Rain Gardens

Across Maryland



Cleaning Maryland's waterways one rain garden at a time.

Preface

Introduction

If you enjoyed reading *Rain Gardens in Maryland's Coastal Plain*, you will enjoy reading *Rain Gardens Across Maryland*. This new and improved "how-to" manual discusses the benefits of incorporating multiple small-scale practices into a rain garden design. You will also learn how to:

- Reduce impervious surfaces
- Size your rain garden to capture the maximum rainfall amount
- Select rain garden plants native to Maryland
- Install rain barrels
- Measure your rain garden's performance

Environmental Site Design

For homeowners required to install stormwater management practices, this manual provides environmental site design, or ESD sizing criteria for rain gardens. Just look for "ESD criteria" text boxes. The ESD criteria outlines the minimum requirements homeowners shall implement in order to satisfy Maryland's stormwater regulations and should be approved by your local approving authority before you begin building your rain garden. Homeowners installing rain gardens voluntarily do not have to meet ESD criteria.

Title 4, Subtitle 201.1(B) of the Stormwater Management Act of 2007 defines an ESD as using small-scale stormwater management practices, nonstructural techniques, and better site planning to mimic natural hydrologic runoff characteristics and minimize the impact of land development on water resources to the maximum extent practical. Under this definition, ESD includes:

- Minimizing impervious surfaces
- Conserving natural features e.g., drainage patterns, soil, vegetation
- Slowing down runoff to maintain discharge timing and to increase infiltration
- Using other nonstructural practices or innovative technologies approved by the Maryland Department of the Environment

Small-scale practices

Small-scale practices capture and treat stormwater runoff from impervious areas usually less than one acre in size. These practices typically include natural systems, vegetation, and soils and may be interconnected to create a more natural drainage system. Although this manual focuses on installing rain gardens, the ESD strategy requires that stormwater management practices, including the small-scale practices listed below, be integrated into one project to the maximum extent practical. Small-scale practices include:

- Rain gardens
- Rainwater harvesting
- Submerged gravel wetlands
- Landscape infiltration
- Infiltration berms
- Dry wells
- Micro bioretention
- Swales
- Enhanced filters

Stormwater Design Manual

The primary goal of Maryland's stormwater management program is to maintain predevelopment runoff characteristics as nearly as possible. The ESD criteria provides a comprehensive design strategy to achieve this goal and is described in *Maryland's Stormwater Design Manual*. To learn more about the Maryland Department of the Environment's approved rain garden ESD sizing criteria and other approved small-scale practices, refer to chapter 5 of the *Maryland Stormwater Design Manual*, "Environmental Site Design." This document can also be found at http://www.mde.state.md.us/Programs/WaterPrograms/SedimentandStormwater/swm2007.asp.

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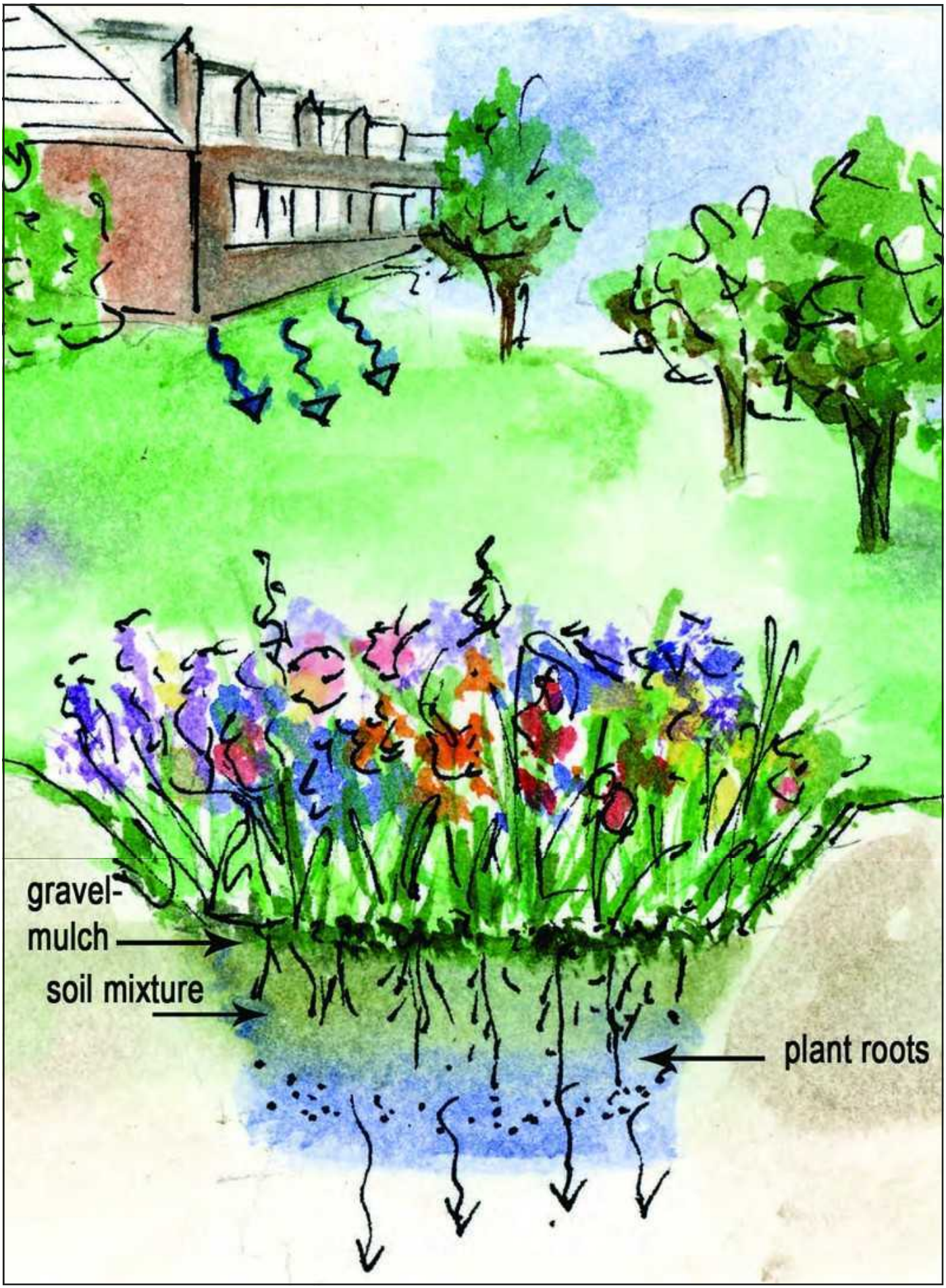


Figure 1. As runoff passes through the soil mixture, chemical and biological processes break down the pollutants. This helps protect the Atlantic Coastal and Chesapeake Bays from fertilizers, oils, and other pollutants carried by runoff.

Introduction



Figure 2. Rain gardens absorb rainwater flowing from roofs, lawns and other impervious surfaces.

Homeowners across Maryland are improving water quality, reducing flooding, and increasing their property values by adding rain gardens to their landscape (figure 2). A typical rain garden consists of a shallow depression that is a planting bed of native plants, loose soil, mulch, and sometimes stone. Together, these elements collect, absorb, and clean runoff.

Well designed rain gardens collect and soak up rainwater that flows off of hard surfaces. Commonly referred to as stormwater runoff, the rainwater spreads throughout the rain garden. As the stormwater runoff passes through the soil mixture, physical and biological processes such as plant uptake and adsorption to soil particles remove pollutants and nutrients in stormwater runoff (figure 1).

ESD Criteria # 1. Definition

A rain garden is a shallow, excavated landscape feature or a saucer-shaped depression that temporarily holds runoff for a short period of time. Rain gardens typically consist of an absorbent-planted soil bed, a mulch layer and planting materials such as shrubs, grasses and flowers (figure 1). An overflow conveyance system is included to pass larger storms. Captured runoff from downspouts, roof drains, pipes, swales, or curb openings temporarily ponds and slowly filters into the soil over 24 to 48 hours.

Source: Maryland's Stormwater Management Act of 2007, Environment Article 4 §201.1 and §203. *ff.*



Figure 3. When hard surfaces prevent rainwater from seeping into the ground it will flow into drain systems carrying with it pollutants and nutrients. The stormwater, if left untreated, can harm our local streams, creeks, rivers, and lakes and everything dependent on clean healthy waterways.

Your rain garden(s) can help infiltrate 100% of the runoff in your drainage area with proper planning. That's less runoff entering storm drains that eventually flow into our waterways and ultimately the Atlantic Coastal and Chesapeake Bays (figure 3). In addition to cleaning our waterways, rain gardens also help:

- Replenish groundwater resources
- Protect structures and landscaping
- Enhance the beauty of yards
- Provide wildlife habitat

You can contribute to cleaner water by building a rain garden in your landscape. By using this document to help guide you through the rain garden planning and building process, you will learn how to:

- Locate your rain garden
- Size your rain garden
- Build your rain garden
- Select native plants
- Maintain your rain garden

ESD Criteria # 2. Micro-scale Practice

Rain gardens can be primary or secondary practices on residential, commercial, industrial, or institutional sites. This practice is typically used to treat runoff from small impervious areas like rooftops, driveways and sidewalks. Rain gardens can also be used in retrofitting and redevelopment applications and in a series where existing slopes require energy dissipation.

Rain Garden Facts

Does a rain garden form a pond or wetland?

No. The rainwater will soak into the ground within 24-48 hours after a storm (figure 4).

Will a rain garden become a mosquito breeding ground?

No. Mosquitoes lay eggs in standing water. Rain gardens do not hold rainwater long enough for mosquitoes to reproduce successfully (figure 5).

Does a rain garden require a lot of maintenance?

No. Established native plants require no more maintenance than any other type of garden. Native species generally require less maintenance if they are planted in the right place. They do not need fertilizers, pesticides, or additional water other than what nature provides (unless there is a severe drought).

Is a rain garden expensive to build and maintain?

No. With any gardening project, the cost is related to the location, size, labor, tools, supplies and materials, and plants. To keep the costs low, invite family and friends to help build the rain garden (figure 6) and buy perennials. Your one-time investment will come back each growing season.



Figure 4. Don't be surprised if your rain garden has water in it after a storm. It's supposed to. The rain garden installed across from the town hall in Highland Beach, Maryland is strategically placed to collect runoff from the road and lawns.



Figure 5. The rain garden installed across from the Highland Beach Town Hall drains water after each storm. Well designed rain gardens drain 24-48 hours after a storm.



Figure 6. Sweat equity cuts costs. Shown above, volunteers install a shade rain garden at the Chesapeake Ecology Center in Annapolis, Maryland.



Figure 7. Identify existing landscaping features relative to your house to help locate the best place to build your rain garden. This can help you capture runoff from impervious surfaces and improve your landscape.

Location

This section explains how to locate your rain garden by answering the following questions:

1. What elements should you consider when choosing a location for your rain garden?
2. What type of soil do you have?
3. What shape should it be?

1. Where?

To determine where to build your rain garden, you will need a good understanding of the layout of your yard. To begin, identify existing landscaping features and hard surfaces like the driveway, any outbuildings, and house (figure 7). Map these features on paper to help you begin envisioning where a rain garden could be built. Consider the tips below to help you choose the best rain garden location.

- When it rains, watch the flow of water on and around your property. Using arrows, draw the movement of water from your house or driveway (both going away from or toward your house). You'll begin to see the direction runoff flows towards storm drains or waterways. Locate your rain garden so that it intercepts the runoff before flowing into these outlets.
- Low-lying wet areas where water naturally ponds after a heavy storm may be good areas for your rain garden too.

ESD Criteria # 3. Location

Lot-by-lot use of rain gardens is not recommended in residential subdivisions due to subsequent removal by homeowners. If used on a lot-by-lot basis, educating the homeowners will be needed to prevent removal. An educational sign similar to the one shown below in figure 8 is helpful. Rain garden excavation in areas with heavy tree cover may damage adjacent tree root systems.



Figure 8. Install rain garden signs to raise awareness.

ESD Criteria #4. Infrastructure

The location of existing and proposed buildings and utilities (e.g., water supply wells, sewer, storm drains, electricity) will influence rain garden design and construction. Landscape designers should also consider overhead telecommunication and electrical lines when selecting trees to be planted. Read the "Construction" section to learn more (pages 17-21).

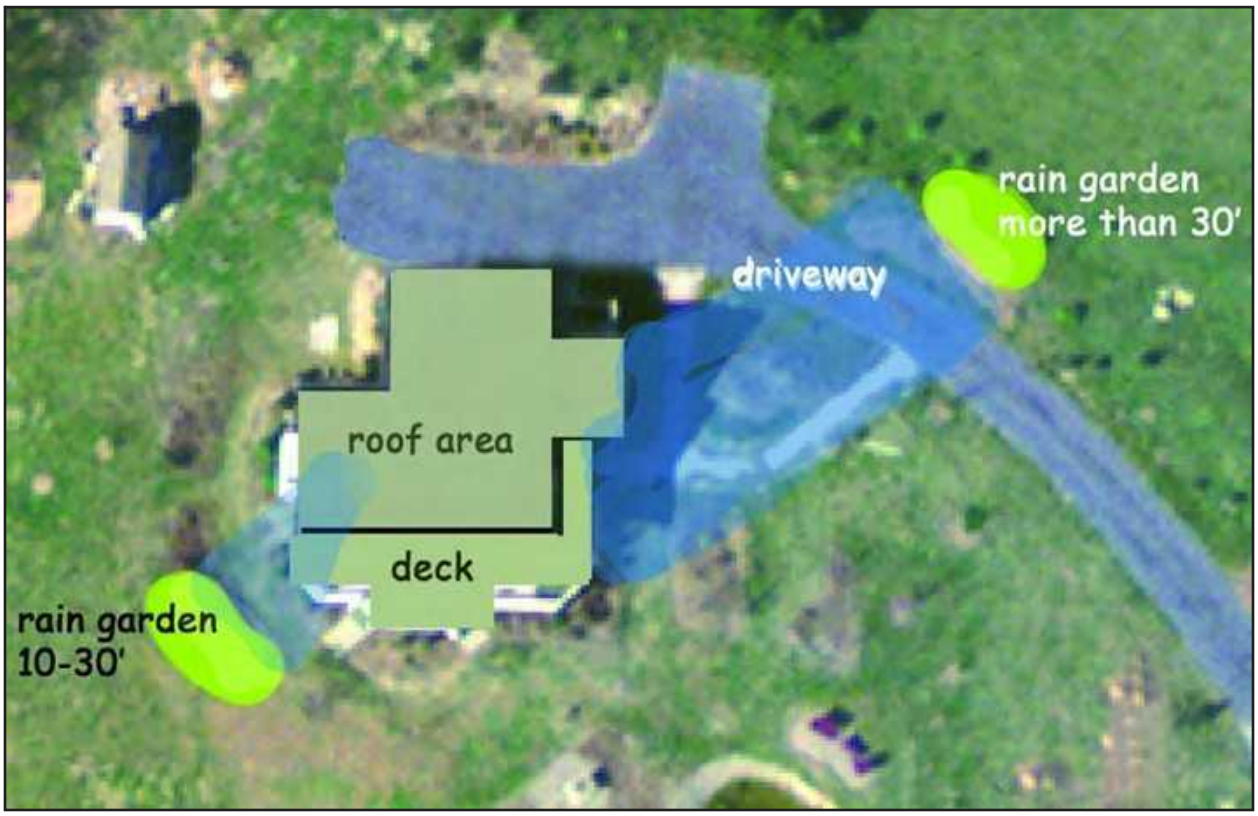


Figure 9. The rain garden installed more than 30 feet from the house has a larger drainage area than the garden located within 30 feet of the house. The farthest garden will likely capture and treat more runoff.

- The best location for the rain garden is in partial to full sun.
- Locate rain gardens downslope from a downspout, driveway or other impervious surfaces to capture and treat more runoff (figure 9).
- Rain gardens should be at least 25 feet away from a septic drain field or well head and 10 feet away from a dwelling foundation to prevent water from seeping into basements or crawl spaces. Check with your local approving agency for additional guidance.
- Level or gently sloping sites require the least amount of digging.
- Think about the views of your rain garden within the existing landscape from different perspectives, including inside the house.

1. Your rain garden is _____ feet from the _____.
(impervious surface)

ESD Criteria # 5. Soils

Clay soils or soils that have been compacted by construction equipment greatly reduce the effectiveness of rain gardens. Loosening of compacted soils may improve drainage capability.

2. Identify soil type

Check the soil type of your rain garden site before you begin digging. Your soil type influences the garden's drainage and size. If your rain garden is sandy,

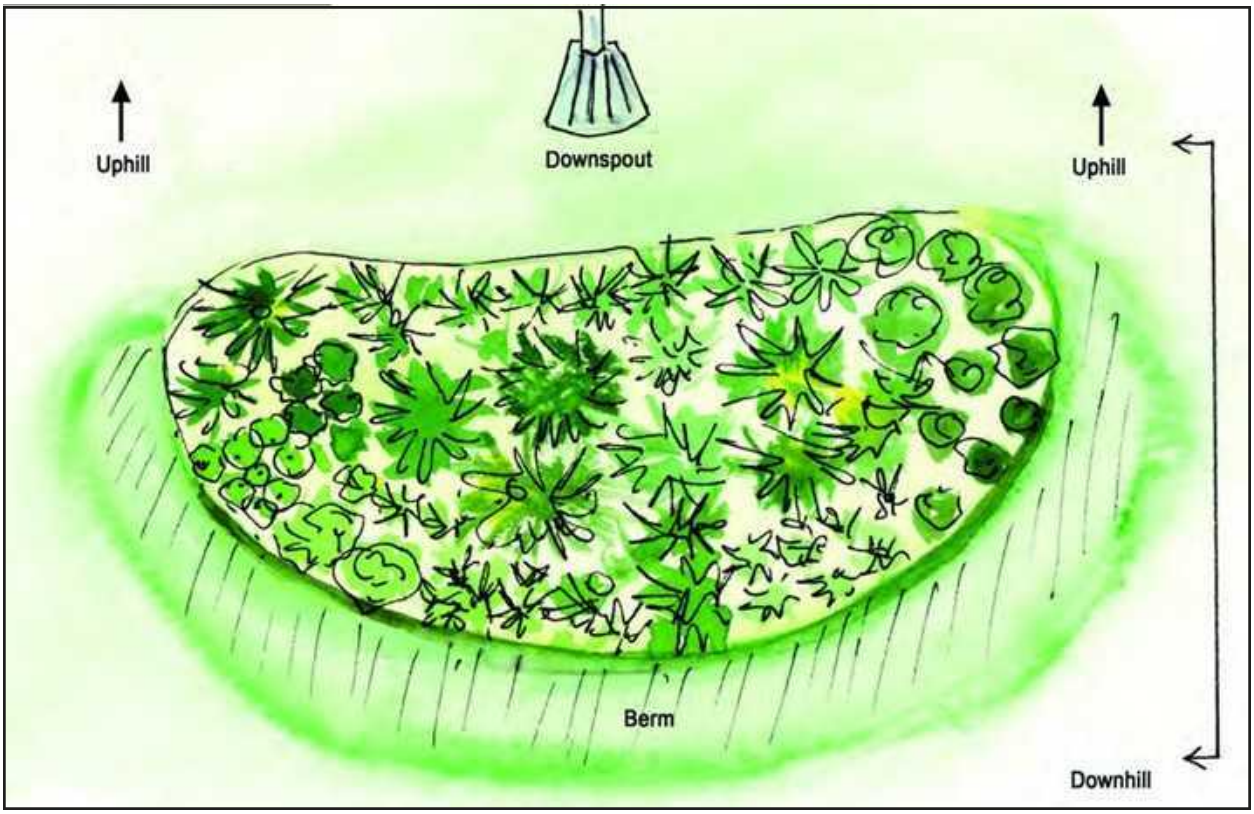


Figure 10. A quick sketch can help you visualize the garden's location. Its longest side should be oriented to intercept runoff flowing downhill and from any direct sources of runoff like a downspout.

then you have the best drainage and can build the garden smaller than those built on clay or silt laden sites.

To identify your soil type put some soil in your hands. If the soil feels gritty and coarse, it's probably sandy soil. Silty soil, however, feels smooth but not sticky. Clay soils are very sticky and plastic-like to handle when wet. You'll be able to form a ball with it. A visual inspection can also indicate the soil type at your site. If you still have standing water 24 hours after a rain event then you probably have some clay soils at the site.

Rain garden areas high in clay content may require you to amend the native soil with a rain garden planting soil mixture (read pages 20 and 21 for more information). Another option is to select another rain garden location. If you are unsure about your soil type, refer to appendix A for other types of soil tests.

2. Your soil type is sand silt or clay.

3. Shape

Once you've picked out the location for your rain garden, determine its shape. Your rain garden can be any shape—crescent or kidney shapes are attractive—but a long and narrow rain garden works well if you are placing it between structures, such as a driveway and patio. Long rain gardens can capture the greatest amount of runoff if located properly (figure 10).

3. Your rain garden's shape is a _____.

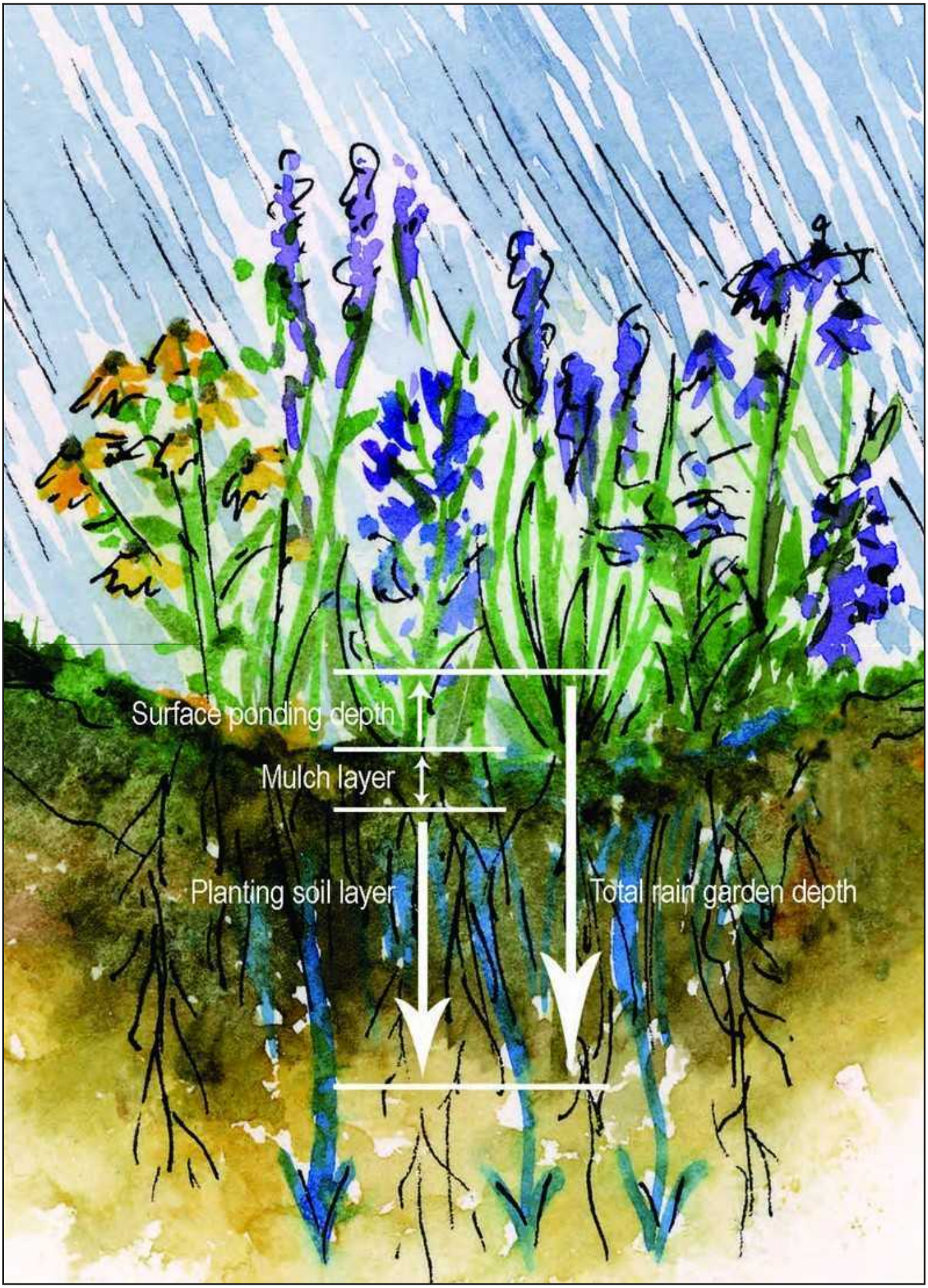


Figure 11. Make sure your rain garden surface ponding depth is deep enough to hold runoff, allowing it to gradually soak into the native soils.

Sizing

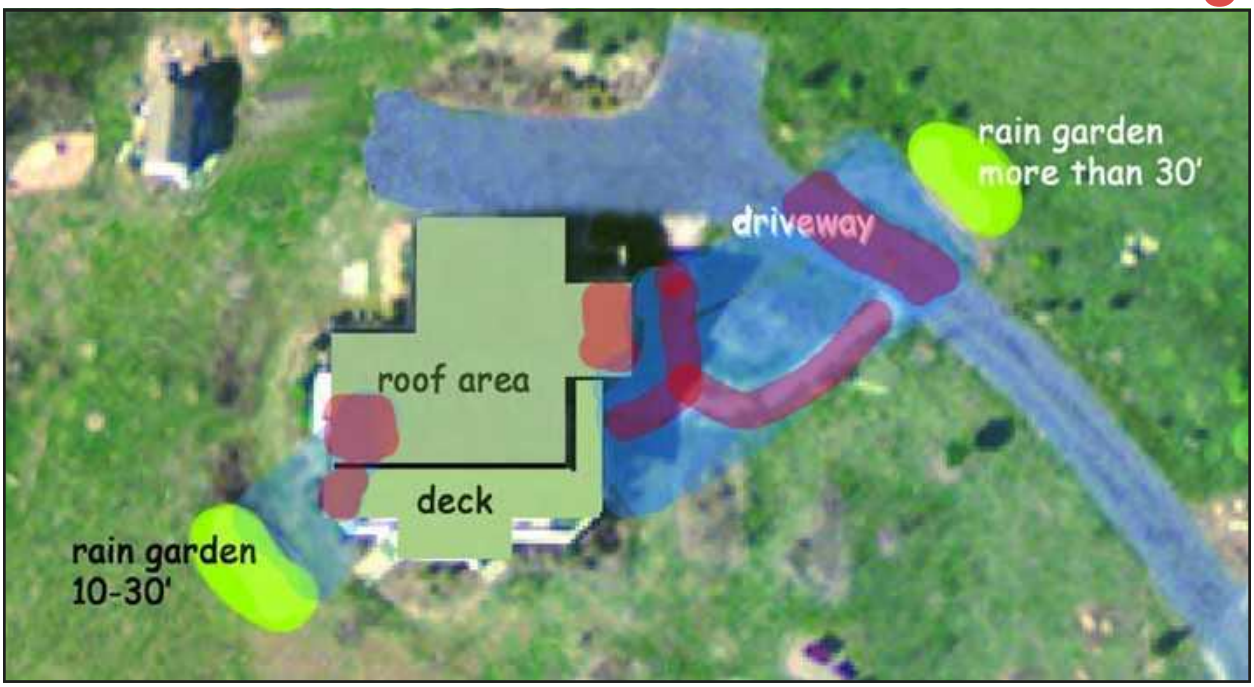


Figure 12: Your drainage area may include impervious surfaces like portions of the lawn (highlighted in blue), roof, sidewalk, and driveway (highlighted in red). These elements can direct more stormwater runoff into rain gardens.

This section provides guidance on sizing your rain garden to capture at least 70% of the runoff for the average yearly rainfall. In Maryland, the annual average rainfall is 42 inches. To capture 100% of the runoff from a specific storm event, refer to appendix B to determine your rainfall depth. You can skip to page 15 to determine how to size your garden based on targeting a rainfall amount. Reading through this section, however, will help you understand what you will need to consider when sizing your rain garden. You can adapt these guidelines to meet your site's unique conditions and personal water quality goals. Read further to learn about these topics:

1. Impervious surfaces
2. Improving your drainage area
3. Sizing your rain garden
4. Quantifying performance

1. Impervious surfaces

Impervious surfaces in your drainage area prevent water from seeping into the ground, thereby increasing the amount of stormwater runoff captured in your rain garden. The rain garden, shown in figure 12, is located less than 30 feet from a roof downspout and has a drainage area that includes the portion of the roof that feeds the downspout and any ground level hard surfaces that slope to the rain garden.

ESD Criteria # 6. Treatment

The rainfall amount used to size ESD practices shall be applied to the contributing drainage area. ESD practices shall be used to treat the runoff from one inch of rainfall on all new developments where stormwater management is required.



Figure 13. Permeable pavers installed at the Back Creek Nature Park in Annapolis, Maryland provide a solid ground surface that can support vehicles.

The rain garden located more than 30 feet from the house can capture more runoff because of the increased amount of impervious surfaces, including the lawn (which can be partially impervious), deck, roof, sidewalk, and driveway.

2. Improving your drainage area

Consider reducing impervious surfaces on your property to reduce the amount of runoff entering your rain garden by replacing asphalt with permeable pavers or permeable concrete. They provide a solid ground surface, strong enough to take heavy loads, like large vehicles, while at the same time allowing water to filter through the surface and reach the underlying soils (figure 13). Permeable pavers are also ideal for patios, sidewalks, and driveways. The voids in the surface of the paving allow water to drain through and into the soil beneath. Other benefits of permeable pavers and permeable concrete include:

- Increased groundwater recharge and/or storage, thereby lessening surface puddles and local flooding.
- Reduced stream bank erosion and downstream flooding.
- Capturing of nearly 100% of polluted runoff depending on project design parameters, thereby mitigating impact on surrounding surface waters.
- Decreased project cost by reducing retention/detention systems and runoff.
- Minimization of impacts and stress on existing storm sewer systems through reduced peak discharges.
- Reduced heat island effect and thermal loading on surrounding surface waters.

- Faster snow melt on permeable pavement and drains, reducing winter ice hazards, deicing salt use, and snow removal costs.

Another way to improve your drainage area is to divert flows away from impervious surfaces. This is known as non-rooftop disconnection. Simply direct flow from impervious surfaces onto vegetated areas, where it can soak into or filter over the ground. This will disconnect these surfaces from the storm drain system, reducing runoff volume and pollutants delivered to waterways.

Non-rooftop disconnection is commonly applied to smaller or narrower impervious areas like driveways, open section roads, and small parking lots and depends on several site conditions (e.g., permeable flow path length, soils, slopes, compaction) to function well.

Consider how you can improve your drainage area as you work through the following calculations that will help determine your rain garden's size.

3. Dimensions

To determine the dimensions of your rain garden, you'll need to do a little math to assess the following:

3a. Drainage area
3b. Ponding depth
3c. Rain garden area
3d. Width and length

3a. *Calculate drainage area*

The following five steps will help you determine your drainage area.

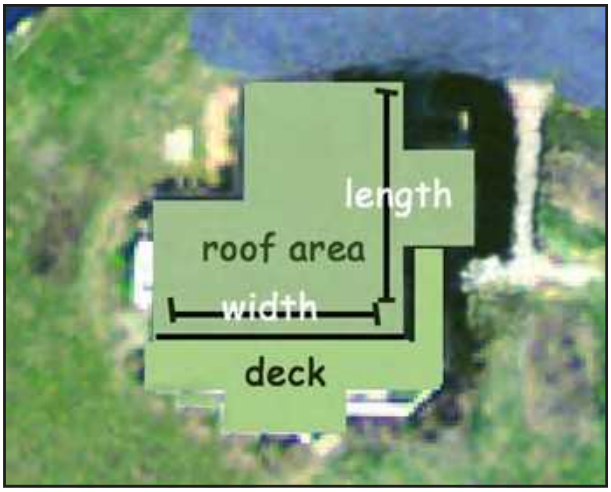


Figure 14. In the example above, the roof is about 60 feet by 40 feet. The total roof area is 2,400 ft².



Figure 15. In the example above, about 25% of the total roof area feeds water to the downspout.

1. Estimate the total roof area (in square feet), **roof area=length x width** (figure 14).
2. Estimate the percentage of roof feeding the downspout (figure 15).
1. The roof drainage area (RDA) equals the total roof area multiplied by the percentage of roof feeding a downspout (see sample calculation below).

   RDA = (40' x 60') x 25%
   RDA = 2,400 ft^2 x 25%
   RDA = 600 ft^2

4. Calculate the ground surface area draining to the site by multiplying its length and width.

ESD Criteria # 7. Target rainfall

During the project planning and preliminary design, site soils and proposed imperviousness are used to determine target rainfall for sizing ESD practices to mimic wooded conditions (refer to page 15).

ESD Criteria # 8. Drainage Area

A rain garden's drainage area serving a single lot in a residential subdivision shall be 2,000 ft^2 or less. The maximum drainage area for all other applications shall be 10,000 ft^2. Micro-bioretention or bioretention should be considered when these requirements are exceeded.

ESD Criteria # 9. Topography

Rain gardens require relatively flat slopes (<5%) to accommodate runoff filtering through the system. Some design modifications can address this constraint through the use of infiltration berms, terracing, and timber or block retaining walls on moderate slopes.

ESD Criteria # 10. Treatment

The surface area of rain gardens shall be at least 2% of the contributing drainage area. The rainfall target value shall be applied to the contributing drainage area (refer to page 15). Temporary storage of the runoff volume may be provided above the facility with a surface ponding depth of 6 inches or less (see figure 11 on page 8) .

Be sure to include all impervious surfaces that drain to your garden. Break the total area into rectangles for easy calculations.

5. The sum of the ground surface area and roof drainage area equals the total drainage area.

3a. Your drainage area is _____ ft^2.

3b. *Determine ponding depth & slope*

Your rain garden's surface ponding depth, as shown in figure 11 on page 8, depends on your site's slope. To determine your slope, you will need a level and to do a little math. Read all of the instructions below before beginning. Figure 16 may also help you visualize the instructions below.

1. Securely drive a stake on the uphill side near the mid-point of the garden's top edge. Drive a second stake just past the downhill edge of the site. The downhill stake must be tall enough to tie the string in the next step.
2. Tie stretchy string near the bottom of the uphill stake. The string should not touch the ground or other objects. Using a string level or carpenter's level, level the string from the uphill stake to the downhill stake.
3. Measure the string's length (in inches) between the stakes.
4. Measure the height (in inches) of the downhill stake from the string to the ground.
5. To calculate the slope of your site, divide the height by the

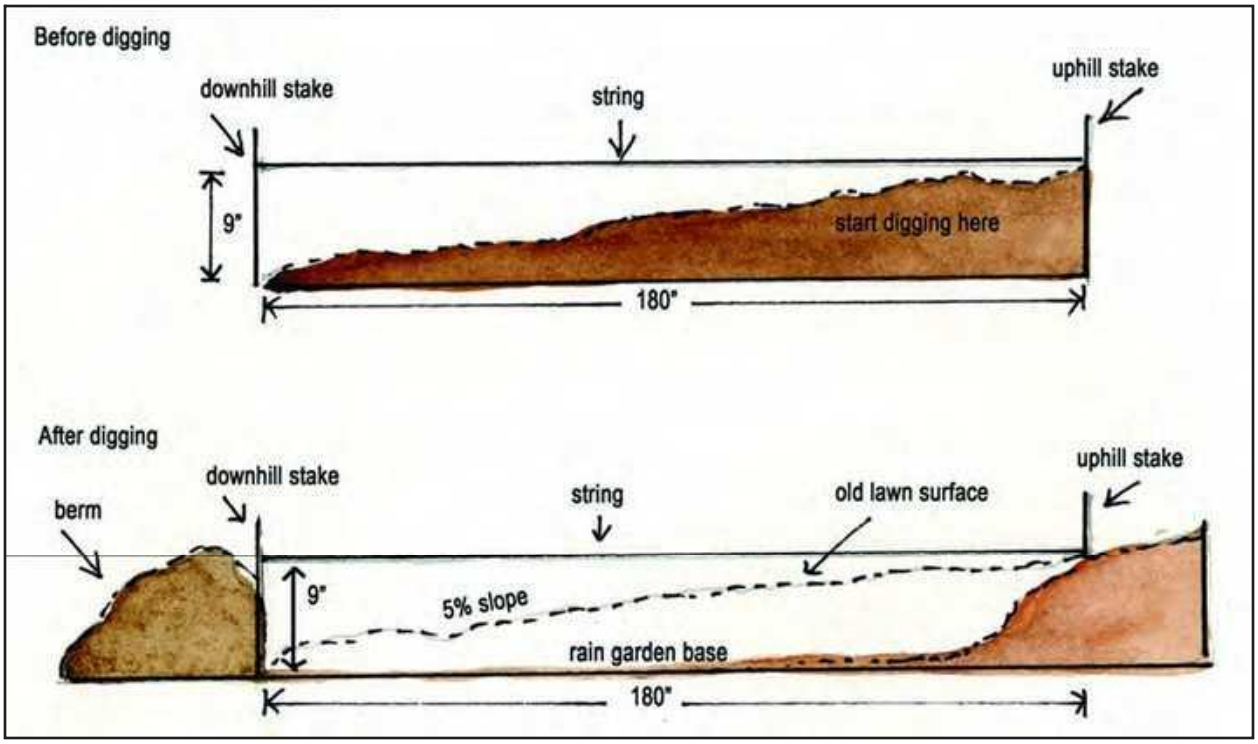


Figure 16: A rain garden with a 5% slope (shown above) should have a surface ponding depth of 5 inches (table 1 below). A surface ponding depth of 9 inches will allow for 3-4 inches of a topping layer.

string's length and multiply the result by 100. A sample calculation is provided below.

Slope % = (9"/180") x 100
Slope % = 0.05 x 100
Slope % = 5%

Slope: _____%

Use table 1 below to determine your garden's surface ponding depth. Add more depth, inch for inch, if you plan to spread mulch on the surface. If you have a more sloping site, you may need to remove or add soil to create a level base. Circle the proposed depth below.

Slope	Surface Ponding Depth
Less than 5%	5 inches deep
Equal to or greater than 5-7%	6-7 inches deep
Equal to or greater than 7-12%	~8 inches deep
Equal to or greater than 12%	Select another site or talk to a professional landscaper

Table 1. Slope and ponding depth reference table.

3b. Ponding depth: 5" 6-7" 8" (circle one)
add mulch layer (if any) _____ inches.

3c. *Determine rain garden area*

Use the sizing worksheet on the next page to determine your rain garden's area. If you decide that the area is too big consider breaking up the garden area into two or three smaller gardens. If you discover that your garden is too small to hold the amount of water flowing into it create an overflow area (e.g., with stone) to relieve excess water or create a system of interconnected rain gardens. More than one rain garden can be installed to better disperse and absorb runoff.

Rain Garden Sizing Worksheet

Insert your answers from the previous pages to determine your rain garden's dimensions.

- Garden's distance from impervious surface(s): _____ (page 6)
- Soil type: _____ (page 7)
- Shape: _____ (page 7)
- Drainage area: _____ ft^2 (page 12)
- Total surface ponding depth:_____ inches (page 13)
- The size factor is _____ (see table 2 below)

	Rain Garden Surface Ponding Depth				
Soil type	5"	6-7"	8"	All depths	
Sand	**0.19**	**0.15**	**0.08**	**0.03**	**Size factor**
Silt	**0.34**	**0.25**	**0.16**	**0.06**	
Clay	**0.43**	**0.32**	**0.20**	**0.10**	
	Less than 30 feet			More than 30 feet	
	Distance from downspout				

Table 2. In the table above, the size factor is determined by three items: the rain garden surface ponding depth, soil type, and distance from the downspout. To determine the size factor for your rain garden, locate the intersection of these three items in the table above. For example, a rain garden that has a surface ponding depth of six inches, contains sandy soils, and is less than 30 feet from a downspout has a size factor of 0.15. A rain gardens installed more than 30 feet away from a downspout and has sandy soils will have a size factor is 0.03 regardless of its surface ponding depth.

- Rain garden area = _____ ft^2

Rain garden area = drainage area x size factor

- Width = _____ feet (page 15)
- Length = _____ feet



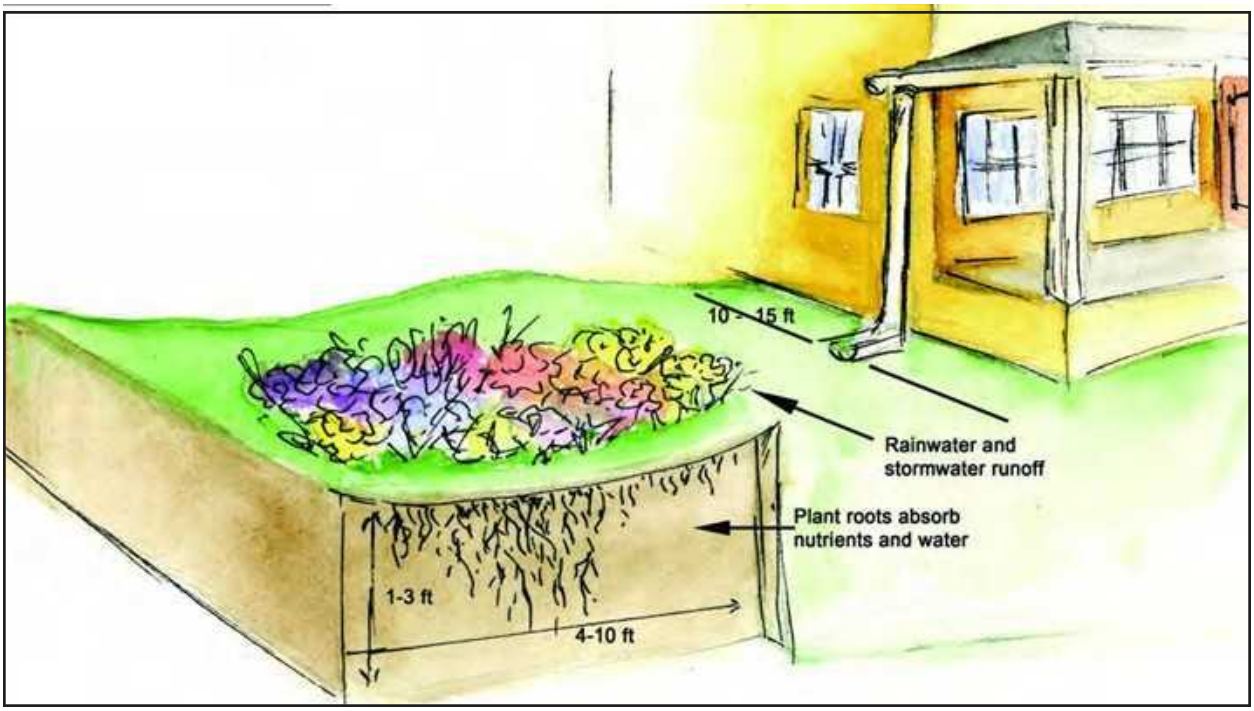


Figure 17. The shortest side should be 4-10 feet wide to balance the effect of slope with the rain garden depth and is best placed perpendicular to the slope. For lawns with a slope greater than 8%, the maximum recommended width is 15 feet.

3d. *Determine length and width*

Estimating the rain garden length (longest side) and width (shortest side) is based on your garden area, personal preferences, and a little bit of math. To begin, estimate how wide your garden should be by considering your garden's shape and unique site conditions. This includes the available yard space, the distance between landscaped areas, and any physical constraints. By considering these elements, you may decide that your garden should be 5 feet wide (figure 17). You've just selected the width of your garden. Use the selected width in the sizing worksheet on the opposite page to calculate the garden's length.

4. Performance measures

With a little bit of math work, you can quantify the impact your rain garden has on capturing stormwater runoff. Following, you will learn how to build your rain garden based on a rainfall amount and calculate your drainage area's recharge volume.

1. *Target rainfall*

Maryland's environmental site design criteria for sizing rain gardens are based on capturing and retaining enough rainfall so that the runoff leaving a site is reduced to a level equivalent to a wooded site in good condition. To estimate the amount of rainfall treated by your rain garden use the formula below.

If you would like to capture 100% runoff, refer to appendix B for your local rainfall depth and consider installing other small-scale practices discussed on pages 9 to 11 to improve your drainage capacity.

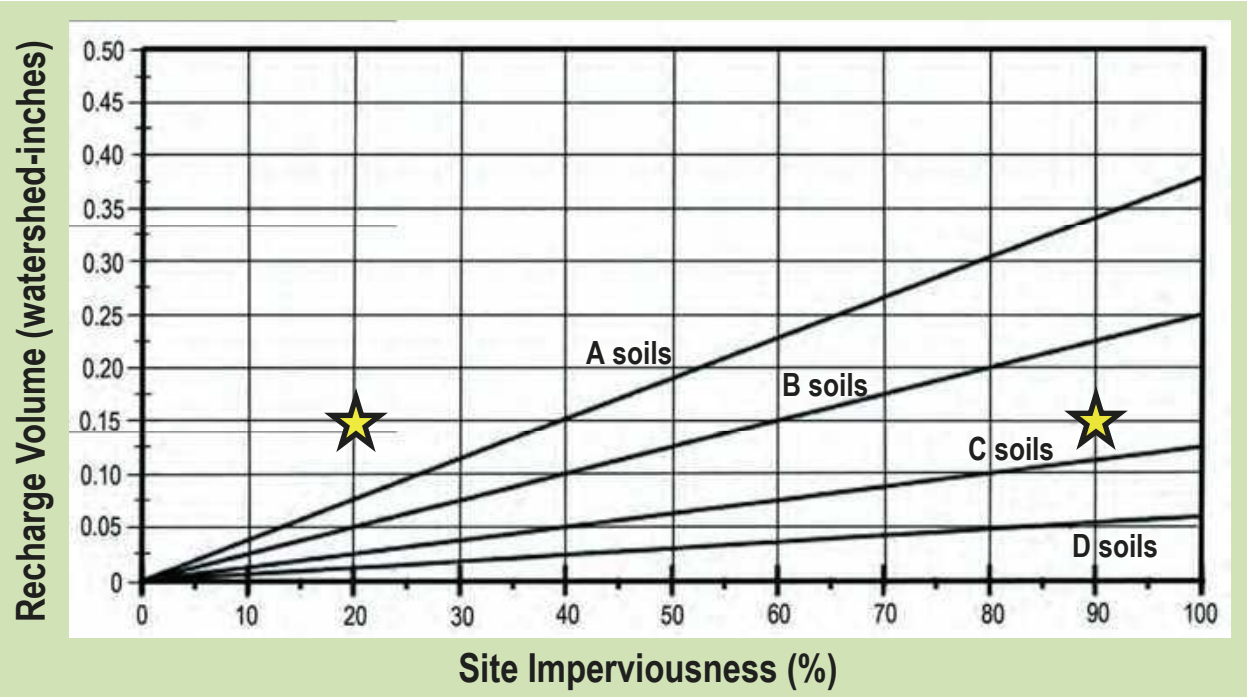


Figure 18. Use the line graph above to plot your site's imperviousness and recharge volume. For example, if your recharge volume equals 0.15 and your site imperviousness equals 20% you are above the minimum recharge volume for all HSG soils. However, if your site imperviousness is 90% you do not meet the minimum recharge volume for HSG A or B soils. Additional small-scale practices may be necessary to achieve the site's recharge volume. Source: Maryland Stormwater Design Manual, "Unified Stormwater Sizing Criteria", p 2.6.

2. *Recharge volume*

Impervious surfaces prevent rainfall from percolating into the ground, reducing the amount of groundwater recharge. This change alters the natural hydrology of stream and wetland systems and harms the habitat of many aquatic organisms. Exceeding the minimum recharge volume attempts to reverse this impact by requiring that a specific amount of stormwater be recharged into the groundwater. Recharge volume is based on the hydrologic soil groups (HSG) at the site, and the amount of impervious cover created by the development. Follow the next steps to calculate the recharge volume.

HSG - Description	SSRF
A ~ excessively drained	0.38
B ~ well drained	0.26
C ~ moderately well drained	0.13
D ~ somewhat poorly drained	0.07

Table 3. Consult chapter 2 of the Maryland Stormwater Design Manual, "Unified Stormwater Sizing Criteria", and chapter 3 of the Natural Resources Conservation Service Soil Survey Manual, "Examination and Description of Soils", for details.

1. Referring to table 3, classify your soil type within a HSG and identify the HSG soil specific recharge factor (SSRF).
2. Calculate the drainage area's imperviousness (I).
3. Calculate the recharge volume.
   Recharge volume = SSRF X I
4. Plot your drainage area's imperviousness on the line graph above to evaluate the recharge volume (figure 18).

Construction

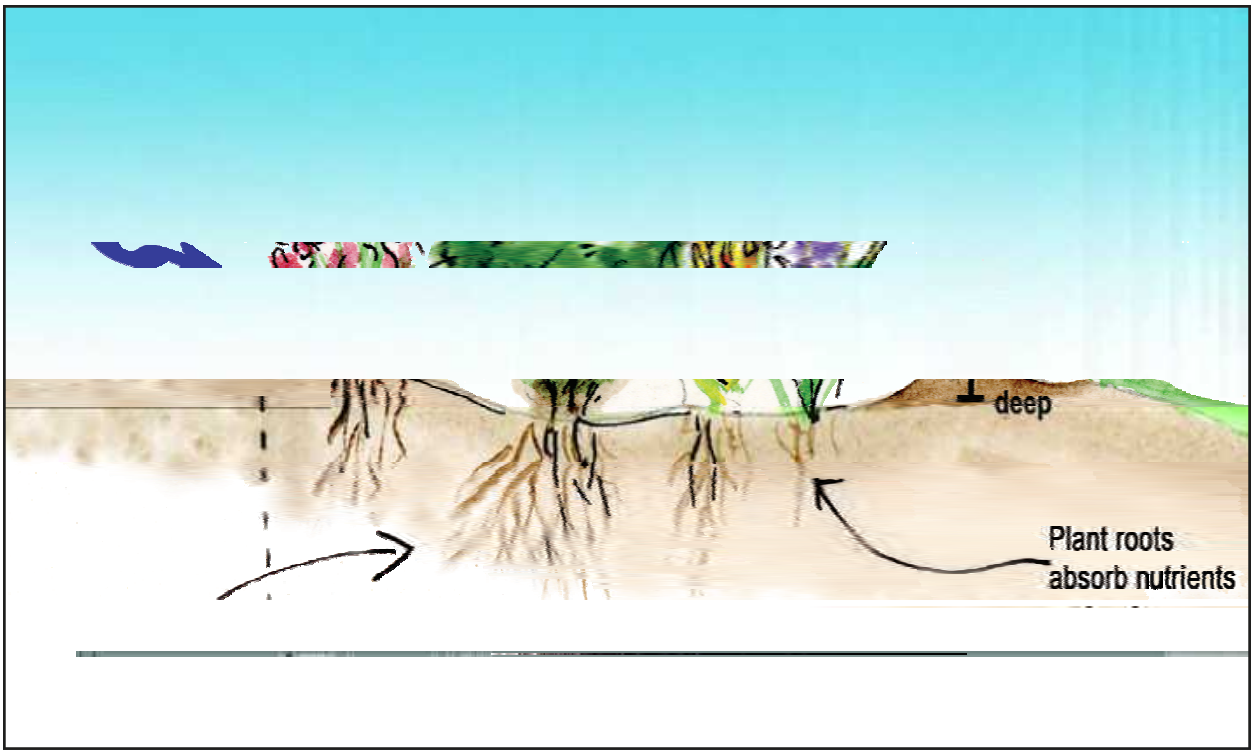


Figure 19. A sketch of your rain garden can help guide the construction process. In the example above, the rain garden is about 4-8 feet wide and has a surface ponding depth of 5-6 inches. Rocks located at the entrance point helps to dissipate runoff and the berm helps to hold water in the rain garden.

In this section, you will learn how to prepare the site and dig your rain garden. To help guide you through the construction process sketch out the garden's dimensions and surroundings. A sketch similar to figure 19 is an example that can help you during construction.

Preparing the site

To avoid digging on or near utility lines or pipes, contact Miss Utility at 1-800-257-7777 or www.missutility.net 48 business hours prior to digging. To be on the safe side, you may consider contacting Miss Utility one week prior to digging. The following tips will also help you prepare your site for digging.

- For a self-installed rain garden, expect to pay between $3 and $5 per square foot in plant costs and soil amendments. When working with a landscaping company to design and install your rain garden, the cost will

ESD Criteria # 11. Inspection

Regular inspections shall be made during the following stages of construction.

- *During excavation to subgrade and placement of planting soil.*
- *Upon completion of final grading and establishment of permanent stabilization.*



Figure 20. Bay-Wise master gardeners installed a rain garden at the Chesapeake Ecology Center in Annapolis, MD.

ESD Criteria # 12. Conveyance

Runoff shall enter, flow through, and exit rain gardens in a safe and non-erosive manner.

ESD Criteria # 13. Internal slope

A minimum internal slope of 1% should be maintained and a shallow berm surrounding the rain garden is recommended to avoid short-circuiting. For sloped applications, a series of rain gardens can be used as "scalloped" terraces to convey water non-erosively (refer to pages 12-13).

ESD Criteria # 14. Erosion & Sediment Control

Rain gardens shall not be constructed until the contributing drainage area is stabilized. During construction, runoff should be diverted and the use of heavy equipment avoided to minimize compaction.

significantly increase to around $10 to $15 per square foot.

- Depending on your rain garden size you may want additional help (figure 20). Building an average-size rain garden can take one person several hours, while a team of friends or neighbors can dig a rain garden in a fraction of the time. With more friends it's also twice as much fun.
- At the site use a flat shovel to peel the grass away from the soil. You might be able to reuse the sod to build a vegetated berm.
- If the grass is too tough to peel, cover it with black plastic until the grass dies. This usually takes 3-4 weeks. Pesticides should only be used as a last resort as this could harm pets, local wildlife, and nearby plants.



Figure 21. Creating a curb cut allows stormwater runoff from streets to enter rain gardens.

- If possible, plan to install your rain garden in the late spring or fall when the soil will be easier to dig and when the plants are more likely to thrive.

Excavation

Follow the steps below to begin digging your rain garden.

1. Capturing runoff

Be sure the runoff sources will flow to the garden site. If your rain garden will receive runoff from roadways, make sure curb cuts are created (figure 21 and 22). This assures rainwater will flow into the garden.

2. Outlining the rain garden shape

While referring to your sketches, lay out the approximate shape of your rain garden with marking paint, heavy rope, or a hose. You can also use surveyor flags or overturn the grass to mark the garden's edge (figure 23 on page 20). Another way to mark the edge is to mow the shape of your garden. If you decide to do so, make the corners gentle, otherwise they will be difficult to mow. Remove and replace the stakes when you are done mowing (refer to page 12). You'll need the stakes for building a berm. The edge between cut and uncut grass will give you an easy to



Figure 22. A curb cut allows runoff to flow into a rain garden at Heritage Baptist Church in Annapolis, MD.



Figure 23. The Lower Eastern Shore Tributary Strategy Team outlines the garden's shape by marking it with paint and overturning sod.



Figure 24. To construct the rain garden at the Ward Museum of Wildfowl Art in Salisbury, Maryland, the Lower Eastern Shore Tributary Strategy Team reused the garden area's sod to build a vegetated berm along the downslope side of the garden.

maintain shape. Be creative with the shape, but gentle curves look the most natural.

3. Constructing the berm

A berm is a low soil mound constructed along the width and downhill side of your rain garden. Its top should be about level with the uphill side and its base should be a foot or more wide with gently sloping sides. Berms on the downhill side of a garden are necessary on sloping sites. This will help hold water in your garden giving it time to seep into the soil.

To build your berm, consider reusing the sod and soil from your rain garden area (figure 24). This will help create a vegetated berm which is more likely to withstand berm erosion.

4. Soil mixture (optional)

Amend soil only if necessary. If you are planning to remove existing soil in order to add rain garden soil mixture, make sure you dig a few more inches below the garden base (refer to figure 16 on page 13). A soil mixture consisting of 50-60% sand, 20-30% topsoil (no clay), and 20-30% compost will help establish plants and allow water to soak in. Use the formula below to help estimate the amount of total fill needed for your garden.

Fill = width x length x depth below garden base

Follow the ESD criteria #15 if you are required to implement stormwater management by your local approving authority.



Figure 25. If your level is long enough, use it to level the height of your rain garden berm.

5. *Putting it all together*

Referring to your sketches, you will know how deep to dig. If your ponding depth is 6 inches, you will remove all the sod and soil 6 inches below the level string line. Remember to dig a few more inches if you are adding mulch, compost, or soil.

Begin digging at the uphill side near the stake and place the dirt (and sod) in the berm location. Level the berm's height with the uphill side by eye-balling it, moving the downhill stake along the lower edge of the rain garden while making sure the string is level, or by placing a carpenter's level on a straight 2x4 that reaches from the uphill side to the berm (figure 25).

Now that the rain garden is dug you are ready to plant herbaceous flowering perennials (flowers and grasses) or woodies (shrubs and trees) in your garden. Read the next section to learn how to select and install native plants in your rain garden.

ESD Criteria # 15. Planting Soil

Planting soil should be mixed on-site prior to installation. If poor soils are encountered beneath the rain garden, a four-inch layer of washed gravel (1/8 to 3/8 inch gravel preferred) may be used below the planting soil mix. The planting soil and mulch shall conform to the specifications found in appendix B.4 of the Maryland Stormwater Design Manual at www.mde.state.md.us/Programs/WaterPrograms/SedimentandStormwater/stormwater_design/index.asp.



Marsh Marigold



Spiderwort



Tall White Beardtongue



Figure 26. Rain gardens add color and life to your landscape.



Swamp Milkweed



Blueflag Iris



Blueberry Bush

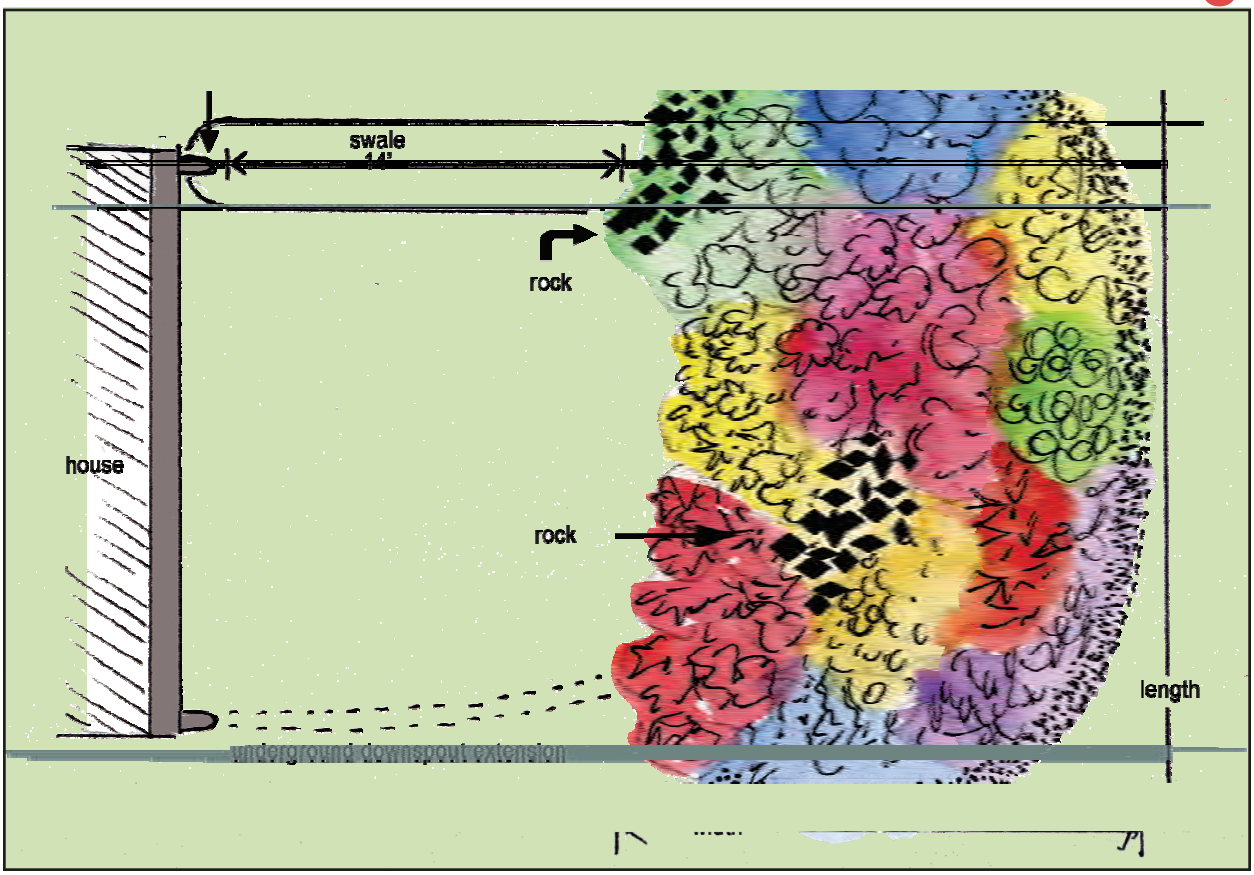


Figure 27. Sketch out your basic rain garden design. You don't have to be an architect!

With the grunt work done, you're now ready to bring your rain garden to life with your native plant selection (figure 26). In this section, you will learn how to select plants, lay out a rain garden design, install plants, and apply mulch.

Rain garden design

Create a sketch of your rain garden design to help guide your plant selection (figure 27). To help you brainstorm, refer to appendix C for a sample design and review the tips below.

- For a bold impact, reduce the amount of space between plants by a few inches from the

ESD Criteria # 16. Design

Landscaping plans shall clearly specify how vegetation will be established and managed. A rain garden should be located in full to partial sun, at least two feet above the seasonal high water table and have a total rain garden depth of 12 to 18 inches (refer to figure 11 on page 8). Plants selected for use in the rain garden should tolerate both saturated and dry conditions and be native or adapted to Maryland. Neatly trimmed shrubs, a crisp lawn edge, stone retaining walls, and other devices can be used to keep a rain garden neat and visually appealing.



Figure 28. Clustering creates the visual impact in the rain garden along Lincoln Drive in Annapolis, MD.

recommended spacing. This allows mature plants to overlap.

- Plant your native shrubs and flowers where their unique textures, colors, and heights will complement one another and help achieve the desired visual impact. Like grade-school pictures, tallest in the back and shortest up front.

Plant Selection

Native plants create habitat suited for wildlife, grow well without chemical supplements, and require less maintenance. With native species, your rain garden will be beautiful, healthy, and safely enjoyed by insects, birds, pets, and children. Decide which native plants meet your personal preferences by referring to appendix D for a list of native plants or visit your local nursery. Online resources like the *Native Plants for Wildlife Habitat and Conservation Landscaping: Chesapeake Bay Watershed,* www.RainScaping.org, and The Low Impact Development Center also provide helpful tips on how to choose the plants for your garden and provides pictures of them too. Below are some tips to help you select plants.

Sun, partial sun, and shade

Select native plants adapted to the sunlight your rain garden will receive.

Height, color, and texture

The physical properties of your plants will help add variety and interest to your rain garden. If your rain garden lacks flowering blooms, then take advantage of different leaf shades, shapes, and colors. For example, combining a variety of textures, staggering heights, and plants bearing variegation increases visual interest if clustered properly (figure 28).



Figure 29. White Turtlehead.



Figure 30. Baltimore Checkerspot Butterfly.

Cluster

Like real estate, landscaping has three rules: cluster, cluster, and cluster. Buy at least three individual plants of each species, but seven is typically the minimum number for a cluster.

Blooms

Design your rain garden to be "alive" spring through fall by selecting plants that bloom throughout the seasons. For example, beardtongue blooms from April to June and cardinal flower, a hummingbird favorite, blooms from July to September (see front cover). White turtlehead (figure 29) blooms from August to October and is the only plant that the Maryland state insect, the Baltimore Checkerspot Butterfly, will lay its eggs on (figure 30). By designing your garden to bloom year round with native plants, local insects and wildlife will benefit too.

Roots

Buy one or two-year old plants with well-established root systems that are beginning to circle or mat the pot, yet are young enough to adapt well to new growing conditions.

Incorporating clusters of ferns, rushes, and grasses with your flowering plants creates good root competition. This is normal and causes a healthier root pattern to develop. Blending a mix of clustered plant species reduces the chance of the garden being overrun by one species. If you would like to plant shrubs and trees, make sure they are well adapted to at least part-time wet conditions.

Plant!

While referring to your rain garden design sketch, place the potted plants in your rain garden. Try to visualize them full grown and move them around



Figure 31. Lower Eastern Shore Tributary Team members and volunteers planted native grasses, flowers, and shrubs at one of two rain gardens installed at the Providence Presbyterian Church in Salisbury, MD.

ESD Criteria # 17. Landscape Installation

The optimum planting time is during the Fall. Spring planting is also acceptable but may require watering.

ESD Criteria# 18. Conveyance

Runoff shall enter a rain garden at the surface through grass swales and/or a gravel bed. Energy dissipation shall be provided for downspout discharges using a plunge area, rocks, splash blocks, stone dams, etc.

ESD Criteria # 19. Treatment

- *A minimum layer of 6-12 inches of planting soil shall be provided (refer to figure 11 on page 8).*
- *A mulch layer 2-3 inches deep shall be applied to the planting soil to maintain soil moisture and to prevent premature clogging.*

until you've reached the best effect. Be bold, but cluster! The following tips will help you begin planting your potted plants.

- Dig each hole so it is at least twice as wide as the pot and no deeper than the pot. You will know if the hole is deep enough when the pot's soil and the plant's crown are level with the existing grade.
- Plant one plant at a time from one side to the other or from the middle out to avoid stepping on plants.
- Remove the plants by tapping the side of the pots to loosen them. Do not expose plant roots any longer than necessary.
- Loosen the matted roots circling with the shape of the pot.



Figure 32. The rain garden above, designed by Kara Bowne Crissey and installed by the Severn Grove Ecological Design, placed rocks along the edge to dissipate runoff during storm events.

- Place the plant in the hole, fill the hole with soil, and firmly tamp it.
- Water your plants immediately.
- To help remember what's what, put plant labels next to each cluster.

With the helping hand of a friend, you will be able finish in an hour or two (figure 31). Once all are planted, round up your pots and either reuse or recycle them.

Toppings: stone and mulch

Until the native plants can establish themselves, spread stone across the entrance point of your rain garden to slow water flow (figure 32). This will also help prevent strong storm events from washing out the mulch, soil, or breaking through the berm. To look more natural, stones should be buried at a depth of about one quarter of their height.

Another option is adding organic matter, such as shredded leaf mulch, to improve soil structure. It also conserves moisture, blocks light that many weed seeds need to germinate, lessens erosion, and is an attractive top dressing for your planting bed.

As a rule-of-thumb, apply mulch to a depth of 2-3 inches in planting beds. The depth of mulch to apply will depend upon the type of material used. Be sure not to bury seedlings or dormant plants, and keep it a few inches from the trunks of trees and shrubs. Commonly used organic mulches include: chipped or shredded wood mulch, such as pine or cypress; pin needles; and shredded leaves. Inorganic mulches include: gravel and other types of stone.

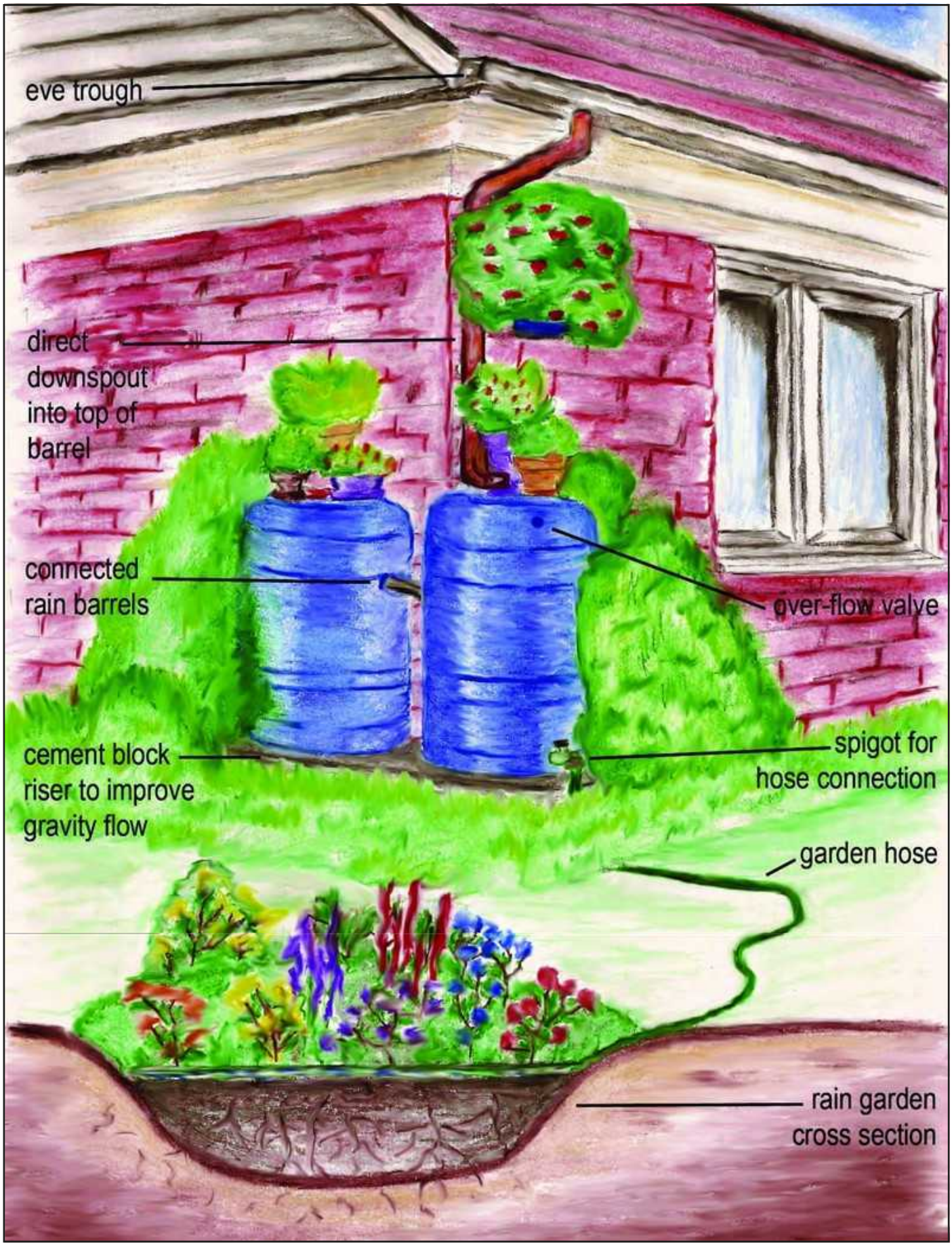


Figure 33. The drawing above illustrates how rain gardens and rain barrels work together to capture runoff. The downspout is directed into a rain barrel to collect roof runoff. In order to collect more roof runoff, two rain barrels are connected to each other. The excess runoff will pour out through the rain barrel's over-flow valve. You can attach an overflow hose to the valve to help direct flow towards your rain garden. By storing the stormwater runoff in rain barrels, you'll be able to water your rain garden during dry periods.



Figure 34. A Burnsville, MN home before and after rain garden construction. The City of Burnsville, MN constructed rain gardens to improve the water quality of Crystal Lake by adding rain gardens to a 20-year-old neighborhood. To learn more about the project visit http://www.landandwater.com/features/vol48no5/vol48no5_2.html.

Give your rain garden TLC to ensure it functions properly. Tender loving care does not mean 24-7 maintenance, but by making adjustments when needed, you'll be able to enjoy your garden throughout the seasons (figure 34). In this section you'll learn how to maintain your rain garden by measuring its performance over time and incorporating rain barrels into your rain garden design.

Rain barrels

Water your plants immediately. They will need about an inch of water per week to become established. To help regulate watering, incorporate rain barrels into your rain garden design (figure 33). Simply connect your rain barrel to the downspout draining to your garden (figures 36 and 37 on page 30). Direct the overflow hose into your garden so that excessive runoff will flow from the hose into your garden. Whatever is left inside the rain barrel can be used to water your garden in times of prolonged drought. Other rain barrel benefits include:

- Lower water costs (a rain barrel can save approximately 1,300 gallons of water during peak summer months).
- Beautifully designed rain barrels if built with the proper materials and tools (figure 35 on page 30).
- Naturally recharges groundwater.
- Reduced water pollution by reducing stormwater runoff, which can contain pollutants like sediment, oil, grease, bacteria, and nutrients.



Figure 35. Rain barrel artwork.



Figure 36. Highland Beach Town Hall rain barrels.



Figure 37. Connected rain barrels at Arlington Echo.

Maintaining your rain barrel is easy too. Keep these simple tips in mind for a properly functioning rain barrel.

- Clear debris away from the inlet on a regular basis to allow roof runoff to pour into the rain barrel.
- Unless your rain barrel can withstand freezing temperatures, clean out your rain barrel at the end of the season and store it indoors to prevent water from freezing inside of it. Freezing temperatures could damage your rain barrel.

Performance evaluation

Once you've constructed your rain garden you'll need to maintain proper drainage and healthy plants. Consider the following tips to maintain your rain garden's performance.

Rain garden performance

Visual inspections offer the easiest way to evaluate your garden for proper drainage. After a storm ends, visually inspect the rain garden for standing water at 24 and 48 hours. You'll need about an inch of rain or more. If there is still standing water after 48 hours, you'll need to make adjustments based on your site's conditions (refer to pages 9 to 11). To verify proper construction and ensure long-term performance, check for the items below.

- Sediment accumulation in the basin from the drainage area
- Clogged inlet or outlet
- Excessive erosion within the garden

Healthy native plants

Your native plants are the stars of the garden. Take care of them by applying the tips below to evaluate the health of your plants.

- Begin with a record of the garden design showing the plants installed and their location (refer to page 22).
- Record the time of growing season and age of the garden.
- Describe the condition of the site when you assess your plants.
- With the help of a plant field guide and your original garden design, identify the species present and their growth requirements. This will help determine whether or not the correct species are present.
- Record the color, size, and quality of the leaves, stem, and flowers. Compare this to your original garden design.
- Estimate the percentage of vegetative cover to determine if plants are established.
- Inspect your garden for wetland plant species to determine if hydric soils may be present, indicating prolonged periods of saturation.
- Take pictures of your garden to develop a complete record of conditions at the time of your assessment.
- During a growing season, record observations as needed. Follow these tips annually so that you'll have records to compare growing seasons and note any changes.

ESD Criteria # 20. Maintenance

- *Rain garden maintenance is generally no different than that required of other landscaped areas.*
- *The top few inches of the planting soil should be removed and replaced when water ponds for more than 48 hours. Silts and sediment should be removed from the surface of the bed as needed.*
- *Where practices are used to treat areas with higher concentrations of heavy metals (e.g., parking lots, roads), mulch should be replaced annually. Otherwise, the top two to three inches should be replaced as necessary.*
- *Occasional pruning and replacement of dead vegetation is necessary. If specific plants are not surviving, more appropriate species should be used. Watering may be required during prolonged dry periods.*
- *Rain gardens shall have a maintenance plan and be protected by an easement, deed restriction, ordinance, or other legal measures preventing its neglect, adverse alteration and removal.*

Your contribution

Each rain garden you build cleans our waterways so that one day we'll say in the watershed of the Chesapeake and Coastal Bays, "What falls on site, stays on site". -www.RainScaping.org

Rain Garden Checklist

No.		Task	Page
1.		Locate your rain garden site.	5-6
2.		Decide the best shape for your garden.	7, 19-20
3.		Estimate its drainage area.	11-12
4.		Figure out its surface ponding depth.	12-13
5.		Determine your rain garden's area.	13-14
6.		Sketch out your garden's dimensions.	15, 17, 23
7.		Contact Miss Utility 1-800-257-7777.	17
8.		Figure out your budget.	17
9.		Make sure your garden catches the runoff you're planning to treat.	19
10.		Build a berm.	20-21
11.		Dig your rain garden.	21
12.		Consider adding rain garden soil mixture, mulch, or stones (optional).	6-7, 20, 21, 27
13.		Buy native plants.	24-25, 38-43
14.		Lay out and plant the rain garden design. Remember to cluster, cluster, and cluster!	23-27, 37
15.		Incorporate a rain barrel into your garden layout.	29-30
16.		Evaluate your rain garden for proper drainage and healthy plants.	30-31
17.		Review environmental site design criteria tips 1-20 to meet Maryland's stormwater managemet criteria.	ii, 1, 2-3, 5-6, 9, 12, 17-18, 21, 23, 26, 31

Appendices

Appendix A:

Soil tests

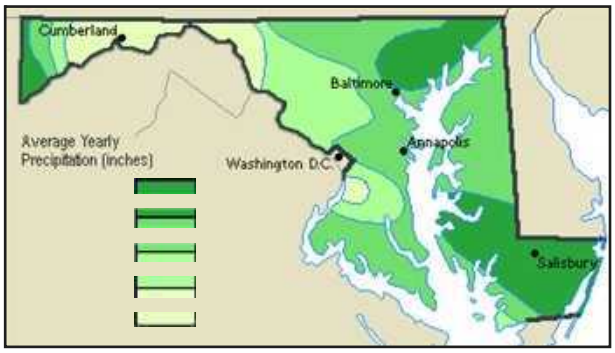


Appendix B:

Rainfall depth

by the Maryland Department of the Environment.

Maryland Stormwater Design Manual, "Unified Stormwater Sizing Criteria"



Appendix C:

Rain garden templates

by Low Impact Development Center



Appendix D:

Native plants

by Maryland Cooperative Extension



Soil tests



Figure 38. Dig a hole first.



Figure 39. Fill the hole with water.



Figure 40. Lastly, track time.

The percolation test and the clay test can help you identify soil type in your rain garden area.

Percolation Test

There are two percolation tests that can help you determine how fast water drains in your soil.

1. Water in a hole

- Dig a hole about 1-2 feet wide and 2 feet deep at the rain garden site (figure 38).
- Fill the hole with water (figure 39).
- If the hole drains in less than 24 hours, your soil is probably suitable for a rain garden (figure 40).
- If there's water in the hole after 24 hours select another site or talk to a professional landscaper.

2. Water in a can

- Remove the ends from a 46-ounce can or a large can of juice.
- Insert the can two inches into the ground.
- Pour a quart of water into the can.
- Depending on how many minutes it takes for the water to drain, you may or may not have suitable soils for a rain garden (table 4).

Drainage Time	Soil Porosity	Drainage Conditions
Less than 4 minutes	Excellent percolations and air circulation.	This soil offers the best drainage conditions for planting a rain garden.
4 to 10 minutes	Somewhat compact or dense soil.	Acceptable drainage for a rain garden but slower; may need to aerate or augment soil.
Over 10 minutes	Overly compact or dense.	Very poor drainage; challenging conditions. Must augment soil, mill, and aerate.

Table 4. Drainage time.

Clay-sandy soils test

Soils with high clay content may prevent proper drainage. Sandy soils are the best soils for drainage. You can use the tests below to identify soil type or contact your local Natural Resources Conservation Service extension office for assistance.

1. *Clay ribbon*

- The simplest way to test for clay or sandy soils (and at no cost) is to dampen a handful of soil in your hands (figure 41).
- Knead the soil into a ball (figure 42).
- Roll the ball between your hands to make a rope of soil uniformly thick (figure 43).
- Allow the rope to extend unsupported over your forefinger until it breaks from its own weight.
- If the rope extends unsupported greater than an inch before it breaks, and feels more smooth than gritty, the soil may have too much clay in it. This site may be unsuitable for a rain garden. Select another site or talk to a professional landscaper.

2. *Soil maps*

- Soil maps are a good reference for a basic understanding of the soils in your neighborhood. They will tell you what soils are on and near the land.
- Your local Natural Resources Conservation Service extension office will have soil maps for your area.



Figure 41. Dampen a handful of soil in your hands and knead the soil. Clay soil, when compacted, can prevent drainage. Sandy soil feels gritty and may be more difficult to knead, crumbling in the palm of your hands.



Figure 42. Knead the soil into a ball about an inch in diameter.



Figure 43. Roll the ball between your hands to make a rope of soil uniformly thick. If your rope breaks before extending an inch then you probably have sandy soils that allow proper drainage. This site may be suitable for your rain garden.

Rainfall Depth Chart

County	Rainfall Depth (inches)			
	1 yr - 24 hr	2 yr - 24 hr	10 yr - 24 hr	100 yr - 24 hr
Allegany	2.4	2.9	4.5	6.2
Anne Arundel	2.7	3.3	5.2	7.4
Baltimore	2.6	3.2	5.1	7.1
Calvert	2.8	3.4	5.3	7.6
Caroline	2.8	3.4	5.3	7.6
Carroll	2.5	3.1	5.0	7.1
Cecil	2.7	3.3	5.1	7.3
Charles	2.7	3.3	5.3	7.5
Dorchester	2.8	3.4	5.4	7.8
Frederick	2.5	3.1	5.0	7.0
Garrett	2.4	2.8	4.3	5.9
Harford	2.6	3.2	5.1	7.2
Howard	2.6	3.2	5.1	7.2
Kent	2.7	3.3	5.2	7.4
Montgomery	2.6	3.2	5.1	7.2
Prince George's	2.7	3.3	5.3	7.4
Queen Anne's	2.7	3.3	5.3	7.5
St. Mary's	2.8	3.4	5.4	7.7
Somerset	2.9	3.5	5.6	8.1
Talbot	2.8	3.4	5.3	7.6
Washington	2.5	3.0	4.8	6.7
Wicomico	2.9	3.5	5.6	7.9
Worcester	3.0	3.6	5.6	8.1

Table 5. Listed in the table above are rainfall depths associated with the 1, 2, 10 and 100-year, 24-hour storm events (source: Chapter 2 of the Maryland Stormwater Design Manual, "Unified Stormwater Sizing Criteria", page 2.11) . Maryland's environmental site design (ESD) sizing criteria for new development requiring stormwater management states that ESD practices shall treat the runoff from one inch of rainfall. However, if your water quality goal is to treat 100% of the runoff from a 1 year, 24-hour storm event, use the rainfall depth chart above to determine how much rainfall you need to plan for. For instance, a Worcester County resident treating 100% of runoff from the 1 year, 24-hour storm event needs to size their rain garden to treat the runoff from a three inch storm event. Refer to page 15 to learn more about sizing your rain garden based on targeting a rainfall amount.

Rain garden template



Note: The number of plants for each designated area is approximate.

Butterfly Swale
Low Maintenance, 250 SF, Coastal Plain, Full Sun

A - 10 *Chelone glabra* (White turtlehead)
B - 13 *Verbena hastate* (Blue Vervain)
C - 10 *Amsonia tabernaemontana* (Blue-star flower)
D - 12 *Lobelia cardinalis* (Cardinal Flower)
E - 13 *Amsonia hubrechtii* (Narrow-leaf Blue-Star flower)
F - 12 *Muhlenbergia capillaries* (Pink Muhly Grass)
G - 52 *Carex stricta* (Tussock sedge)
H - 1 *Magnolia virginiana* (Sweetbay)
I - 16 *Aster novi-belgii,* 'Professor Anton Kippenburg' (New York Aster)
J - 7 *Chelone lyonii* (Pink Turtlehead)

Butterfly Swale,
Low Maintenance, 250 SF, Coastal Plain, Pt Shade/Shade

A - 10 *Myosotis scorpioides* (Forget-me-not) or *Mertensia virginiana* (Virginia bluebell)
B - 13 *Gentiana andrewsii* (Bottle Gentian) or *Aster cordifolius* (Blue Wood Aster)
C - 10 *Amsonia tabernaemontana* (Blue-star flower)
D - 12 *Lobelia siphilitica* (Great Blue Lobelia)
E - 13 *Phlox divaricata* (Woodland Phlox)
F - 12 *Aruncus dioicus* (Goatsbeard)
G - 32 *Elymus hystrix* (Bottlebrush Grass) or *Ajuga reptans* (Carpetbugle)
H - 1 *Aesculus parviflora* (Bottlebrush buckeye)
I - 16 *Aster cordifolius* (Blue Wood Aster) or *Tradescantia virginiana* (Spiderwort)
J - 7 *Viola papilionacea* (Common Blue Violet) or *Dicentra eximia* (Hardy Bleeding Heart)

Native plants



Jacob's Ladder



Lyre-leaf Sage



Beebalm

Whether you live in the coastal plain, piedmont, or mountain regions of the Chesapeake and Atlantic Coastal Bays Watersheds, the native plants you select will provide many benefits to your rain garden and the environment. Native plant benefits include:

- Resilient to insects and disease, and are less likely to need pesticides
- Best adapted to local conditions, e.g., no need to use chemical fertilizers
- Conserving water , i.e., once plants are established in the right place, no need for supplemental watering
- High habitat value provides food, shelter, and nesting areas for wildlife

By growing native trees and shrubs you will also improve air quality and save energy. Trees and shrubs can remove carbon dioxide (CO_2) from the atmosphere during photosynthesis to form carbohydrates that are used in plant structure/function and return oxygen back to the atmosphere as a byproduct. About half of the greenhouse effect is caused by CO_2. Trees also reduce the greenhouse effect by shading our homes and office buildings, lowering the cost of air conditioning during the summer.

This section lists a few native ferns, grasses, sedges, flowers, shrubs, and trees adaptable to the coastal plain, piedmont, or mountain regions.

The key following will help you identify which native plants are suitable for your rain garden based on sunlight exposure, its soil moisture content, color, height, and bloom time. For additional native plants, refer to *Native Plants for Wildlife Habitat and Conservation Landscaping: Chesapeake Bay Watershed.*

Sunlight

- **Full sun** (**Su**) receives direct sunlight for at least six hours a day during the growing season.
- **Partial shade** (**PS**) receives approximately three to six hours of direct sunlight during the growing season.
- **Shade** (**Sh**) receives less than three hours of direct sunlight or filtered light.

Soil Moisture

- **Moist** (**M**) areas are where the soil is saturated for much of the growing season, except in droughts. These plants can handle saturated areas longer.
- **Average** (**A**) areas are where the soil is damp, and may be occasionally saturated. Plants can handle saturated and dry soils.
- **Dry** (**D**) areas are where water does not remain after a rain. These 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.

Flower colors

The key below is a simplified list of colors and includes all shades.

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

Ferns


Cinnamon Fern


Royal Fern


Sensitive Fern

Common Name	Scientific Name	M	A	D	Su	PS	Sh	Height
Cinnamon Fern	*Osmunda cinnamomea*	X	X		X	X	X	2-5'
Maidenhair Fern	*Adiantum pedatum*		X			X	X	1-2'
Northern Lady Fern	*Athyrium filix-femina*	X	X			X		1-3'
Royal Fern	*Osmunda regalis*	X	X		X	X	X	1.5-6'
Sensitive Fern	*Onoclea sensibilis*	X	X		X	X	X	1-3.5'

Grasses and sedges


Broomsedge


Switchgrass


Tussock Sedge

Common Name	Scientific Name	M	A	D	Su	PS	Sh	Height
Broomsedge	*Andropogon virginicus*	X	X	X	X			1-3′
Switch Grass	*Panicum Virgatum*	X	X	X	X	X		3-6′
Tussock Sedge	*Carex stricta*	X	X		X			1-3.5′

Herbaceous


Wild Ginger


Great Blue Lobelia


Smooth Solomon's Seal

Common Name	Scientific Name	M	A	D	Su	PS	Sh	Height	Color	Bloom
Beebalm	*Monarda didyma*	X	X		X	X		2-5′	R, Pu	Jul-Aug
Blueflag Iris	*Iris versicolor*	X	X		X	X		3′	Bl, Pu	May-Jun
Ginger, Wild	*Asarum canadense*	X	X			X	X	0.5-1′	B, Pu	Apr-May
Cardinal Flower	*Lobelia cardinalis*	X	X		X	X		2-4′	R	Jul-Sept
Common boneset	*Eupatorium perfoliatum*	X	X	X	X	X		1-5′	W	Jul-Sept
Foamflower	*Tiarella cordifolia*		X			X	X	0.5-1′	W	Apr-Jul
Goldenrod, Wrinkled-leaf	*Solidago rugosa*	X	X		X	X		1-6.5′	Y	Sept-Oct
Great Blue Lobelia	*Lobelia siphilitica*	X	X		X	X		2-3′	Bl	Aug-Oct
Jacob's Ladder	*Polemonium reptans*	X	X			X	X	0.5-1.5′	Bl	Apr-Aug

Herbaceous cont.

Common Name	Scientific Name	M	A	D	Su	PS	Sh	Height	Color	Bloom
Joe Pye Weed	*Eupatorium fistulosum*	X	X	X	X	X		1.5-10′	P	Jul-Sept
Lyre-leaf Sage	*Salvia lyrata*	X	X	X	X	X		1-2′	Pu	Apr-Jun
Marsh Marigold	*Caltha palustris*	X			X	X		1-2′	Y	Apr-Jun
Meadow Phlox	*Phlox maculata*	X	X		X	X	X	1-3′	P, Pu	May-Sept
Mist Flower	*Conoclinium coelestinum*	X	X	X	X	X	X	1-3.5′	Pu	Jul-Oct
Narrow-Leaved Mountain Mint	*Pycnanthemum tenuifolium*	X	X	X	X	X		1.5-2.5′	Pu, W	Jul-Sept
New York Ironweed	*Vernonia noveboracensis*	X	X		X	X		3.5-8′	Pu	Aug-Oct
Obedient Plant	*Physostegia virginiana*	X	X	X	X	X		1.5-5′	P, Pu	Jun-Sept
Rose Mallow	*Hibiscus mosheutos*	X	X		X	X		3-6′	P, W	Jul-Sept
Smooth Solomon's Seal	*Polygonatum biflorum*	X	X	X		X	X	1-3.5′	Y	Apr-Jun
Spiderwort	*Tradescantia virginiana*		X		X	X	X	1-3′	B, Pu	Apr-Jul
Summer Phlox	*Phlox paniculata*		X		X	X		1.5-6.5′	P, Pu	Jul-Oct
Swamp Milkweed	*Asclepias incarnata*	X	X		X	X		4-6′	P, W	May-Jun
Swamp Sunflower	*Helianthus angustifolius*	X	X		X			1.5-5.5′	Y	Aug-Oct
Tall White Beardtongue	*Penstemon digitalis*	X	X	X	X	X		2-5′	W	Apr-Jun
Turtlehead	*Chelone glabra*	X	X		X	X		1-3′	W, P	Aug-Oct
Woodland Phlox	*Phlox divaricata*		X			X	X	1.5′	Bl, W	Apr-Jun


New York Ironweed


Obedient Plant


Woodland Phlox

Shrubs


Mountain Laurel


Red Chokeberry


Sourthern Arrowwood

Common Name	Scientific Name	M	A	D	Su	PS	Sh	Height	Color	Bloom
American Beautyberry	*Callicarpa americana*	X	X	X	X	X		6′	Pu	Jun-Aug
Black Chokeberry	*Photinia melanocarpa*	X	X	X	X	X		3-6′	W	Apr-May
Buttonbush	*Cephalanthus occidentalis*	X	X		X	X	X	5-12′	W, P	Jun-Sept
Elderberry	*Sambucus canadensis*	X	X	X	X	X	X	6-12′	W	May-Jun
Highbush Blueberry	*Vaccinium corymbosum*	X	X	X	X	X		6-12′	P	May-Jun
Inkberry	*Ilex glabra*	X	X	X	X	X	X	6-10′	W	May-Jul
Mountain Laurel	*Kalmia latifolia*	X	X	X	X	X	X	12-20′	W, P	Jun-Jul
Northern Bayberry	*Morella pensylvanica*	X	X	X	X	X		5-10′	Y	Mar-Apr
Pink Azalea	*Rhododendron periclymenoides*	X	X	X	X	X	X	3-10′	P, W	Apr-May
Red Chokeberry	*Photinia pyrifolia*	X	X	X	X	X		1.5′-13′	W	Mar-May
Silky Dogwood	*Cornus amomum*	X	X		X	X		6′-12′	W	Mar-Apr
Southern Arrowwood	*Viburnum dentatum*	X	X	X	X	X	X	10-15′	W, P	Apr-May
Spicebush	*Lindera benzoin*	X	X			X	X	6.5-16′	W, Y	Mar-May

Shrubs cont.

Common Name	Scientific Name	M	A	D	Su	PS	Sh	Height	Color	Bloom
Swamp Azalea	*Rhododendron viscosum*	X	X		X	X		6.5-10′	W, P	May-Aug
Sweet Pepper Bush	*Clethra alnifolia*	X	X			X	X	6-12′	W	Jul-Aug
Virginia Sweetspire	*Itea virginica*	X	X	X	X	X	X	6-10′	W	Apr-Jun
Wax Myrtle	*Myrica cerifera*	X	X	X	X	X		6-15′	G	Mar-Apr
Winterberry	*Ilex verticillata*	X	X		X	X	X	6-12′	W, Y, G, B	Apr-Jul
Witherod	*Viburnum nudum*	X	X		X	X	X	6.5-20′	W	Jun-Jul

Trees


White Fringetree


Sweetbay Magnolia


Red Maple

Common Name	Scientific Name	M	A	D	Su	PS	Sh	Height
American Holly	*Ilex opaca*	X	X		X	X	X	15-50′
Black Gum	*Nyssa sylvatica*	X	X	X	X	X		30-75′
Fringetree, White	*Chionanthus virginicus*		X		X	X		20-35′
Red Maple	*Acer rubrum*	X	X		X	X		40-100′
River Birch	*Betula nigra*	X	X		X	X		50-75′
Serviceberry/Shadbush	*Amelanchier canadensis*	X	X			X	X	35′-50′
Swamp White Oak	*Quercus bicolor*	X			X	X		60-100′
Sweetbay Magnolia	*Magnolia virginiana*	X	X		X	X	X	12-30′
Willow Oak	*Quercus phellos*	X	X		X	X		80-100′

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Acknowledgements

Worcester County Commissioners:

Bud Church, President
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Back cover—Cardinal flower image courtesy of William C. Miller III, The Azalea Works.

Revised & printed January 2010.
Originally printed September 2008.

Special Thanks

Rain Gardens Across Maryland is based on original content from *Rain Gardens—A How-To Manual for Homeowners* developed by the Wisconsin Department of Natural Resources and the University of Wisconsin-Extension and *Rain Gardens in Maryland's Coastal Plain* developed by the Worcester County Department of Comprehensive Planning.

This project was funded by the Maryland Coastal Bays Program, the RainScaping Campaign, and Arlington Echo Outdoor Education Center.

For more information, contact the Worcester County Department of Development Review and Permitting at (410) 632-1200, 1 West Market Street, room 1200, Snow Hill, Maryland 21863. Additional copies of *Rain Gardens Across Maryland* can be downloaded from www.co.worcester.md.us, www.mdcoastalbays.org, www.arlingtonecho.org, www.aacountywatershedstewards.org, and www.RainScaping.org.



The original hardcopy document has been printed by Delmarva Printing, Salisbury, Maryland.

Final thought

"Don't stress too much over it. The rain garden does not have to be perfect to do its job, and it will change over time—that's one of the things that makes it so rewarding; it's a living, dynamic system. Dig a hole, relax, and let nature take its course. Observe and have fun".

-Spencer Rowe, Wetland Scientist
June 1, 2008