as “retrofitting”, must be done by qualified professionals. Common types of maintenance for wet ponds may include algae removal, forebay maintenance, trash and debris removal, and invasive species removal.

Infiltration Basins



Infiltration basins act quite differently from the two types of ponds described above. They collect stormwater runoff in the same ways that wet and dry ponds do, but they do not release the water through an outlet structure. Infiltration basins are designed so that stormwater eventually soaks into the ground, imitating natural conditions and recharging groundwater supplies. In addition to recharging groundwater, infiltration basins also trap pollutants, making them a highly valued stormwater management tool.

Although these structures are preferred when managing stormwater, this technique cannot always be implemented. If the soils on the site are somewhat impermeable (impenetrable), containing a lot of clay, this practice can not be used. Similarly, water will not infiltrate if the water table is particularly high at the site. Again, an infiltration basin cannot be used. The result is also the same if heavy construction equipment compacts the soil in the basin. However, when infiltration basins are appropriate and they are properly designed and constructed, the benefits far surpass those of any other stormwater management structure. If they drain completely in 48 hours or less, they are functioning properly. Maintenance and beneficial landscaping have the same positive outcome on these structures as they do on wet and dry ponds. Common maintenance needs for infiltration basins include trash and debris removal in addition to sediment removal to alleviate standing water.

Green Technology



Scientists and engineers are currently designing and promoting new stormwater management devices, called Green Technology BMPs, that mimic nature, require much less maintenance, and enhance local property values. One example is the bioretention cell. Although it has the appearance of a landscape island, it is designed to temporarily store and treat stormwater runoff. Most of the time, Green Technology BMPs are incorporated into the landscaping, so most people don't even realize when they see them.

Another example of Green Technology is the use of filter strips, where runoff flows evenly across a vegetated area that absorbs the water and removes the pollutants. Other Green Technology BMPs include biofiltration swales, riparian buffers, and terraces. Each of these relies on the vegetation to remove pollutants, and promotes infiltration of runoff into the soil. They are all very good alternatives to other structures such as ponds, when appropriate. Common maintenance needs for Green Technology BMPs may include vegetation maintenance, proper grass height maintenance for bioswales, mulch replacement, and trash and debris removal.

FIVE SIMPLE STEPS TO MAINTAINING AND ENHANCING STORMWATER MANAGEMENT AREAS

Like any other structure, stormwater ponds, pipes conveying stormwater, outfall structures, and other types of stormwater facilities need to be routinely maintained to function properly. Fortunately, enhancing these facilities in order to improve their environmental attributes can also make them more aesthetically pleasing and reduce their maintenance costs.

Step 1: Organize an Open Space Management Group

Most housing developments have homeowners associations or maintenance corporations already established; however, if one does not exist for your development, organize one. Remember that it is the responsibility of the property owners within your community to maintain stormwater facilities and open space. If you would like more information on setting up a maintenance corporation, please contact your county office (Kent County 302-744-2305; Sussex County 302-855-7700; New Castle County 302-395-5555). Also, here are a few tips that you can use to help make your homeowners association or maintenance corporation more successful.

Maintenance Corporation Tips

- ✓ Establish By-Laws (guidelines)
- ✓ Hold elections and nominations
 - Provide proxy ballots for those who cannot attend
- ✓ Hold regular meetings (monthly or quarterly)
 - Make a meeting notice
 - Send mailings and include an agenda
 - Schedule a guest speaker to improve meeting attendance
- ✓ Hold board meetings and community meetings
- ✓ Use newsletters to keep people up-to-date (keep the residents informed)
- ✓ Set up a website

(New Castle County Department of Land Use 2004)

Step 2: Secure Funding

Funding is the most essential component of stormwater management maintenance and community open space maintenance. Just like investing for your retirement, you need to plan for the future when managing stormwater management facilities. Stormwater facility maintenance costs can be divided into routine and non-routine (see page 25 for a list of routine and non-routine maintenance tasks).

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 basin system. A general rule of thumb is that annual maintenance will run from \$100 per acre for a minimal maintenance including mowing to \$500 per acre for more intensive maintenance including

mowing, weed control, fertilization, re-establishment of vegetation and debris removal.

Non-routine maintenance, however, can be costly over the long term, 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 monthly or annual contributions, be established. As an example, for dry ponds which need to have sediment removed once every 2 to 10 years, 10 to 50 percent of anticipated dredging costs should be collected, annually. In addition, the average dry pond has a useful service life (life span) of 20 to 50 years. A separate fund that collects 2 to 5 percent a year should be established for major reconstruction of the facility. Anticipated interest may be used to offset the effects of inflation (Northern Virginia Planning District Commission 2000).

REOCCURRENCE OF NON - ROUTINE COSTS (Northern Virginia Planning District Commission 2000)		
BMP	Sediment Removal	Life span
Wet pond	5-10 years	20-50 years
Dry pond	2-10 years	20-50 years
Infiltration trench	As needed	10 years
Rain garden	5+ years	Indefinite
Grassed swale	As needed	Indefinite
Sand filter	Every 6 mo.	20-50 years or as required

For both types of maintenance, you should create a budget. We have provided a brief example below.

Maintenance Corporation Budget 2004

Lawn care services	5,500.00
Other open space maintenance	1,000.00
Liability Insurance	3,500.00
Legal Services	2,500.00
Taxes/Fees	150.00
Business Supplies	1,000.00
Contingency Fund	2,500.00
Playground Maintenance	500.00

← Routine Maintenance

← Non-routine Maintenance

(New Castle County Department of Land Use 2004) **Total 16,900.00**

When creating your budget, it is important to remember that 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 most common non-routine costs are sediment/pollutant removal and BMP renovation/reconstruction. The following sections provide information on 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.

Wet and Dry Pond Pollutant Removal Costs

In general, both wet and dry pond pollutant removal costs are similar unless otherwise noted.

- *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 is usually around \$10,000 for large wet ponds. 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 will range from between \$1,000 and \$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 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.

$$\text{Surface area } \underline{\hspace{2cm}} \text{ (acres) X depth of sediment } \underline{\hspace{2cm}} \text{ (feet) X 43.560 = } \underline{\hspace{2cm}} \text{ cubic feet. Cubic feet } \underline{\hspace{2cm}} / 27 = \underline{\hspace{2cm}} \text{ cubic yards.}$$

- *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 at recent prices (1999) was estimated at \$47 per cubic yard (\$37 for dumping and \$10 for transportation depending on the dump location, mileage, and hourly charges).

By adding the likely costs of these three components in a dredging activity, one can establish a range in which an owner can expect to pay for sediment/pollutant removal (Northern Virginia Planning District Commission 2000).

Sample Wet and Dry Pond Sediment Removal Costs								
Component	Surface Area .25 Acres		Surface Area 1 Acre		Surface Area 2 Acres		Surface Area 10 Acres	
	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	\$1,613 (\$8/cy)	\$3,025 (\$15/cy)	\$12,090 (\$15/cy)	\$16,120 (\$20/cy)	\$24,195 (\$15/cy)	\$32,260 (\$20/cy)	\$120,990 (\$15/cy)	\$161,320 (\$20/cy)
Disposal (Onsite/Offsite)	\$1,008 (\$5/cy)	\$9,474 (\$47/cy)	\$4,030 (\$5/cy)	\$37,882 (\$47/cy)	\$8,065 (\$5/cy)	\$78,811 (\$47/cy)	\$40,330 (\$5/cy)	\$379,102 (\$47/cy)
Total Cost	\$3,621		\$19,120		\$37,260		\$166,320	
Typical	Backhoe		1. Loader/dozer 2. Crane dragline or clambucket					

(Northern Virginia Planning District Commission 2000)

Please refer to Appendix C for more extensive cost estimates on specific management techniques.

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 6 to 12 inches of gravel and to replace the filter cloth sediment barrier. The cost of such an operation is generally \$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 between \$1,500 to \$2,000, depending upon the size and complexity of the facility (Northern Virginia Planning District Commission 2000). Cost of infiltration trench and rain garden maintenance will vary depending on the frequency of maintenance, so the owner should consult a local government representative to determine an appropriate funding level (Appendix A).

Sand and Filter Pollutant Removal Costs

Although there are three major types of filtration systems, all three systems have two main components, a filtration chamber and a sedimentation chamber (Shaver et al. 1997). The most common pollutant removal cost of a sand filter is

to remove the top filter cloth (if applicable) and to 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.

In general, filters may require cleanout every year. When the filtration chamber needs to be cleaned, the sediment along with the top two to three inches of sand should be removed using a small shovel. The sand color is a good indication of the proper removal depth. Apply clean sand to the original depth, and dispose of the old sand.

Maintenance of the sedimentation chamber will not need to be performed as frequently as the filtration chamber. Removal of those sediments will be a bit more difficult because the sedimentation chamber will be full of water making the sediment more difficult to remove. Prior to disposal, be sure to allow the removed material to dry (Shaver 1991).

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. Some grassed swales have been designed and constructed as biofiltration swales to help address water quality. The vegetation in these swales should be maintained at a height of about six inches. The taller vegetation helps to trap pollutants as stormwater runoff flows through the channel. Such an operation should need to be performed only once every two years (Northern Virginia Planning District Commission 2000). When the grassed swale is on highway right-of-way, this type of activity may be covered through state maintenance. To find out if the swale is on state property, please call the Delaware Department of Transportation (Appendix A).

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 properly maintained. However, BMP requirements have been in place long enough (since the 1970s and 1980s) for many businesses 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.

In all cases, it is recommended that the owner consult the appropriate government agency to perform a BMP replacement fund study (Northern Virginia Planning District Commission 2000).

Step 3: Perform Routine Maintenance and Self Inspections

Routine Maintenance

There are two types of maintenance when dealing with stormwater facilities, routine maintenance such as mowing, and non-routine maintenance like dredging.

Routine Maintenance Includes:

- ✓ Visual inspections
- ✓ Removal of exotic (non-native) plants
- ✓ Debris and litter control
- ✓ Minimizing nutrients and odors
- ✓ Minor bank stabilization and erosion control
- ✓ Algae and aquatic vegetation control (minor)
- ✓ Mowing and harvesting upland woody plants
- ✓ Stabilization of upstream areas
- ✓ Maintenance of a 10-foot access path to all Inlet and outlet structures by moving regularly
- ✓ Inspection of all inlet and outlet structures for blockage after each storm (removal of blockage when needed)

Non-routine maintenance includes:

- ✓ Major bank stabilization
- ✓ Removal of excessive sediment
- ✓ Structural repairs (embankment, outlet structure, etc.)
- ✓ Rare conditions (low Ph, spills, etc.)
- ✓ Algae and aquatic vegetation control (major)
- ✓ Nuisance wildlife management (geese, beaver, etc.)
- ✓ Mosquito control

Appendix D lists both routine and non-routine measures categorized by wet ponds, dry ponds, infiltration trenches, grassed swales, sand filters, and rain gardens. Mowing is one type of maintenance that needs to be performed on a regular basis, along with other smaller tasks. Some of the equipment needed for routine maintenance may include the following:

Grass maintenance equipment: Mower, Trimmer/edger, spreader, chemical sprayer

Vegetation cover maintenance equipment: Hand saw, chain saw, pruning shears, brush chipper

Sediment, debris, and trash removal equipment: Backhoe, excavator, grader, front end loader

Transportation equipment: Van, pickup truck, dump truck, light duty trailer

Miscellaneous: Shovel, rake, pick, wheel barrow, portable compressor, portable generator, concrete mixer

Materials: Topsoil, fill soil, grass seed, mulch, dry mortar mix

There are routine types of maintenance that can be performed less frequently, such as performing self inspections. An example check sheet is provided for you in Appendix E.

Inspections Required by Regulation

Inspecting your stormwater management pond or facility allows you to detect problems early and to avoid long-term complications. It is also sometimes a requirement of your maintenance agreement. Inspection requirements vary from jurisdiction to jurisdiction, depending on the specific BMP. Some sand filtration systems require monthly inspections, while other BMPs can be inspected on a yearly basis such as wet ponds. Some localities provide inspections of all facilities, while others require that the responsible party arrange for an inspection and send the results for confirmation.

The local sediment and stormwater agency, also known as the delegated agency, in your area performs annual inspections for all types of stormwater management facilities. Before performing a self inspection on any type of facility, obtain a copy of the inspection report for the stormwater facility of interest and a copy of the engineering plans for the subdivision from the delegated agency. See Appendix A for contact information of your local sediment and stormwater agency.

Step 4: Hire a Professional

If there is any doubt, err on the side of caution and hire a professional to solve big problems, especially if your self inspection indicates a problem. Hiring a professional such as an engineer, landscape architect, or surveyor would be another alternative to obtaining routine inspection reports.

When to call a professional

Algal blooms

Invasive (non-native) vegetation

Deterioration of pipes

Unexpected ponding

Low spots or sinkholes in bottom areas

(Modified from Northern Virginia Planning District Commission 2000)

Cracking or settling structural components

Poor health of vegetation

Excessive erosion or sedimentation

Step 5: Correct Any Problems

As discussed previously, dredging and other types of non-routine maintenance can be very costly, so be prepared. Have the funds available for such non-routine types of maintenance. Please refer to Step 2 (Secure Funds) for information regarding the funding of such maintenance. Remember that Appendix C contains information regarding relative costs of stormwater facility maintenance, and Appendix F contains contractors that perform such types of work. When choosing any type of contractor, here are some key tips:

Checklist for hiring a contractor

- ✓ Get at least three bids.
- ✓ Get a written contract and don't sign anything until you completely understand the terms.
- ✓ Verify that all permits and certificates of compliance are obtained.
- ✓ Don't let payments get ahead of work. Keep records of payments.
- ✓ Don't make the final payment until you're satisfied with the job.
- ✓ Get receipts for payments.
- ✓ Keep a job file of all papers related to your project.

(Modified from New Castle County, Department of Land Use)

TIPS ON KEEPING MAINTENANCE COSTS DOWN

DO NOT!	DO!
<p>Do not overfertilize the lawn. This can cause algal blooms in stormwater ponds.</p> <p>Do not dump used motor oil, antifreeze, left over paint into storm inlets. This is a criminal offense.</p> <p>Do not dump grass clippings, leaves, soil, or trash into a storm inlet or stormwater management facility.</p> <p>Do not dispose of pet wastes into the storm system.</p> <p>Do not wash dirty vehicles on streets or driveways.</p> <p>Do not mow natural areas.</p>	<p>Keep properties, streets and gutters free of trash and debris such as lawn clippings.</p> <p>Take dirty vehicles to commercial carwash.</p> <p>Educate residents about the importance of not disposing of oils and other substances into stormwater inlets.</p> <p>Plan lawn care to minimize the use of fertilizers.</p> <p>Incorporate native trees, shrubs, and groundcover.</p> <p>Install "no mowing" signs in conservation areas.</p>

(Northern Virginia Planning District Commission 2000)

COMMON PROBLEMS ASSOCIATED WITH STORMWATER MANAGEMENT PONDS

Algal Blooms



Algae are a diverse group of rootless plants that are found in both salt and fresh water. They range from microscopic, single-celled plants to the large plants we know as seaweed or kelp. They don't have the leaves, stems or roots that we associate with higher plants. They also lack specialized systems that transport nutrients within the plants. In freshwater ponds, the single-celled algae form the basis of the pond food chain. These single-celled plants, called phytoplankton, serve as food for the zooplankton, or microscopic animals, that in turn are eaten by larger organisms such as pond fishes. It is when one or more forms of algae become overabundant (sometimes called algal blooms) that problems arise, notably water discoloration, foul odors, or unsightly mats of floating filamentous (thread-like) algae.

In contrast to the planktonic algae that can give water a green appearance, filamentous algae are clusters or strings of algal cells that clump and form mats that either sink to the bottom of the pond or float to the top, depending on the time of year. Thick clumps of floating filamentous algae can severely hinder boating, fishing and swimming.

Herbicide Precautions

Any individuals wishing to apply herbicides must (by law) be a Certified Pesticide Applicator. Therefore, you can choose to hire someone who is certified to do such work, or you can have someone within your homeowners association become certified. This program is regulated through the Delaware Department of Agriculture (<http://www.state.de.us/deptagri/>).

Copper Sulfate

Copper sulfate (CuSO_4) in either granulated or pulverized form is used as herbicide control for some species of planktonic and filamentous algae. It may be purchased from farm supply stores and does not require an applicator's license. Copper sulfate should be effective within a few days; however, control is not generally long lasting. More than three or four treatments per year are not recommended due to a possible build-up of toxic copper in the sediments.

Applications should be made on warm, sunny mornings after the water temperature reaches 60°F . Under these conditions, algae are growing vigorously and will take up the maximum amount of copper. Different methods of application can be used depending on the size of the pond. A small pond can be treated by mixing one part of copper sulfate with nine parts water in a bucket and disbursing it (a coffee can or margarine tub will do) over the surface of the pond. Larger ponds will require either a backpack or hand-held pressure sprayer or a boat bailer using a small boat and motor. Copper sulfate is very corrosive to most metals, so it is not recommended for piston or roller-bearing pumps. Stainless steel, plastic and fiberglass are the best materials to use with copper sulfate. Carefully clean any metal surfaces exposed, including aluminum boats. Since the pulverized form goes into solution quicker, it is preferred for spraying.

The effectiveness of CuSO_4 (and its safety for fish) varies according to the pond water chemistry. A higher treatment rate may be needed for controlling algae in alkaline waters, which are defined as those exceeding 50 parts per million (ppm) total alkalinity as measured with a water test kit. Copper is more toxic to fish in waters of low alkalinity (less than 50 ppm), so if your pond has soft water, it is better to cut the recommended dosage in half and see what happens. Water temperature should exceed 60°F for effective treatment.

Several brands of herbicides containing organic complexes of copper are available in liquid form. The advantage of these complexes is that the copper precipitates out slower and controls algae longer than copper sulfate. Also, these products are safer to use in fish ponds as they are less toxic to fish than copper sulfate. The principal drawback is their expense and the fact that they cannot be used where the pH is less than 6. (Delaware Department of Natural Resources and Environmental Control, Division of Fish and Wildlife).

Other Methods

Mechanical

In small ponds, algal mats can be raked to the pond edge and removed. Although labor intensive, this has the advantage of removing those nutrients bound up in the algae. The material can then be composted. There are also coloring agents that can be added to the pond water to shade or lessen the amount of sunlight available to aquatic plants, thereby deterring algae growth.

Biological

Although the grass carp (*Ctenopharyngodon idella*) can be effective in controlling a few types of algae, this fish does not control all plant species. Because this species is highly prolific, grass carp may only be used in Delaware if certified as infertile grass carp. Possession requires a permit from the Division of Fish and Wildlife.

Nutrient Management

Since algae respond to the presence of dissolved nutrients such as nitrates and phosphates, one way of controlling algae is to limit the amount of nutrients that enter a pond, such as limiting the amount of fertilizers used on lawns to the required level of nutrients. Other steps that a landowner can take include fencing livestock out of the pond and planting vegetated buffer strips around the pond to prevent runoff of fertilizers and other nutrients. Septic tank leakage is another nutrient source that can be prevented. For more information on nutrient management, please consult the section on nutrient management located on page 10 of this manual.

Nutrient Inactivation

Several relatively new products profess algae control capabilities by tying up or deactivating nutrients needed to support algae growth. Some of these provide a culture media for beneficial bacterial that out-compete the algae for available nutrients, thus limiting algae growth. Others inoculate the waters directly with bacterial cultures that tie up the nutrients. Another method is adding aluminum sulfate (alum) to the pond water to chemically bind up the phosphorus needed for algae growth (Delaware Department of Natural Resources and Environmental Control, Division of Fish and Wildlife).

Barley Straw

In order to use barley straw effectively, it is necessary to understand something about how the process works. When barley straw is placed into water, it starts to decompose. During this process, chemicals are released which inhibit the growth of algae. Rotting is a microbial process and is temperature dependent, being faster in summer than in winter. It may take 6 to 8 weeks for straw to become active when water temperatures are below 10 degrees Celsius but only 1 to 2 weeks when the water is above 20 degrees Celsius. Once the straw has started to release the chemical, it will remain active until it has almost completely decomposed. The duration of the period varies with the temperature and the form in which the straw is applied. The straw should remain active from four to six months, after which its activity decreases rapidly.

Straw should be applied in the summer in a loose form, either in gabions or as straw sausages. Typically in ponds and lakes, bales are broken up on the bank and the loose straw is wrapped in some form of netting or wire. This increases the diffusion of oxygen to the site of decomposition and speeds up the process in this type of environment. Don't forget to anchor the straw to the bottom of the pond because it is more effective that way. Also, it is always preferable to apply several small quantities of straw to a water body rather than one large quantity. In small ponds, only a single net of straw is required. This should be placed in the center of the pond. However, if there is an incoming flow of water, the straw net should be placed where there is a continuous flow of water over and through the straw. This will help to keep the straw oxygenated (IECR Center for Aquatic Management 1999).

Geese



Canada geese can be a cause of complaints for parks, businesses, and golf course superintendents. Using the ecosystem approach, our first question is: *“Why are geese attracted to the property?”* When you begin to learn more about the habitat and life habits of this species, you'll better understand why Canada geese so often cause problems (Audubon International Sanctuary System).

Canada Geese Natural History

Overview:

There are 11 subspecies of geese. The giant Canada goose, known for its large size and long neck, is most commonly thought of as being problematic. It can weigh 14 to 20 pounds and is the largest of all Canada geese. This species was once hunted so extensively that it almost became extinct in the 1920's. Wildlife management, including hunting restrictions and captive breeding and re-stocking programs, and agricultural practices are largely responsible for today's largely numbered populations.

Food:

Geese are grazing birds that eat a varied diet. They eat the roots, shoots, stems, seeds, and leaves of grass and sedges, grain, bulbs, and berries. They also eat insects and aquatic invertebrates. Geese often spend the winter in agricultural areas where they feed on post-harvested grain and foliage. Geese generally feed in early morning and late afternoon.

Cover:

Geese prefer open water with open shorelines where they are safe from disturbance. An expansive view affords them a degree of safety from predators, and long sight lines for take-off and landing.

Breeding Habits:

Geese nest in a variety of habitats, generally on the ground near water. They will also nest on islands, rocky cliffs, and even large tree cavities. The female builds the nest of grasses and moss, lined with feathers. On average, five to six eggs are laid and incubated for 25 to 28 days. Geese usually mate for the first time in their second or third year, and pairs remain together as long as both are alive and healthy. They often return to the same spot, year after year, if they are successful in raising young there. Geese raise an average of four to seven goslings each year.

Family Habits:

Adult geese pair for life. Young geese stay with adults their entire first year. They migrate south with their parents and return north with them to their nest site in the spring. Young form yearling flocks that often remain together until they have matured and are ready to mate.

Predators:

Because of their size, intelligence, and wariness, geese are less subject to predation than most other waterfowl. Hawks and owls prey on immature and some adult geese. Snapping turtles, snakes, and land-based predators take goslings that stray from parental protection.

Migration:

Geese migrate along predictable routes known as *flyways*. Year after year, they travel, rest, feed, and nest in fairly predictable locations, called *staging areas*, along these routes. In the fall, family groups from different areas assemble into large flocks, preparing for migration.

In recent years, wildlife biologists have identified a change in Canada goose migration patterns. Many geese are no longer migrating great distances, but are forming “resident” populations that remain within a limited geographic area. The dwindling numbers of Canada geese that breed in the arctic and sub-arctic and winter throughout the United States is a concern to biologists. It is not well understood why these changes are taking place. Changing population dynamics may be attributed to loss of habitat, current agricultural practices, and altered natural environments (Audubon International Sanctuary System).

Controlling Canada Geese

Canada geese are perceived by some property owners to be a nuisance. Their feces can leave a substantial mess that must be cleaned regularly. Many people encourage geese when they first arrive, only to find that after several years of nesting success, they can no longer tolerate the large flock that have made the place their home.

Without realizing it, many properties provide ideal goose habitat. Open water, an extensive food supply, and lots of open space are precisely what geese need. Here are some tips to try to resolve the problem.

1. Evaluate the problem.

Try to define the problem specifically. Is the problem only in certain areas? Is the feces causing damage? Survey your property to determine how you might actually be encouraging geese. Very short grass, an expansive view around a pond, and people who are feeding geese are likely attractants. When does the problem occur? If geese seem to be a problem only in the fall or spring, they are using the area for a rest stop during migration. If geese are wintering on your property, you are likely providing habitat for a migratory population.

2. Reduce your frustration.

It is important to recognize that it is extremely difficult to control nature. If your goal is to remove every goose from your land, you will likely end up frustrated, angry and unsatisfied. However, there are things you can do to try to lessen the impact of geese and discourage them from overrunning the land. Be realistic in your attempts to control geese. You will have much greater success if you try to strike a balance between Canada geese and the needs of visitors, employees, and maintenance personnel.

3. Choose the most effective control measure for your situation.

Control measures fall roughly into three categories: altered habitat, scare tactics, and intervention. Some combination of these may prove to be most successful.

Remember that the easiest time to deal with geese is before they start nesting. Be ready in early spring when geese begin to breed. Even if they are well established on the property, preventing them from nesting will break their successful breeding record, and discourage them from returning or staying (Audubon International Sanctuary System).

Altered Habitat

- Mechanical Barriers

String monofilament line or wire around the edge of your ponds where geese are most prevalent. The wire should be approximately six inches above the water line. Several places have found that two rows of string, one at the water's edge and one about two to three feet in the water, are most effective. Fencing can also be used.

- Vegetative Barriers

In stead of mowing right to the water's edge, plant aquatic vegetation around lake and pond margins. This helps to disrupt the expansive view, acts as a physical barrier, and provides excellent habitat for other more desirable wading birds and wildlife.

- Unpalatable vegetation

If possible, plant grass that geese don't like to eat such as fescues. Kentucky Blue Grass should be avoided as it is a goose favorite. A non-toxic chemical, called methyl-anthranilate (REJEX-IT) can be applied to lawns, fields, or other areas to deter geese from feeding. The chemical is a flavoring found in grapes that is sweet to humans and abhorred by geese.

- Prohibit Feeding

If people are feeding the geese and attracting them, prohibit feeding. Communicate to people with signs or other means of education.

- Visual scare Tactics

Streamers, balloons, flags, scarecrows, and even dead goose decoys can be used to frighten geese away. Mylar bird scare tape can be tied to stakes near ponds, but is of limited value for geese control. Remember, geese are big birds that don't scare easily. Visual tactics should be used on a varied schedule and alternated to prevent geese from becoming used to them.

- Dogs

Many areas have successfully used dogs to chase or stalk the birds. Because of their gentle, but energetic nature, border collies and English setters make good choices.

Intervention

When other control methods have failed, local authorities should be contacted to help you deal with Canada geese. The Delaware state wildlife department (302-653-2883) can help you determine the best method of intervention. Some options include both egg addling and roundups. Never destroy Canada geese or disturb their nests without a permit. Canada geese are protected by the Migratory Bird Treaty Act. Not only may you pay large fines for killing geese, the resulting negative publicity can be devastating (Audubon International Sanctuary System).

Education

If geese are a problem, you must not only deal with the geese, but you must also effectively deal with patrons of your property. Communicate what you know about Canada geese natural history and goose control. Use a newsletter or bulletin board to let people know what strategies you have employed or plan to implement to minimize nuisance or damage. By regularly updating people about your efforts, you can help to lessen complaints.

Finally, recognize that you are not alone. Many people are struggling with the same problem. Encourage people to open a dialogue with the U.S. Department of Fish & Wildlife or Ministry of Natural Resources (Canada). Wildlife biologists are conducting on-going research about Canada geese. They are interested in learning more about why migratory populations are declining while resident populations are on the rise. (Audubon International Sanctuary System).

Pond Safety

Pond safety is a big concern among homeowners, especially those with children. First and foremost, please keep all children out of stormwater ponds. These structures can be dangerous during flooding stages, and they are not meant to be used as a swimming area. In the unlikely event that an accident may occur, stormwater ponds are constructed specifically to address such safety concerns. The following list describes some of the design measures that address safety issues for stormwater ponds.



When constructed, stormwater ponds should:

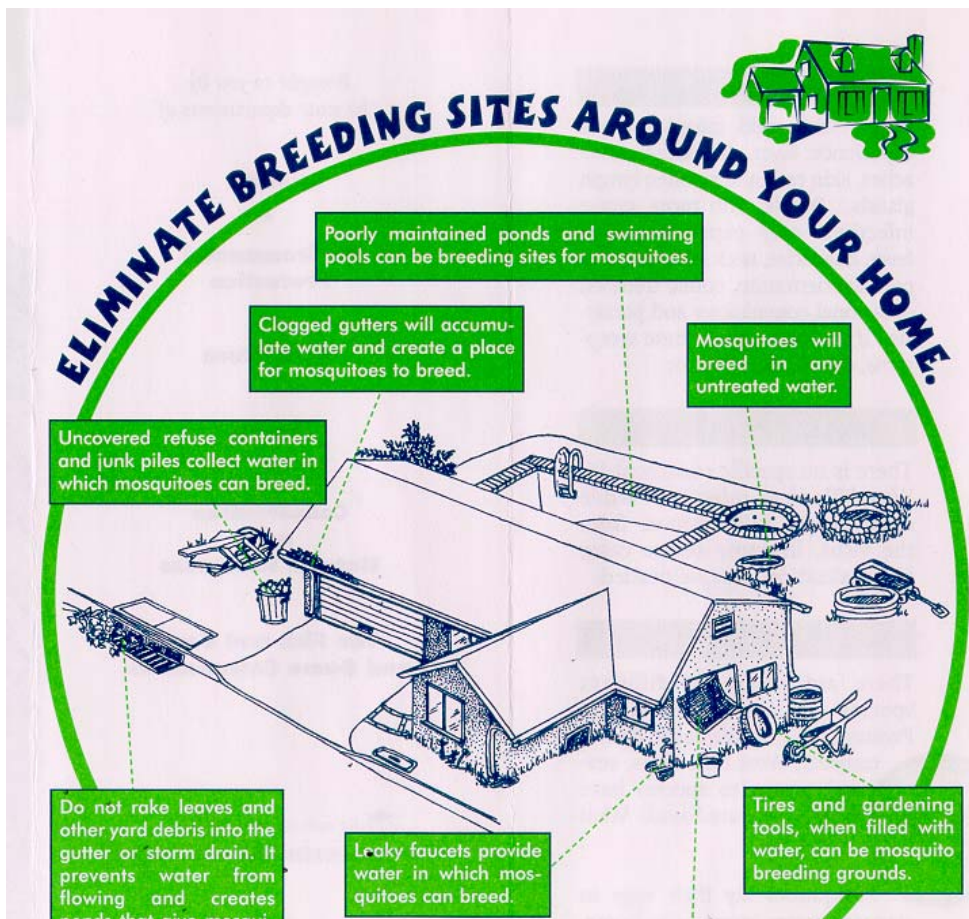
- Have an original depth of 3 to 4 feet, but no more than 6
- Have side slopes no steeper than 3:1
- Have two benches that are 10-feet wide
 - One at 1-foot above permanent pool elevation
 - One at 1-foot below permanent pool elevation
- Have an outlet structure that has a grate on it

Each design specification has its own purpose. For example, benches are flat areas that provide a level surface both above and below the normal water level of the pond. If anyone should fall in, there is a 10-foot level surface to fall onto, instead of falling into deep water. Similarly, more gradual side slopes will also decrease the likelihood of someone accidentally falling into the water.

Please note that fences around stormwater ponds are neither recommended nor required. It is quite easy for a child to climb a fence. However, if a child is in need of help while inside of the fenced-in area, it will be quite difficult for an adult to climb the fence to assist the child.

Mosquitoes

Oftentimes, mosquitoes are a common topic of discussion among homeowners who are concerned about their presence in stormwater ponds and other similar stormwater management BMPs. Typically, mosquitoes breed in shallow, ponding water. Mosquitos do not prefer deeper water habitat, so it is unlikely that they will breed in areas such as properly functioning wet ponds.



If you believe that your stormwater pond could be the source of mosquito proliferation, you can have a professional sample your pond to determine if the mosquito larvae exist there. For this type of assistance, please utilize the following Delaware Department of Natural Resources and Environmental Control phone numbers (Dover 302-739-9917; Kent and Sussex 302-422-1512; New Castle 302-836-2555).

If you have a mosquito problem, first follow these tips:

- Dispose of tin cans, plastic containers, ceramic pots or other water-holding containers on your property
- Pay special attention to discarded tires on your property
- Drill holes in the bottom of recycling bins that are left outdoors
- Clean clogged roof gutters
- Turn over plastic wading pools when not in use
- Aerate ornamental pools or stock them with fish
- Use landscaping to eliminate standing water on your property

REFERENCES

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- Delaware Nutrient Management Commission. Educational pamphlet: managing nutrients for your turf grass and lawns. Dover, Delaware.
- Gingrich, J. B. and C. E. Mason. 2003. Draft: Characterization of stormwater management and constructed wetland ponds as potential breeding sites for west nile virus vectors in Delaware during 2003. Department of Entomology and Wildlife Ecology. University of Delaware. Newark, Delaware.
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- Shaver, E. 1991. Sand Filtration Design for Water Quality Treatment. Delaware Department of Natural Resources and Environmental Control, Division of Soil and Water. Dover, Delaware.

U.S. Fish and Wildlife Service. 2001. Native Plants for Wildlife Habitat and Conservation Landscaping (Maryland: Coastal Plain). Chesapeake Bay Field Office. Annapolis, Maryland.

Shaver, E. H, J. J. Skupien, and R. R. Horner. 1997. Operation, Maintenance, and Management of Stormwater Management Systems. Watershed Management Institute. Crawfordville, Florida.



LIST OF DELEGATED AGENCIES

The following agencies have delegation of Sediment and Stormwater Program elements consisting of plan review, construction inspection, and maintenance inspection for their geographic boundaries.

1) State Agencies

- a. Department of Natural Resources & Environmental Control
Division of Soil and Water Conservation
Sediment and Stormwater Program
89 Kings Highway
Dover DE 19901

Phone: (302) 739-9921

Fax: (302) 739-6724

<http://www.dnrec.state.de.us/DNREC2000/Divisions/Soil/Stormwater/StormWater.htm>

Responsible for all aspects of administration of the state sediment and stormwater management program under the Delaware Sediment and Stormwater Law and Regulations. Responsible for plan review and inspection of State and Federal Projects.

- b. Department of Transportation
800 Bay Road
P.O. Box 778
Dover DE 19903

Phone: (302) 760-2251

Fax: (302) 739-6360

<http://www.deldot.net/>

Delegated Area: DeIDOT Construction

2) New Castle County

- a. New Castle County Dept. of Land Use
Licensing Division
87 Reads Way
Corporate Commons
New Castle DE 19720

Phone: (302) 395-5400

Fax: (302) 395-5488

<http://www.co.new-castle.de.us/flash1.html>

Delegated Area: All unincorporated areas of New Castle County

- b. New Castle Conservation District
2430 Old County Road
Newark DE 19702

Phone: (302) 832-3100, Ext. 3

Fax: (302) 834-0783

Delegated Area: All Incorporated areas of New Castle County (except City of Newark, City of Wilmington and Town of Middletown).

- c. City of Newark
Public Works Department
220 Elkton Road
Newark DE 19711

Phone: (302) 366-7040

(302) 366-7045

Fax: (302) 366-7160

http://newark.de.us/docs/departments/public_works.html

Delegated Area: City of Newark

- d. City of Wilmington
Dept. of Public Works
800 North French Street
Wilmington DE 19801

Phone: (302) 576-3056

Fax: (302) 571-4423

<http://www.ci.wilmington.de.us/departments/pubworks.htm>

Delegated Area: City of Wilmington

e. Town of Middletown
216 N. Broad Street
Middletown DE 19709

Phone: (302) 378-9120
Fax: (302) 378-1167

<http://208.234.27.227/middletownonline/midtown.htm>

Delegated Area: Town of Middletown

3) Kent County

Kent Conservation District
800 Bay Road, Suite 2
Dover, DE 19901

Phone: 302-741-2600 (X 3)
Fax: 302-741-0347

<http://kentcd.org/>

Delegated Area: Kent County

4) Sussex County

Sussex Conservation District
23818 Shortly Road
Georgetown DE 19947

Phone: (302) 856-7219
Fax: (302) 856-0951

http://www.sussexconservation.org/sed_sw.htm

Delegated Area: Sussex County

Native Plants for Wildlife Habitat and Conservation Landscaping

Maryland: Coastal Plain

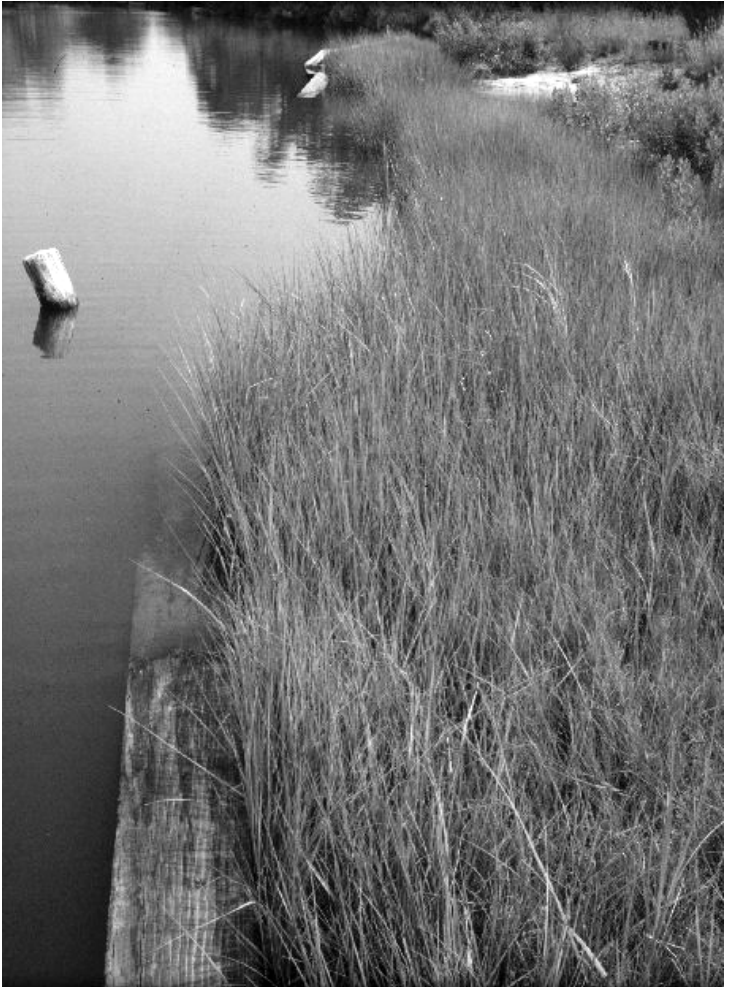


photo credit: USFWS

ABOUT THIS PLANT LIST

*This list provides information about native plants that can be used for habitat restoration and natural or environmentally beneficial landscaping projects such as **BayScapes**. All of the plants listed occur naturally in Maryland. Plants are grouped by plant type, then listed alphabetically by Latin name. This is not intended as a complete list of plants native to Maryland. Rather, plants have been included because they have both ornamental and wildlife value, and are generally available for sale.*

WHY USE NATIVE PLANTS?

Native or indigenous plants naturally occur in the region in which they evolved. They are adapted to local soil, rainfall and temperature conditions, and have developed natural defenses to many insects and diseases. Because of these traits, native plants will grow with minimal use of water, fertilizers, and pesticides. Wildlife species evolve with plants; therefore, they use native plant communities as their habitat. Using native plants helps preserve the balance and beauty of natural ecosystems.

TREASURED NATURAL RESOURCES

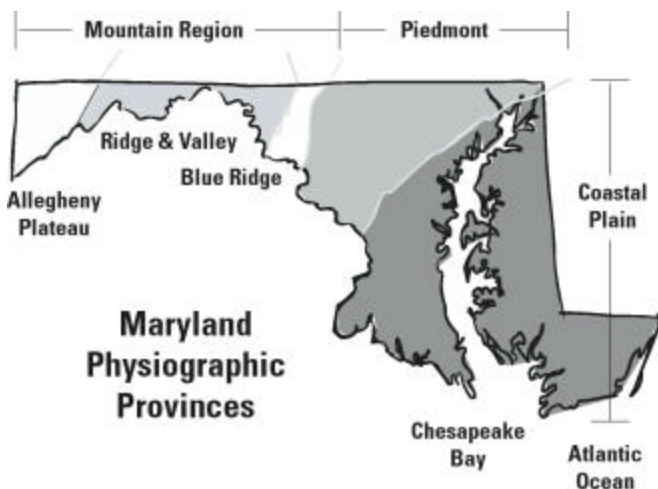
Maryland's landscape includes a wide range of natural communities, physiographic provinces, and natural features. Here, one can find both southern and northern ecosystems in close proximity. From the cypress swamps, barrier islands, and Delmarva bays of the Eastern Shore; to the rolling hills, stream valleys, and hardwood forests of the Piedmont plateau; to the mountain boreal bogs, caves, and limestone woods to the west, Maryland offers a diversity of habitats that support an impressive variety of species.

Rich in plants and animals, Maryland harbors some species with extremely limited ranges -- the nationally endangered dwarf wedge mussel and Delmarva fox squirrel find refuge within our borders, along with rare subterranean invertebrates, beach-loving beetles, and uncommon shale barren plants, like Kate's-mountain clover. When early colonists first explored this part of the New World, they found an abundance of wildlife, including elk, wolves, bison, and prairie-chickens. Today, these species are gone from Maryland and many more have declined. Much of our natural heritage is now confined to small fragments of the original wilderness.

As our population grows and land-use pressures intensify it is increasingly important that we protect our vanishing species and remaining natural areas, and restore or create habitat for the wildlife that remains. Maryland's wildlife, plants, habitats, and network of streams and rivers that lead to the Chesapeake Bay hold tremendous resource potential, as well as educational, recreational, aesthetic, and cultural values. By working together, these treasures can be conserved for future generations.

MARYLAND'S REGIONS AND HABITATS

From the sandy dunes of the coast to the rocky slopes of the mountains, Maryland's rich variety of habitats are strongly linked to its geology (see map). For this guide, the state has been divided into three regions: (1) the **coastal plain**, an area with a more southern climate in the eastern part of the state, which includes the Chesapeake Bay's eastern and western shores, up to the fall line roughly represented by U.S. Route 1; (2) the **Piedmont plateau**, which extends roughly from the fall line to Frederick, MD; and (3) the **mountain zone**, a more northern climate, which reaches from Frederick westward, above the 1500' elevation level. Some native plants are common throughout the state, while others are adapted to the unique conditions found only in one or two regions.



This publication is part of a set of three brochures that feature lists of species appropriate for planting in Maryland's coastal plain, Piedmont plateau, and mountain region. To help ensure successful landscaping and restoration, use plants' natural ranges to guide your plant selection. For more complete plant information, request a copy of U.S. Fish and Wildlife Service's new edition of *Native Plants for Wildlife Habitat*, a more comprehensive guide to native plants for the full Chesapeake Bay watershed (see references list in this brochure).

Wetland, forest, meadow, and thicket are just a few of Maryland's habitats, each of which is characterized by plants that have adapted to the available growing conditions. Plants usually do best when placed in sites with the same light, moisture, and soil conditions as their natural habitats.

GROWTH CONDITIONS

LIGHT The amount of sunlight a plant requires is defined as: (1) **Full sun (Su)**, the site is in direct sunlight for at least six hours a day during the growing season; (2) **Partial shade (PS)**, the site receives approximately three to six hours of direct sunlight; and (3) **Shade (Sh)**, the site receives less than three hours of direct sunlight or filtered light.

MOISTURE The amount of soil moisture a plant requires is defined as: (1) **Wet (W)**, areas where the soil is saturated for much of the growing season, except in droughts. Many of the plants designated for wet areas tolerate specific ranges of water depths. Consult a wetland plant specialist or reference book; (2) **Moist (M)**, areas where the soil is damp, and may be occasionally saturated ("average soil" has been included in this category); and (3) **Dry (D)**, areas where water does not remain after a rain. The latter areas may be in full sun or in a windy location, on a steep slope, or have sandy soil. Plants in this category are drought tolerant.

SOIL Many of the native plants listed will tolerate a range of soil types. For best results, select plants suited to existing site conditions rather than amending the soil. However, be aware that plant selection may be limited if your site has very sandy soil, heavy clay, compacted soil, or extreme soil pH (above 6.8 or below 5.5). In these cases, seek advice from a nurseryman, horticulturist, botanist, Maryland Cooperative Extension, or other expert.

DESIGNING A HABITAT

In addition to providing the growth conditions that native plants prefer in the wild, it is also a good idea to try to re-create a natural habitat. Consider using plants together as they grow in the wild (known as plant communities). Arrange plants in groups or groves, providing several layers of vegetation. Select plants that fruit or bloom during different times of the year to provide food for wildlife year round. For more information and assistance, particularly with large habitat projects, contact the U.S. Fish and Wildlife Service, Maryland Department of Natural Resources, U.S. Department of Agriculture Natural Resources Conservation Service, county Soil Conservation District, Maryland Cooperative Extension, or other natural resources agency or organization.

WHERE TO FIND NATIVE PLANTS

Most nurseries carry some native plants, and some nurseries specialize and carry a greater selection. Some plants will be more readily available than others will. If you have a favorite that you can't obtain, be sure to ask your local nursery to consider adding it to their stock. A list of native plant nurseries in the Chesapeake Bay region is available from the U.S. Fish and Wildlife Service Chesapeake Bay Field Office at www.fws.gov/r5cbfo/bayscapes.htm.

Native plants should not be removed from the wild unless an area is about to be developed. Even then, it is difficult to transplant wild-collected plants and to duplicate their soil and other growth requirements in a home garden. Plants that are grown from seed or cuttings by nurseries have a much greater tolerance for garden conditions. Help to preserve natural areas by purchasing plants that have been grown, not collected.

AVOID USING INVASIVE NON-NATIVE PLANTS

Non-native or exotic plants introduced from other parts of the world or other parts of the country have degraded many natural ecosystems. Although many non-native plants are considered beneficial and do not escape into the natural environment, it is difficult for most gardeners to know the risks of every ornamental plant. Some of these introduced plants are invasive, meaning that there are few or no naturally occurring measures such as insects or competitors to control them. Invasive plants can spread rapidly and smother or out-compete native vegetation. Ecosystems impacted by invasive, non-native plants have a reduced ability to clean our air and water, stabilize the soil, buffer floods, and provide wildlife food and shelter. Lists of non-native plants to avoid in your landscape are available from the Maryland Native Plant Society, Maryland DNR Heritage Program, or Plant Conservation Alliance (see contact information in this brochure).

FOR MORE INFORMATION

There are many resources available that provide information on native plants and natural landscaping. Walking in natural areas near your home is a good way to see the plants in their native habitats, and to get ideas on how to plant them in your landscape. Check libraries and bookstores for field guides to native plants and wildlife in the Chesapeake Bay region. You will also find books on how to create native plant landscapes. Organizations such as the Maryland Native Plant Society and the Plant Conservation Alliance publish newsletters and maintain Web sites. Landscaping with native plants has become very popular, and you will be joining many others in this effort to help preserve Maryland's natural resources.

PLANTS NATIVE TO MARYLAND'S COASTAL PLAIN REGION

Soil Moisture:

W = wet
M = moist
D = Dry

Sunlight:

Su = full sun
PS = part shade
Sh = full shade

Flower Color (simplified, all shades):

B = brown R = red O = orange
W = white P = pink G = green
Y = yellow Pu = purple Bl = blue

* denotes evergreen or semi-evergreen foliage

Scientific Name	Common Name	W	M	D	Su	PS	Sh	Height	Color	Bloom
FERN / FERN ALLY										
<i>Adiantum pedatum</i>	maidenhair fern		●			●		1-2'		
<i>Asplenium platyneuron</i>	ebony spleenwort		●			●	●	1-1.5'	*	
<i>Athyrium asplenoides</i>	southern lady fern	●	●			●		1.5-3'		
<i>Botrychium virginianum</i>	rattlesnake fern		●	●		●	●	1.5'		
<i>Dennstaedtia punctilobula</i>	hay-scented fern		●	●	●	●		1-3'		
<i>Onoclea sensibilis</i>	sensitive fern	●	●			●	●	1-2'		
<i>Osmunda cinnamomea</i>	cinnamon fern	●	●		●	●	●	2-3'		
<i>Osmunda regalis</i>	royal fern	●	●		●	●	●	2-3'		
<i>Polystichum acrostichoides</i>	Christmas fern		●			●	●	1.5-2'	*	
<i>Thelypteris noveboracensis</i>	New York fern	●	●			●	●	1-2.5'		
<i>Thelypteris palustris</i>	marsh fern	●	●		●	●		2-3'		
<i>Woodwardia areolata</i>	netted chain fern		●			●	●	1-2'		
<i>Woodwardia virginica</i>	Virginia chain fern	●	●			●	●	4'		
GRASS / GRASSLIKE										
<i>Andropogon virginicus</i>	broomsedge			●	●	●		1-3'		Aug-Nov
<i>Carex glaucoidea</i> or <i>C. flaccosperma</i>	blue wood sedge		●	●		●		0.5-2'	B-R	Jun-Jul
<i>Carex pennsylvanica</i>	sedge			●		●	●	0.5-1.5'	R-W	May-Jun
<i>Carex stricta</i>	tussock sedge	●	●		●	●		1-3'		May-Aug
<i>Chasmanthium latifolium</i>	wild oats, river oats		●			●		2-3'		Jul-Sep
<i>Elymus canadensis</i>	Canada wild rye		●	●	●			3-4.5'		Jun-Oct
<i>Elymus hystrix</i> (<i>Hystrix patula</i>)	bottlebrush grass		●	●	●	●	●	3'		
<i>Elymus virginicus</i>	Virginia wild rye		●	●		●	●	1.5-5.5'		Jun-Oct
<i>Panicum amarum</i>	coastal panic grass			●	●			1-3'		
<i>Panicum virgatum</i>	Virginia switchgrass	●	●		●			3-6'		Jul-Oct
<i>Schizachyrium scoparium</i>	little bluestem			●	●	●		4'		Aug-Oct
<i>Sorghastrum nutans</i>	Indiangrass			●	●	●		5-7'		Aug-Sep
<i>Tripsacum dactyloides</i>	gama grass	●	●		●	●		6-9'		
GROUNDCOVER										
<i>Asarum canadense</i>	wild ginger		●			●	●	<1'	B*	Apr-May
<i>Carex glaucoidea</i> or <i>C. flaccosperma</i>	blue wood sedge		●	●		●		0.5-2'	B-R	Jun-Jul
<i>Carex pennsylvanica</i>	sedge			●		●	●	0.5-1.5'	R-W	May-Jun
<i>Chimaphila maculata</i>	striped wintergreen			●		●	●	<1'	W	Jun-Aug
<i>Chrysogonum virginianum</i>	green-and-gold		●	●		●		<1'	Y	Mar-Jun
<i>Gaultheria procumbens</i>	wintergreen		●	●		●	●	<1'	W, P*	Jun-Aug
<i>Hepatica americana</i>	round-lobed hepatica		●	●		●	●	<1'	W	Mar-Jun
<i>Opuntia humifusa</i> (<i>O. compressa</i>)	eastern prickly-pear cactus			●	●			<1'	Y	Jun-Jul
<i>Maianthemum canadense</i>	Canada mayflower		●			●	●	<1'	W	May-Jul
<i>Mitchella repens</i>	partridgeberry		●	●		●	●	<1'	W*	Jul-Sep
<i>Sedum ternatum</i>	mountain stonecrop		●			●	●	<1'	G-W*	Apr
<i>Uvularia sessilifolia</i>	straw lily		●		●	●	●	<1'	Y	May-Jun
HERBACEOUS										
<i>Arisaema triphyllum</i>	Jack-in-the-pulpit	●	●			●	●	1'	striped	Apr-Jun
<i>Asclepias incarnata</i>	swamp milk weed		●		●	●		4'	P	May-Jun
<i>Asclepias syriaca</i>	common milk weed			●	●			6'	Pu	Jun-Aug
<i>Asclepias tuberosa</i>	butterflyweed		●	●	●	●		3'	O	May-Jun
<i>Aster laevis</i>	smooth blue aster			●	●			2-5'	Bl, Pu	Aug-Oct
<i>Aster novae-angliae</i>	New England aster		●	●	●	●		to 6'	Pu	Sep-Oct
<i>Aster novi-belgii</i>	New York aster		●		●	●		3-4'	Bl, Pu	Jul-Oct
<i>Aster pilosus</i>	white heath aster			●	●	●		3.5'	W	Aug-Oct
<i>Baptisia tinctoria</i>	wild indigo			●	●	●		3'	Y	Jun-Sep
<i>Caltha palustris</i>	marsh marigold	●			●	●		1-2'	Y	Apr-Jun
<i>Chelone glabra</i>	white turtlehead	●	●			●		3'	W	Aug-Oct
<i>Chrysogonum virginianum</i>	green-and-gold		●	●		●		<1'	Y	Mar-Jun
<i>Chrysopsis mariana</i>	Maryland golden aster			●	●	●		0.5-2'	Y	Aug-Oct
<i>Cimicifuga racemosa</i>	black snakeroot		●				●	5'	W	Jun-Jul
<i>Coreopsis tinctoria</i>	tickseed sunflower			●	●	●		1-3'	Y	Jun-Sep
<i>Desmodium paniculatum</i>	panicked tick-trefoil		●	●	●	●		2-4'	Pu	Jul-Sep
Scientific Name	Common Name	W	M	D	Su	PS	Sh	Height	Color	Bloom

Scientific Name	Common Name	W	M	D	Su	PS	Sh	Height	Color	Bloom
HERBACEOUS, continued										
<i>Eupatorium dubium</i>	Joe-Pye weed	●	●		●	●		4-7'	Pu	Jul-Sep
<i>Eupatorium fistulosum</i>	Joe-Pye weed		●	●	●			1.5-6'	P	Jul-Sep
<i>Eupatorium hyssopifolium</i>	hyssop-leaved thoroughwort		●	●	●	●	●	1-4'	W	Aug-Oct
<i>Eupatorium perfoliatum</i>	common boneset	●	●		●	●		3.5'	W	Jul-Oct
<i>Eupatorium purpureum</i>	green-stemmed Joe-Pye weed		●		●	●		2-6'	P	Jul-Sep
<i>Eupatorium rugosum</i>	white snakeroot		●	●		●		3.5'	W	Jun-Aug
<i>Helenium autumnale</i>	yellow sneezeweed		●		●	●	●	1.5-3'	Y	Aug-Nov
<i>Helianthus angustifolius</i>	swamp sunflower	●	●		●			5'	Y	Aug-Oct
<i>Houstonia caerulea</i>	bluet, innocence		●		●	●		<1'	Bl, Pu, W	Apr-Jun
<i>Liatris graminifolia</i>	grass-leaf blazingstar		●	●	●	●		1-3'	Pu	Sep-Oct
<i>Liatris spicata</i>	gayfeather, blazingstar	●	●		●			3'	Pu	Aug-Oct
<i>Lilium superbum</i>	Turk's cap lily	●	●		●	●		4-7'	Y, O, R	Jul-Aug
<i>Lobelia cardinalis</i>	cardinal flower	●	●		●	●		3'	R	Jul-Sep
<i>Monarda fistulosa</i>	wild bergamot		●	●	●	●		1.5-5'	P, Pu	Jul-Aug
<i>Monarda punctata</i>	horsemint			●	●			0.5-3'	Y-Pu	Jun-Oct
<i>Oenothera fruticosa</i>	narrow-leaved sundrops	●	●		●			2'	Y	Jun-Sep
<i>Opuntia humifusa (O. compressa)</i>	eastern prickly-pear cactus			●	●			<1'	Y	Jun-Jul
<i>Podophyllum peltatum</i>	Mayapple		●			●	●	1'	W	Apr-May
<i>Polygonatum biflorum</i>	Solomon's seal		●	●		●	●	0.5-2'	W	May-Jun
<i>Rudbeckia hirta</i>	black-eyed Susan		●	●	●	●		2'	Y	Jun-Oct
<i>Rudbeckia laciniata</i>	tall or green-headed coneflower		●		●	●		1.5-9'	Y	Jul-Sep
<i>Senna marilandica (Cassia marilandica)</i>	Maryland wild senna			●		●		3-4'	Y	Jul-Aug
<i>Silene caroliniana</i>	wild pink		●	●	●	●		0.5'	W, P*	Apr-May
<i>Sisyrinchium atlanticum</i>	coastal blue-eyed grass	●	●		●			0.5-2.5'	Bl, Pu	May-Jul
<i>Sisyrinchium graminoides</i>	blue-eyed grass		●	●	●	●		0.5-1.5'	Bl, Pu	Apr-Jun
<i>Smilacina racemosa</i>	false Solomon's seal		●			●	●	2.5'	W	May-Jul
<i>Solidago caesia</i>	blue-stemmed goldenrod		●	●	●	●		1-3'	Y	Aug-Oct
<i>Solidago juncea</i>	early goldenrod		●	●	●			1-4'	Y	Jun-Oct
<i>Solidago nemoralis</i>	gray goldenrod		●	●	●	●		0.5-3'	Y	Jul-Nov
<i>Solidago rugosa</i>	wrinkle leaf goldenrod	●	●		●			1-6'	Y	Aug-Oct
<i>Solidago sempervirens</i>	seaside goldenrod		●		●	●		6'	Y*	Aug-Oct
<i>Symplocarpus foetidus</i>	skunk cabbage	●					●	1-3'		Mar-Apr
<i>Thalictrum dioicum</i>	early meadow rue		●				●	2'	G, Pu	Apr-May
<i>Thalictrum polygamum</i>	tall meadow rue		●		●	●	●	3-6'	W	Jun-Jul
<i>Tiarella cordifolia</i>	foamflower		●		●	●	●	1'	W	Apr-Jul
<i>Tradescantia virginiana</i>	Virginia spiderwort		●		●	●	●	2-3'	Bl, Pu	Apr-Jun
<i>Trillium grandiflorum</i>	white trillium		●				●	1'	W	Apr-Jun
<i>Verbena hastata</i>	blue vervain	●	●		●	●		4'	Bl, Pu	Jun-Oct
<i>Vernonia noveboracensis</i>	New York ironweed		●		●			4-8'	Pu	Aug-Oct
<i>Viola pedata</i>	bird's foot violet			●	●	●		<1'	Pu	Mar-Jun
<i>Yucca filamentosa</i>	Adam's needle			●	●			2'	W	Jun-Sep
HERBACEOUS EMERGENT (can grow with roots in water)										
<i>Acorus calamus</i>	sweet flag	●	●		●	●		2-3'	Y, W	May-Jul
<i>Hibiscus moscheutos</i>	rose mallow	●	●		●	●		3-6'	W, P	Jul-Sep
<i>Iris versicolor</i>	blue flag	●	●		●	●		3'	Bl, Pu	May-Jun
<i>Juncus canadensis</i>	Canada rush	●	●		●	●		1-3'		
<i>Juncus effusus</i>	soft rush	●	●		●			2-3'		Jun-Sep
<i>Kosteletskya virginica</i>	seashore mallow	●			●			1.5-4.5'	P	Jul-Sep
<i>Nuphar luteum (Nuphar advena)</i>	spatterdock, yellow water lily	●			●	●		1'	Y	May-Oct
<i>Nymphaea odorata</i>	fragrant water lily	●			●			<1'	W	Jun-Sep
<i>Osmunda regalis</i>	royal fern	●	●		●	●	●	2-3'		
<i>Peltandra virginica</i>	arrow arum	●			●	●		to 2'	G-W	Apr-Jul
<i>Pontederia cordata</i>	pickerelweed	●			●	●		3'	Pu	Jun-Nov
<i>Sagittaria latifolia</i>	duck potato	●			●			0.5-2'	W	Jul-Oct
<i>Saururus cernuus</i>	lizard's tail	●			●	●		1.5-4.5'	W	Jun-Aug
<i>Scirpus cyperinus</i>	woolgrass	●	●		●	●		3-4'		Aug-Sep
<i>Scirpus pungens (S. americanus)</i>	common three-square	●			●			4'		Jun-Sep
<i>Spartina alterniflora</i>	salt marsh cordgrass or smooth cordgrass	●	●		●			2-5'		Jul-Sep
<i>Spartina patens</i>	salt meadow hay	●	●		●			1-3'		Jul-Sep
<i>Typha angustifolia</i>	narrow-leaved cattail	●	●		●			10'		Jun-Jul
<i>Typha latifolia</i>	broad-leaved cattail	●	●		●			5-7'		May-Jun
<i>Zizania aquatica</i>	wild rice	●	●		●			6-10'		Jun-Sep
Scientific Name	Common Name	W	M	D	Su	PS	Sh	Height	Color	Bloom

Scientific Name	Common Name	W	M	D	Su	PS	Sh	Height	Color	Bloom
SHRUB, low										
<i>Comptonia peregrina</i>	sweet fern		●		●	●		3'	G	Apr-May
<i>Euonymus americanus</i>	strawberry bush, hearts-a-bustin'		●			●		1.5-6.5'	G	May-Jun
<i>Gaylussacia baccata</i>	black huckleberry		●	●		●	●	1.5'	W, P	May-Jun
<i>Gaylussacia frondosa</i>	dangleberry	●	●	●	●	●		2-4'	G, Pu	Apr-Jun
<i>Hypericum densiflorum</i>	dense St. John's wort	●	●	●	●			1.5-6'	Y	Jul-Sep
<i>Kalmia angustifolia</i>	sheep laurel	●	●	●	●	●		2-5'	W, P, Pu*	May-Jul
<i>Lyonia mariana</i>	stagger-bush		●			●	●	0.5-6.5'	W, P	May-Jun
<i>Prunus maritima</i>	beach plum		●		●	●		1-8'	W	Apr-May
<i>Rhododendron atlanticum</i>	dwarf or coast azalea		●			●	●	3-6'	W	Apr-May
<i>Rosa carolina</i>	pasture rose		●	●	●	●		0.5-3'	P	May-Jun
<i>Vaccinium vacillans</i> (<i>V. pallidum</i>)	early lowbush blueberry		●		●	●		1.5'	W, P	Apr-May
<i>Viburnum acerifolium</i>	maple-leaved arrowwood		●	●	●	●		3-6.5'	W, P	Apr-May
SHRUB, medium										
<i>Aronia arbutifolia</i>	red chokeberry	●	●	●	●			1.5-13'	W	Mar-May
<i>Baccharis halimifolia</i>	high-tide bush, groundsel tree	●	●		●			to 10'	W	Aug-Sep
<i>Callicarpa americana</i>	American beautyberry		●			●	●	6'	Pu	Jun-Aug
<i>Cephalanthus occidentalis</i>	buttonbush	●	●		●			to 10'	W	Jul-Aug
<i>Clethra alnifolia</i>	sweet pepperbush, summersweet	●	●			●	●	6-10'	W, P	Jul-Sep
<i>Cornus amomum</i>	silky dogwood		●		●	●		3-10'	W	May-Jun
<i>Hamamelis virginiana</i>	witch hazel		●	●	●	●		3-15'	Y	Sep-Dec
<i>Ilex glabra</i>	inkberry		●		●	●		3-10'	W*	May-Jun
<i>Ilex laevigata</i>	winterberry		●		●	●		10'	W	May-Jul
<i>Itea virginica</i>	tassel-white, Virginia sweetspire	●	●		●	●		3-10'	W	May-Jun
<i>Leucothoe racemosa</i>	fetterbush		●			●	●	13'	W, P	May-Jun
<i>Lindera benzoin</i>	spicebush		●	●		●		6.5-16'	Y	Mar-May
<i>Lyonia ligustrina</i>	male-berry		●			●	●	1.5-10'	W	May-Jul
<i>Myrica cerifera</i>	wax myrtle, southern bayberry		●	●	●	●		6-12'	G*	Mar-Apr
<i>Myrica pensylvanica</i>	northern bayberry	●	●	●		●		8'	G	Apr-May
<i>Rhododendron periclymenoides</i>	pink azalea, pinxterbloom	●	●			●		3-10'	P, W	Apr-May
<i>Rhododendron viscosum</i>	swamp azalea	●	●		●			6.5-10'	W, P	May-Aug
<i>Rhus glabra</i>	sweet or smooth sumac		●	●	●			1.5-10'	G	Jun-Jul
<i>Rosa palustris</i>	swamp rose	●			●	●	●	8'	P	Jul-Aug
<i>Sambucus canadensis</i>	common elderberry	●	●		●	●	●	6-12'	W	Jun-Jul
<i>Vaccinium corymbosum</i>	highbush blueberry	●	●	●	●	●		6-12'	W, P	Apr-May
<i>Vaccinium stamineum</i>	deerberry		●		●	●		5-10'	W, Pu	Apr-Jun
<i>Viburnum dentatum</i> (<i>V. recognitum</i>)	southern arrowwood		●	●	●	●		10'	W	May-Jun
<i>Viburnum nudum</i>	naked witheredod		●		●	●		6.5-13'	W	Apr-May
SHRUB, tall										
<i>Alnus serrulata</i>	smooth alder	●	●		●			12-20'		Mar-Apr
<i>Aralia spinosa</i>	Devil's walking stick		●		●	●		39'	W	Jun-Aug
<i>Ilex decidua</i>	possum haw		●	●	●	●		33'	W	Apr-May
<i>Kalmia latifolia</i>	mountain laurel		●	●	●	●	●	10'	W, P*	May-Jul
<i>Rhus copallina</i>	shining or winged sumac			●	●	●		20-30'	G-Y	Jul-Aug
<i>Rhus typhina</i>	staghorn sumac			●	●			33'	Y, G	Jun-Jul
<i>Viburnum prunifolium</i>	black haw	●	●		●	●		26'	W	Apr-May
TREE, small/ medium (understory)										
<i>Amelanchier canadensis</i>	serviceberry, shadbush	●	●			●	●	35-50'	W	Apr-May
<i>Asimina triloba</i>	paw paw		●		●			39'	Y, R	Mar-Apr
<i>Castanea pumila</i>	chinquapin			●		●		12-20'	Y	Jun
<i>Cercis canadensis</i>	eastern redbud		●	●		●	●	20-35'	P, Pu	Apr-May
<i>Chionanthus virginicus</i>	white fringetree		●	●	●	●	●	20-35'	W	May-Jun
<i>Cornus florida</i>	flowering dogwood		●	●		●	●	35-50'	W	Apr-May
<i>Crataegus crus-galli</i>	cockspur hawthorn		●	●	●	●		20-35'	W	May-Jun
<i>Crataegus viridis</i>	southern thorn	●	●			●	●	20-35'	W	Apr
<i>Ilex opaca</i>	American holly		●		●	●		65'	W*	May-Jun
<i>Juniperus virginiana</i>	eastern red cedar		●	●	●			50'	*	Mar-Apr
<i>Magnolia virginiana</i>	sweetbay magnolia	●	●		●	●	●	30'	W*	May-Jul
<i>Ostrya virginiana</i>	eastern hop- hornbeam, ironwood		●			●	●	25-40'	R, B	May
<i>Pyrus (Malus) angustifolia</i>	southern crabapple		●			●	●	25'		Apr-May
<i>Pyrus (Malus) coronaria</i>	sweet crabapple		●		●			20-26'	P	Apr-May
<i>Sassafras albidum</i>	sassafras		●		●	●		35-50'	Y, G	Apr-May
Scientific Name	Common Name	W	M	D	Su	PS	Sh	Height	Color	Bloom

Scientific Name	Common Name	W	M	D	Su	PS	Sh	Height	Color	Bloom
TREE, tall (canopy)										
<i>Acer negundo</i>	box elder	●	●		●	●		30-60'		
<i>Acer rubrum</i>	red maple	●	●		●	●		40-60'		
<i>Betula nigra</i>	river birch	●	●		●	●		30-50'		
<i>Carya alba</i> (<i>C. tomentosa</i>)	mockernut hickory		●	●		●	●	60-90'		
<i>Carya cordiformis</i>	bitternut hickory	●	●		●			60-80'		
<i>Carya glabra</i>	pignut hickory	●	●	●	●	●		60-80'		
<i>Carya ovata</i>	shagbark hickory		●		●			70-100'		
<i>Cellis occidentalis</i>	hackberry	●	●		●	●		40-60'		
<i>Chamaecyparis thyoides</i>	Atlantic white cedar	●	●			●	●	75'	*	
<i>Diospyros virginiana</i>	common persimmon		●	●	●	●		50-75'		
<i>Fagus grandifolia</i>	American beech		●		●	●		50-100'		
<i>Fraxinus americana</i>	white ash		●		●	●		80'		
<i>Fraxinus pennsylvanica</i>	green ash	●	●		●	●		50-60'		
<i>Juglans nigra</i>	black walnut		●		●			70-90'		
<i>Liquidambar styraciflua</i>	sweet gum	●	●		●	●		60-80'		
<i>Liriodendron tulipifera</i>	tulip poplar		●		●	●		70-120'		
<i>Morus rubra</i>	red mulberry		●		●			60'		
<i>Nyssa sylvatica</i>	black gum, sourgum	●	●	●	●	●		30-60'		
<i>Pinus echinata</i>	shortleaf pine		●	●	●			100'	*	
<i>Pinus rigida</i>	pitch pine			●	●			50-60'	*	
<i>Pinus taeda</i>	loblolly pine	●	●		●			70-90'	*	
<i>Pinus virginiana</i>	Virginia pine		●	●	●			50-80'	*	
<i>Platanus occidentalis</i>	American sycamore	●	●		●	●		75-100'		
<i>Prunus serotina</i>	black or wild cherry		●		●			40-60'		
<i>Quercus alba</i>	white oak		●		●			80-100'		
<i>Quercus bicolor</i>	swamp white oak	●			●	●		60-70'		
<i>Quercus coccinea</i>	scarlet oak		●		●			40-60'		
<i>Quercus falcata</i>	southern red oak		●		●			70-80'		
<i>Quercus marilandica</i>	blackjack oak			●		●		50'		
<i>Quercus michauxii</i>	swamp chestnut oak	●	●		●			60-80'		
<i>Quercus nigra</i>	water oak	●	●			●	●	50-80'		
<i>Quercus palustris</i>	pin oak		●		●			60-80'		
<i>Quercus phellos</i>	willow oak	●	●		●	●		80-100'		
<i>Quercus prinus</i> (<i>Q. montana</i>)	chestnut oak			●	●	●		60-80'		
<i>Quercus rubra</i>	northern red oak		●	●	●	●		90'		
<i>Quercus stellata</i>	post oak		●		●			75'		
<i>Quercus velutina</i>	black oak		●	●	●			50-60'		
<i>Robinia pseudoacacia</i>	black locust		●	●	●			40-80'		
<i>Salix nigra</i>	black willow	●	●		●	●		40-80'		
<i>Taxodium distichum</i>	bald cypress	●			●	●		50-70'		
<i>Tilia americana</i>	American basswood		●			●		> 100'		
<i>Ulmus americana</i>	American elm		●		●			100'		
VINE										
<i>Bignonia capreolata</i>	crossvine	●	●			●	●	30-45'	O, R, Y *	May-Jun
<i>Campsis radicans</i>	trumpet creeper			●	●			30'+	O	Jul-Sep
<i>Celastrus scandens</i>	American bittersweet		●		●	●	●	to 45'	G	May-Jun
<i>Clematis virginiana</i>	virgin's bower			●	●			6-12'	W	Jul-Sep
<i>Lonicera sempervirens</i>	coral honeysuckle			●	●			10-20'+	R *	Apr-Jul
<i>Parthenocissus quinquefolia</i>	Virginia creeper	●	●		●	●	●	to 45'	G, W	Jun-Aug
<i>Passiflora incarnata</i>	passionflower, maypops			●	●				W, P	Jun-Sep
Scientific Name	Common Name	W	M	D	Su	PS	Sh	Height	Color	Bloom



photo credit: Randy Loftus, USFWS

Blazingstar (*Liatris spicata*) is one of many species that attracts birds and beneficial insects such as butterflies.

sample plant lists for Maryland's coastal plain

Plants for Wet Sites, Wetlands, Ponds, and Wet Edges (partial to full sun)

Ferns:

<i>Osmunda cinnamomea</i>	cinnamon fern
<i>Osmunda regalis</i>	royal fern
<i>Thelypteris palustris</i>	marsh fern

Grasses and Grasslike Plants:

<i>Carex stricta</i>	tussock sedge
<i>Festuca rubra</i>	red fescue (turf)
<i>Panicum virgatum</i>	Virginia switchgrass
<i>Tripsacum dactyloides</i>	gama grass

Herbaceous Plants:

<i>Caltha palustris</i>	marsh marigold
<i>Eupatorium dubium</i>	Joe-Pye weed
<i>Eupatorium perfoliatum</i>	common boneset
<i>Helianthus angustifolius</i>	swamp sunflower
<i>Liatris spicata</i>	blazingstar
<i>Lilium canadense</i>	Canada lily
<i>Lilium superbum</i>	Turk's cap lily
<i>Lobelia cardinalis</i>	cardinal flower
<i>Lobelia siphilitica</i>	great blue lobelia
<i>Oenothera fruticosa</i>	sundrops
<i>Senecio aureus</i>	golden ragwort
<i>Sisyrinchium atlanticum</i>	coastal blue-eyed grass
<i>Solidago rugosa</i>	wrinkle leaf goldenrod
<i>Verbena hastata</i>	blue vervain

Herbaceous Emergents

(growing up out of water):

<i>Acorus calamus</i>	sweet flag
<i>Hibiscus moscheutos</i>	rose mallow
<i>Iris versicolor</i>	blue flag iris
<i>Juncus canadensis</i>	Canada rush
<i>Juncus effusus</i>	soft rush
<i>Kosteletskyia virginica</i>	seashore mallow
<i>Nuphar luteum (advena)</i>	yellow water lily
<i>Nymphaea odorata</i>	fragrant water lily
<i>Osmunda regalis</i>	royal fern
<i>Peltandra virginica</i>	arrow arum
<i>Pontederia cordata</i>	pickerelweed
<i>Sagittaria latifolia</i>	duck potato
<i>Saururus cernuus</i>	lizard's tail
<i>Scirpus cyperinus</i>	woolgrass
<i>Scirpus pungens</i>	three-square
<i>Spartina alterniflora</i>	salt marsh cordgrass
<i>Spartina patens</i>	salt meadow hay
<i>Typha angustifolia</i>	narrow-leaved cattail
<i>Typha latifolia</i>	broad-leaved cattail
<i>Zizania aquatica</i>	wild rice

Shrubs:

low:

<i>Aronia melanocarpa</i>	black chokeberry
<i>Gaylussacia frondosa</i>	dangleberry
<i>Hypericum densiflorum</i>	dense St. John's wort
<i>Kalmia angustifolia</i>	sheep laurel (evgr)
<i>Rubus allegheniensis</i>	Allegheny blackberry

medium:

<i>Aronia arbutifolia</i>	red chokeberry
<i>Baccharis halimifolia</i>	high-tide bush
<i>Cephalanthus occidentalis</i>	buttonbush
<i>Ilex verticillata</i>	winterberry holly
<i>Itea virginica</i>	Virginia sweetspire
<i>Rhododendron viscosum</i>	swamp azalea
<i>Rosa palustris</i>	swamp rose
<i>Sambucus canadensis</i>	common elderberry

tall:

<i>Alnus serrulata</i>	smooth alder
<i>Magnolia virginiana</i>	sweetbay (see Trees)
<i>Viburnum prunifolium</i>	black haw viburnum

Trees, tall:

<i>Acer negundo</i>	box elder
<i>Acer rubrum</i>	red maple
<i>Acer saccharinum</i>	silver maple
<i>Betula nigra</i>	river birch
<i>Carya cordiformis</i>	bitternut hickory
<i>Carya glabra</i>	pignut hickory
<i>Celtis occidentalis</i>	hackberry
<i>Fraxinus pennsylvanica</i>	green ash
<i>Liquidambar styraciflua</i>	sweet gum
<i>Nyssa sylvatica</i>	black gum, sourgum
<i>Pinus taeda</i>	loblolly pine
<i>Platanus occidentalis</i>	American sycamore
<i>Populus deltoides</i>	eastern cottonwood
<i>Quercus bicolor</i>	swamp white oak
<i>Quercus michauxii</i>	swamp chestnut oak
<i>Quercus phellos</i>	willow oak
<i>Salix nigra</i>	black willow
<i>Salix sericea</i>	silky willow
<i>Taxodium distichum</i>	bald cypress

Vine:

<i>Parthenocissus quinquefolia</i>	Virginia creeper
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Plants for Dry Sun, Sunny Slopes, Meadows, Hedgerows, or Edges

Ferns:

<i>Dennstaedtia punctilobula</i>	hay-scented fern
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Grasses or Grasslike Plants:

<i>Andropogon virginicus</i>	broomsedge
<i>Elymus canadensis</i>	Canada wild rye
<i>Elymus hystrix</i>	bottlebrush grass
<i>Panicum amarum</i>	coastal panic grass
<i>Schizachyrium scoparium</i>	little bluestem
<i>Sorghastrum nutans</i>	Indiangrass

Herbaceous Plants and Groundcovers:

<i>Asclepias syriaca</i>	common milkweed
<i>Asclepias tuberosa</i>	butterflyweed
<i>Aster laevis</i>	smooth blue aster
<i>Aster novae-angliae</i>	New England aster
<i>Aster pilosus</i>	white heath aster
<i>Baptisia tinctoria</i>	wild indigo
<i>Chrysopsis mariana</i>	Maryland golden aster
<i>Coreopsis tinctoria</i>	tickseed sunflower
<i>Desmodium paniculatum</i>	panicked tick-trefoil
<i>Eupatorium fistulosum</i>	Joe-Pye weed
<i>Eupatorium hyssopifolium</i>	hyssop-leaf thoroughwort
<i>Liatris graminifolia</i>	grass-leaf blazingstar
<i>Monarda fistulosa</i>	wild bergamot
<i>Monarda punctata</i>	horsemint
<i>Opuntia humifusa</i>	prickly-pear cactus
<i>Rudbeckia hirta</i>	black-eyed Susan
<i>Silene caroliniana</i>	wild pink
<i>Sisyrinchium graminoides</i>	blue-eyed grass
<i>Solidago caesia</i>	blue-stem goldenrod
<i>Solidago juncea</i>	early goldenrod
<i>Solidago nemoralis</i>	gray goldenrod
<i>Viola pedata</i>	bird's foot violet
<i>Yucca filamentosa</i>	Adam's needle

Shrubs:

low:

<i>Gaylussacia frondosa</i>	dangleberry
<i>Hypericum densiflorum</i>	dense St. John's wort
<i>Kalmia angustifolia</i>	sheep laurel (evgrn)
<i>Rosa carolina</i>	pasture rose
<i>Viburnum acerifolium</i>	maple-leaved arrowwood

medium:

<i>Aronia arbutifolia</i>	red chokeberry
<i>Hamamelis virginiana</i>	witch hazel
<i>Myrica cerifera</i>	wax myrtle (evgrn)
<i>Rhus glabra</i>	smooth sumac
<i>Vaccinium corymbosum</i>	highbush blueberry
<i>Viburnum dentatum</i>	southern arrowwood

tall:

<i>Ilex decidua</i>	possum haw
<i>Kalmia latifolia</i>	mountain laurel (evgr)
<i>Rhus copallina</i>	shining sumac
<i>Rhus typhina</i>	staghorn sumac

Trees:

small/ medium:

<i>Chionanthus virginicus</i>	white fringetree
<i>Crataegus crus-galli</i>	cockspur hawthorn
<i>Juniperus virginiana</i>	eastern redcedar (evgr)

tall:

<i>Carya glabra</i>	pignut hickory
<i>Diospyros virginiana</i>	common persimmon
<i>Nyssa sylvatica</i>	black gum, sourgum
<i>Pinus echinata</i>	shortleaf pine (evergr)
<i>Pinus rigida</i>	pitch pine (evergrn)
<i>Pinus virginiana</i>	Virginia pine (evergrn)
<i>Quercus prinus (montana)</i>	chestnut oak
<i>Quercus rubra</i>	northern red oak
<i>Quercus velutina</i>	black oak
<i>Robinia pseudoacacia</i>	black locust

Vines:

<i>Campsis radicans</i>	trumpet creeper
<i>Clematis virginiana</i>	virgin's bower
<i>Lonicera sempervirens</i>	coral honeysuckle
<i>Passiflora incarnata</i>	passionflower, Maypops

Plants for Shade, Woodlands, or Woods Edges (dry to moist soil)

* designates plants for part shade (not for full shade)

Ferns:

<i>Adiantum pedatum</i>	maidenhair fern	*
<i>Asplenium platyneuron</i>	ebony spleenwort	
<i>Botrychium virginianum</i>	rattlesnake fern	
<i>Dennstaedtia punctilobula</i>	hay-scented fern	*
<i>Polystichum acrostichoides</i>	Christmas fern (evgr)	
<i>Woodwardia areolata</i>	netted chain fern	

Grasses and Grasslike Plants:

<i>Carex glaucoidea</i>	blue wood sedge	
<i>Carex pennsylvanica</i>	sedge	
<i>Chasmanthium latifolium</i>	wild (river) oats	*
<i>Elymus hystrix</i>	bottlebrush grass	
<i>Elymus virginicus</i>	Virginia wild rye	

Groundcovers:

<i>Asarum canadense</i>	wild ginger	
<i>Carex glaucoidea</i>	blue wood sedge	
<i>Carex pennsylvanica</i>	sedge	
<i>Chimaphila maculata</i>	striped wintergreen	
<i>Chrysogonum virginianum</i>	green-and-gold	*
<i>Gaultheria procumbens</i>	wintergreen	
<i>Hepatica americana</i>	round-lobed hepatica	
<i>Maianthemum canadense</i>	Canada mayflower	
<i>Mitchella repens</i>	partridgeberry	
<i>Sedum ternatum</i>	mountain stonecrop	
<i>Uvularia sessilifolia</i>	straw lily	

Herbaceous Plants:

<i>Arisaema triphyllum</i>	Jack-in-the-pulpit	
<i>Chrysogonum virginianum</i>	green-and-gold	*
<i>Eupatorium hyssopifolium</i>	hyssop thoroughwort	
<i>Eupatorium rugosum</i>	white snakeroot	*
<i>Helenium autumnale</i>	yellow sneezeweed	
<i>Houstonia caerulea</i>	bluet, innocence	*
<i>Monarda fistulosa</i>	wild bergamot	*
<i>Podophyllum peltatum</i>	Mayapple	
<i>Polygonatum biflorum</i>	Solomon's seal	
<i>Senna marilandica</i>	Maryland wild senna*	
<i>Smilacina racemosa</i>	false Solomon's seal	
<i>Thalictrum dioicum</i>	early meadow rue	
<i>Thalictrum polygamum</i>	tall meadow rue	
<i>Tiarella cordifolia</i>	foamflower	
<i>Tradescantia virginiana</i>	Virginia spiderwort	
<i>Trillium grandiflorum</i>	white trillium	
<i>Viola pedata</i>	bird's foot violet	*

Evergreens for various sites

ferns, herbaceous plants and other groundcovers

<i>Asarum canadense</i>	wild ginger (semi-evgr)
<i>Asplenium platyneuron</i>	ebony spleenwort
<i>Gaultheria procumbens</i>	wintergreen
<i>Mitchella repens</i>	partridgeberry
<i>Polystichum acrostichoides</i>	Christmas fern
<i>Sedum ternatum</i>	mountain stonecrop
<i>Silene caroliniana</i>	wild pink
<i>Solidago sempervirens</i>	seaside goldenrod

short shrubs (under 6')

<i>Gaultheria procumbens</i>	wintergreen
<i>Ilex glabra</i>	inkberry
<i>Kalmia angustifolia</i>	sheep laurel

medium shrubs (to 15' or more)

<i>Magnolia virginiana</i>	sweetbay magnolia
<i>Myrica cerifera</i>	wax myrtle

tall shrubs and trees

<i>Ilex opaca</i>	American holly
<i>Juniperus virginiana</i>	eastern redcedar
<i>Kalmia latifolia</i>	mountain laurel
<i>Pinus echinata</i>	shortleaf pine
<i>Pinus rigida</i>	pitch pine
<i>Pinus taeda</i>	loblolly pine
<i>Pinus virginiana</i>	Virginia pine

vines

<i>Bignonia capreolata</i>	crossvine
<i>Lonicera sempervirens</i>	coral honeysuckle

Shrubs:

low:

<i>Gaylussacia baccata</i>	black huckleberry
<i>Kalmia angustifolia</i>	sheep laurel (evgr) *
<i>Lyonia mariana</i>	stagger-bush
<i>Rhododendron atlanticum</i>	coast azalea
<i>Viburnum acerifolium</i>	maple-leaved arrowwood

medium:

<i>Callicarpa americana</i>	beautyberry
<i>Clethra alnifolia</i>	sweet pepperbush
<i>Hamamelis virginiana</i>	witch hazel *
<i>Leucothoe racemosa</i>	fetterbush
<i>Lindera benzoin</i>	spicebush *
<i>Lyonia ligustrina</i>	male-berry
<i>Myrica cerifera</i>	wax myrtle (evgr) *
<i>Myrica pensylvanica</i>	northern bayberry *
<i>Viburnum dentatum</i>	southern arrowwood *

tall:

<i>Ilex decidua</i>	possum haw *
<i>Kalmia latifolia</i>	mountain laurel (evgr)
<i>Rhus copallina</i>	shining sumac

Trees:

small/ medium:

<i>Amelanchier canadensis</i>	serviceberry
<i>Castanea pumila</i>	Chinquapin *
<i>Cercis canadensis</i>	eastern redbud
<i>Chionanthus virginicus</i>	white fringetree
<i>Cornus florida</i>	flowering dogwood
<i>Crataegus crus-galli</i>	cockspur hawthorn *
<i>Magnolia virginiana</i>	sweetbay magnolia
<i>Ostrya virginiana</i>	hop-hornbeam
<i>Pyrus angustifolia</i>	southern crabapple
<i>Sassafras albidum</i>	sassafras *

tall:

<i>Carya alba</i> (C. tomentosa)	mockernut hickory
<i>Carya glabra</i>	pignut hickory
<i>Diospyros virginiana</i>	common persimmon
<i>Nyssa sylvatica</i>	black gum, sourgum
<i>Quercus marilandica</i>	blackjack oak
<i>Quercus prinus</i> (montana)	chestnut oak
<i>Quercus rubra</i>	northern red oak

Vines:

<i>Bignonia capreolata</i>	crossvine
<i>Celastrus scandens</i>	American bittersweet
<i>Parthenocissus quinquefolia</i>	Virginia creeper



photo credit: Britt Slattery, USFWS

Seed heads can be ornamental while providing wildlife food. New York ironweed (*Vernonia noveboracensis*) is one example.

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photo credit: Britt Slattery, USFWS

Many trees and shrubs such as this serviceberry (*Amelanchier canadensis*) provide early spring bloom as well as summer and fall fruits.



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BayScapes Program, Partners for Fish and Wildlife Program (for private lands), Schoolyard Habitats Program



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Thank you to volunteer Carol Jelich for compiling plant information in this guide.

UNIT COSTS FOR STORMWATER TREATMENT PRACTICE MAINTENANCE - DRAFT¹

Maintenance Item	Unit Price (\$)	Unit	Mobilization Cost (\$) ²	Typical Applicability	Maintenance Interval (yrs) ³
Dam/ Embankment					
unclog internal drains for embankments	10	lf	1500	dry pond or infiltration basin	R (10)
low spots in dam or berm	170	cy	1500	ponds, wetlands, infiltration basins and some filters	R (5)
Sediment/ Debris Removal					
debris removal (preventative)	350	event	0	all surface practices	0.25-1
clear outfall channel of sediment	130	cy	0	all practices that outfall to a channel	5-15
clogged low flow	750	event	800	all practices except bioretention, and infiltration practices	0.25-1
dredge wet ponds (jobs larger than 1000 cy) haul offsite	60	cy	>2500	wet ponds and wetlands	5-15
dry pond sediment removal	7,600	event	0	dry pond or infiltration basin	15-25
dewater pond	900	event	0	wet ponds and wetlands	15-25
muck out undergrounds	390	cy	0	underground proprietary filter systems	0.5-1
dewater and remove sludge from underground facilities	1	gal	0	all underground facilities	0.25-1
typical sediment dump fee (not including trucking)	66	ton	0	all practices	NA
truck day for landfill to transport underground dredge materials (minimum, assume 2 to 4 trips in one day)	800	trip-day	0	all underground facilities	NA
<p>1) These costs were largely derived from data from the Maryland region, based on bid proposal and actual project data.</p> <p>2) Cost at four levels: \$0 for no mobilization; \$800 for minimal mobilization; \$1,500 for small project mobilization; >\$2,500 for large project mobilization. Note that these are approximations. For items with no mobilization cost, it is assumed that the mobilization cost is incorporated into the overall unit cost, or that the maintenance can be completed during inspection.</p> <p>3) Bottom number in range represents ideal maintenance interval. Top number represents maximum interval between maintenance activities. R indicates repair items, whose frequency is somewhat unpredictable. The frequencies sometimes reported in parentheses represent an estimate of typical repair frequency.</p>					

UNIT COSTS FOR STORMWATER TREATMENT PRACTICE MAINTENANCE - DRAFT¹

Maintenance Item	Unit Price (\$)	Unit	Mobilization Cost (\$) ²	Typical Applicability	Maintenance Interval (yrs) ³
Restore/Replace Filtering Media Permeability					
fill low spots in bottom of infiltration or dry pond	25	sy	1500	dry pond or infiltration basin	R (2-5)
replace sand filter media surface	2,200	event	0	all sand filters	3-5
replace sand filter media (surface)	300	cy	0	surface sand filters	15-25
replace sand media (underground)	390	cy	0	underground sand filters	15-25
Structural - Riser and Barrel					
re-tar CMP barrel	11	sf	800	ponds, wetlands and infiltration basins	15-20
repair CMP barrel joint leak	530	ea	800	ponds, wetlands, infiltration basins	R (3-5)
repair leaking concrete principal spillway joint	1,200	ea	0	ponds, wetlands, infiltration basins	R (5-10)
replace riser (CMP)	12,000	ea	>2500	ponds, wetlands, infiltration basins	R (25)
replace riser (concrete)	20,000	ea	>2500	ponds, wetlands, infiltration basins	R (50)
replace barrel	1000	lf	>2500	ponds, wetlands and infiltration basins	R (25-50)
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UNIT COSTS FOR STORMWATER TREATMENT PRACTICE MAINTENANCE - DRAFT¹

Maintenance Item	Unit Price (\$)	Unit	Mobilization Cost (\$) ²	Typical Applicability	Maintenance Interval (yrs) ³
Structural - Pipes and Valves					
remove old valve	300	ea	800	all practices designed with valves	R (10)
replace existing underground elbow	1,600	ea	800	oil/grit separators and some underground filters	R (10)
slip line failing pipes	90	lf	>2500	all practices that receive flow from or outfall to a pipe	R
install new valve (< 24 inches)	3,100	ea	1500	ponds, wetlands, infiltration basins	R
install new valve (<11 inches)	1,300	ea	1500	ponds, wetlands, infiltration basins	R
install new valve (<36 inches)	4,600	ea	1500	ponds, wetlands, infiltration basins	R
install new valve (<7 inches)	460	ea	800	ponds, wetlands, infiltration basins	R
replace end sections <36"	600	ea	1500	ponds, wetlands, infiltration basins, surface filters	R
remote control TV video pipes	1	lf	800	all practices that receive flow through pipes	5-25
lubricate valves (same price for first four)	300	ea	0	Ponds, wetlands and infiltration basins	1-2
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Maintenance Item	Unit Price (\$)	Unit	Mobilization Cost (\$) ²	Typical Applicability	Maintenance Interval (yrs) ³
Special Structures: Underdrains, Trash Racks, Observation Wells					
jet observation well	10	lf	800	infiltration and filtering practices	R (3-5)
underdrain jetting not including disposal (25' an hour)	200	hr	800	filtering practices	R (3-5)
replace broken observation well in asphalt parking lot	1,200	ea	0	infiltration and filtering practices	R
replace broken observation wells (not located in pavement or underground)	300	ea	0	infiltration and filtering practices	R
replace observation well cap (each additional cap is \$20)	50	ea	800	infiltration and filtering practices	R
install underground half shell trash rack (4' to 6') (2 pieces is extra \$120)	1,300	ea	0	underground practices	R
repair high stage trash racks (weld new rebar, etc.)	430	event	0	ponds, wetlands, infiltration basins	R (10-20)
new low flow trash rack (surface facilities)	1,700	ea	800	all surface practices except bioretention, infiltration practices, and open channel practices	R (5-10)
install high stage trash rack 4'x2'	1,100	ea	1500	ponds, wetlands, infiltration basins	R (20+)
replace CMP anti-vortex device <48"	1,500	ea	1500	ponds, wetlands, infiltration basins	R (10-15)
replace CMP anti-vortex device >48"	4,600	ea	1500	ponds, wetlands, infiltration basins	R (10-15)
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UNIT COSTS FOR STORMWATER TREATMENT PRACTICE MAINTENANCE - DRAFT¹

Maintenance Item	Unit Price (\$)	Unit	Mobilization Cost (\$) ²	Typical Applicability	Maintenance Interval (yrs) ³
Structural - Other Metal					
remove bolts, lift lugs, form nails	80	ea	800	all practices, except infiltration trench and open channels	R
Structural - Other Concrete					
concrete work under ground	600	cy	1500	all underground practices	R
concrete work above ground	450	cy	1500	all surface practices except infiltration trenches and open channel practices	R
grout cracks	50	lf	0	all practices, except infiltration trench and open channels	R
parge minor spalling	25	sf	0	all practices, except infiltration trench and open channels	R
repair gutter spalling	230	event	800	all underground practices	R
parge major spalling	25	sf	0	all practices except open channels and infiltration trenches	R
injection grout concrete leaks	180	lf	800	all practices, except infiltration trench and open channels	R
Erosion/ Channel Maintenance					
establish new riprap pilot channels (8' wide, 1' deep)	38	lf	1500	dry pond or infiltration basin	5-15
remove and replace rip rap or pea gravel	160	sy	1500	all practices designed with riprap	15-25
shoreline protection	50	lf	1500	wet ponds and wetlands	R
new riprap (general)	80	cy	1500	all practices designed with riprap	R (5-10)
erosion repair	1,100	event	0	all surface practices	R (2-5)
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UNIT COSTS FOR STORMWATER TREATMENT PRACTICE MAINTENANCE - DRAFT¹

Maintenance Item	Unit Price (\$)	Unit	Mobilization Cost (\$) ²	Typical Applicability	Maintenance Interval (yrs) ³
Landscaping/ Vegetation					
sod	3.30	sy	800	all surface practices	1-2
seed and top soil bare areas (3 inch depth)	4.40	sy	800	all surface practices	1-2
plant 1.5 inch tree	84	ea	0	dry pond, infiltration basin, wet ponds, bioretention	R ³
plant shrub	15	ea	0	dry pond, infiltration basin, wet ponds, bioretention	R
mowing	300	ac	0	Ponds, wetlands and infiltration basins. Some surface filters	0.5-1
clear outfall and channel of trees	5.50	sy	800	all practices that outfall to the surface	0.5-1
clear embankment of small trees by hand	3.30	sy	800	Ponds, wetlands, infiltration basin, and surface filters	0.5-1
clear embankment trees with Ambusher or Brushhog	0.9	sy	800	Ponds, wetlands, infiltration basin, and surface filters	0.5-1
remove live tree (<12 inches)	130	ea	800	all surface practices	R (1-10)
remove live trees larger than 12 inches, <24 inches	250	ea	800	all surface practices	R (10-25)
remove downed timber (up to 40 cy of material)	2,200	event	0	all surface practices	0.25-1
remove dumped vegetative material (up to 40 cy)	2,600	event	0	all surface practices	0.25-1
install wetland plant	6	ea	800	wet ponds and wetlands	R (3-5)
remove invasive wetland vegetation (machine remove phragmites) (up to 40 cy)	3,000	event	0	wet ponds and wetlands	0.5-1
spray for algae (0.25 ac pond)	600	ea	0	wet ponds and wetlands	0.25-0.5
spray for cattails (0.25 ac pond)	330	ea	0	wet ponds and wetlands	0.25-0.5

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UNIT COSTS FOR STORMWATER TREATMENT PRACTICE MAINTENANCE - DRAFT¹

Maintenance Item	Unit Price (\$)	Unit	Mobilization Cost (\$) ²	Typical Applicability	Maintenance Interval (yrs) ³
Access/ Safety					
fence repair	1,000	event	800	all practices with fences	R
install warning signs	210	ea	0	wet ponds and wetlands	R
manhole riser repair (in asphalt)	1,900	ea	0	all underground practices	R (10)
add manhole steps	100	ea	800	all practices, except infiltration trench, bioretention, and open channels	R
new manhole cover	250	ea	0	all practices, except infiltration trench, bioretention, and open channels	R
create 12' access road (permanent, cut/fill balances)	40	lf	1500	all surface practices	R
create 12' access road (permanent, cut/fill non-balance)	65	lf	1500	all surface practices	R
create 12' access road (temp)	12	lf	1500	all surface practices	R
install chainlink fence	26	lf	800	all surface practices except infiltration trenches and open channel practices	R
install ladder (8 foot)	27.5	ft	800	all underground practices	R
install three rail fence	15	lf	800	all surface practices except infiltration trenches and open channel practices	R
repair asphalt path	26	cy	800	all above ground practices	R
supply lock and chain for first one (additional at \$30 apiece)	125	ea	0	Ponds, wetlands, infiltration basin, and surface filters	4-8

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UNIT COSTS FOR STORMWATER TREATMENT PRACTICE MAINTENANCE - DRAFT¹

Maintenance Item	Unit Price (\$)	Unit	Mobilization Cost (\$) ²	Typical Applicability	Maintenance Interval (yrs) ³
Animals/ Nuisances					
pond/ wetland aeration	560	ea	0	wet ponds and wetlands	1
treat pond for mosquitoes	1,000	acre	0	wet ponds and wetlands	0.25-0.5
kill trap beavers (one week, one location, family of 6)	1,000	event	0	wet ponds and wetlands	0.5-1
fill animal burrows	23	sy	800	ponds, wetlands and infiltration basins	R (5-10)
remove graffiti	310	day	800	Ponds, wetlands, and infiltration basins	1-3
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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).

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).

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.

Self Inspection Checklist

Stormwater Management Ponds

Date:

Stormwater Pond Location:

Inspected by:

Weather Conditions (note recent rain):

	YES	NO
Does the facility show signs of settling, cracking, bulging, misalignment, or other structural deterioration?	<input type="checkbox"/>	<input type="checkbox"/>
Are the pipes going into or out of the pond clogged?	<input type="checkbox"/>	<input type="checkbox"/>
Do embankments, emergency spillways, side slopes, or inlet/outlet structures show signs of excessive erosion?	<input type="checkbox"/>	<input type="checkbox"/>
Is the outlet pipe damaged or otherwise not functioning properly?	<input type="checkbox"/>	<input type="checkbox"/>
Do impoundment (pond) and inlet areas show erosion, low spots, or lack of stabilization?	<input type="checkbox"/>	<input type="checkbox"/>
Are animal burrows present?	<input type="checkbox"/>	<input type="checkbox"/>
Are trees or saplings present on the embankment?	<input type="checkbox"/>	<input type="checkbox"/>
Are contributing areas unstabilized with evidence of erosion?	<input type="checkbox"/>	<input type="checkbox"/>
Do grassed areas require mowing and/or are clippings building up?	<input type="checkbox"/>	<input type="checkbox"/>
Does the depth of sediment or other factors suggest a loss of storage volume?	<input type="checkbox"/>	<input type="checkbox"/>
Is there standing water in inappropriate areas?	<input type="checkbox"/>	<input type="checkbox"/>
Is there an accumulation of floating debris and/or trash?	<input type="checkbox"/>	<input type="checkbox"/>
Are there signs of vandalism?	<input type="checkbox"/>	<input type="checkbox"/>
If one exists, does the fence need to be repaired?	<input type="checkbox"/>	<input type="checkbox"/>
Is there excessive algae growth, or has one type of vegetation taken over the facility?	<input type="checkbox"/>	<input type="checkbox"/>
Is there evidence of fish kills?	<input type="checkbox"/>	<input type="checkbox"/>

A "YES" REPLY TO ANY OF THESE SHOULD RESULT IN A CORRECTIVE ACTION OR A CALL TO A PROFESSIONAL INSPECTOR.



Note additional observations on the back of this sheet

STORMWATER MAINTENANCE COMPANIES

<i>Last Updated June, 2007</i>	Address	Phone	County	Dewatering	Regular Trash Removal	Sediment Removal/ BMP Cleanout	Erosion Repair	Catch Basins (structural repairs)	Vegetation Maintenance (spraying)	Vegetation Maintenance (mowing/removal)	Aeration Systems
Vegetative Pond Maintenance											
4-Ever Green LLC Ed Foraker	227 Wiggins Mill Road Townsend, DE 19709	Cell (302) 312-7500 Home (302) 378-4905	NC,K				X		X	X	
A and B Lawn Care Contact: Jason Adkins	110 Davannah Dr. Smyrna, DE 19977	302-632-6290	NC, K		X	X	X	X	X	X	X
Atlantic Landscaping Contact: Bill Godfree	P.O. Box 30707 Wilmington, DE 19805	302-661-1950	NC,K,S	X	X	X	X	X	X	X	
Brandywine Nursery Contact: Jamie Jamison	4 James Court Wilmington, DE 19804	302-429-0865	NC	X	X		X		X	X	X
Calpro Pest Services Contact: Vincent Shiwpal	220 Delilah Drive Bear, DE 19701	302-836-1163	NC,K		X				X		
Delmarva Wetlands Management Contact: Kevin Beam	PO Box 455 Nassau, DE 19969	302-245-5642	NC,K,S		X	X	X	X	X	X	X
Environmental Consulting, Inc. Contact: Charlie Miller	PO Box 138 100 S. Cass St. Middletown, DE 19709	302-378-9893	NC,K		X	X	X	X	X	X	X
Envirotech Environmental Consulting Inc. Contact: Todd A. Fritchman	34634 Bay Crossing Blvd. Lewes, DE 19958	302-645-6491	NC,K,S		X	X	X	X	X	X	X
Garden Ponds and Landscaping Contact: Paul Albanese	14680 Coastal Highway Route 1 Milton, DE 19968	302-245-6711	S,K	X	X		X	X	X	X	X
JCM Environmental Contact: David Saveikis	418 N. Bedford St. Georgetown, DE 19947 (Offices also in Newark & Dover)	302-854-9138	NC,K,S	X	X	X	X	X	X	X	X
More than Grass, Contact: Fred Gaylord	3880 Holletts Corner Road Clayton, DE 19938	302-653-9188	K, SNC	X	X	X	X	X	X	X	X
Wispy Pines Environmental Contact: Bryan Hall	9369 Legion Road Denton, MD 21629	(410) 310-2916	K, S						X	X	

STORMWATER MAINTENANCE COMPANIES

<i>Last Updated June, 2007</i>	Address	Phone	County	Dewatering	Regular Trash Removal	Sediment Removal/ BMP Cleanout	Erosion Repair	Catch Basins (structural repairs)	Vegetation Maintenance (spraying)	Vegetation Maintenance (mowing/removal)	Aeration Systems
Structural Services											
A-DEL Construction Co., Inc. Contact: Kenneth A. Monroe	10 Adel Dr. Newark, DE 19702	302-453-8286	NC,K, S	X		X	X				
Austin and Bednash, Inc Mike Austin	5756 Summit Bridge Rd. Townsend, DE 19734	302-376-5590	NC	X	X	X	X	X			
Brandywine Construction Co., Inc. Contact: John Doherty	101 Pigeon Point Rd. New Castle, DE 19720	302-571-9773	NC			X	X	X			
Delaware Shore Builders Contact: John Fink	4 Chief Joseph Trail Millsboro, DE. 19966	302-947-1757	K,S	X	X	X	X	X	X	X	
D.E. Leager Construction Inc.	3725 Washington Ave. Wilmington, DE 19808	302-994-1060	NC,K,S			X	X	X			
EPB Associates, Inc. Contact: Ed Bush	107 W. Sutton Place Wilmington, DE 19810	302-475-7301	NC,K,S		X	X	X	X	X	X	
George & Lynch, Inc. Contact: Chris Baker	150 Lafferty Lane Dover, DE 19901	302-734-5865	NC,K,S	X	X	X	X	X			
Irrigation Maintenance Services Contact: Bob Dickerson	P.O. Box 15030 Newark, DE 19711	302-383-1793	NC								X
Jeff Bartsch Trucking & Excavating Contact: Jeff Bartsch	299 Sawmill Rd. Townsend, DE 19734	302-653-9329	K,NC	X	X	X	X	X			
Lazy B. Construction Corp. Contact: Stephen Batzel	1131 Dutch Neck Road Middletown, DE 19709	302-836-5441	NC,K	X		X	X	X			
Merit Construction Engineers, Inc. Contact: Ronald Dills	5700 Kirkwood Highway Suite 201 Wilmington, DE 19808	302-992-9810	NC			X	X	X			
Mill Creek Construction, Inc. Contact: Doug Beisner	1201 Woodland Beach Road, Smyrna, DE 19977	302-270-7528	NC,K,S	X	X	X	X	X	X	X	
Morton Electric	16867 Kings Hwy. Lewes, DE	302-645-9414	S,K								X
Pearce and Moretto Contact: Jason Wolksee	Suite C PO Box 272 New Castle, DE 19720	302-326-0707	NC, K	X		X	X	X			
Sunnyfield Contractors, Inc. Contact: John Bartsch	150 Sunnyfield Lane Dover, DE 19904	302-674-8610	NC,K,S	X	X	X	X	X		X	
Three Z's, Inc. Contact: Warren Ziesloft	37 Carraige Lane Newark, DE 19711	302-737-2719	NC			X	X	X			
True Green Land Care	718 Grantham Lane New Castle, DE 19720	302-328-7446	NC,K,S	X	X		X	X	X	X	
Turf Equipment and Supply Co. Christina Perro	33180 DuPont Blvd. Frankford, DE 19945	1-877-947-7448	S								X
White Marsh Environmental Systems, Inc. Contact: Samuel R. Schlegel	1100 South Little Creek Rd Dover, DE 19901	302-734-7500			X	X	X	X		X	X
WM. Gunter and Sons, Inc.	220 Redpump Rd. Rising Sun, MD 21911	410-658-3459	S,K		X	X	X	X			
Other Services											
Carson Kennard		Bus. (302) 422-7359 Cell (302) 363-4282									
Envirotech Environmental Consulting Inc. Contact: Todd A. Fritchman	34634 Bay Crossing Blvd. Lewes, DE 19958	302-645-6491	NC,K,S								Goose removal management
Calpro Pest Services Contact: Vincent Shiwpal	220 Delilah Drive Bear, DE 19701	302-836-1163	NC,K								Muskrat removal