How to Install a Rain Garden

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ALABAMA A&M & AUBURN UNIVERSITIES

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Objective: You will learn how to install a rain garden and why installing a rain garden has a positive impact on your environment.

This manual was created as part of the Alabama Watershed Stewards Program, an educational training developed by Alabama Extension in cooperation with the Alabama Department of Environmental Management, U S Environmental Protection Agency (EPA), Alabama Water Watch with the Auburn Water Resources Center, and other local and regional partners. The purpose of the Alabama Watershed Stewards Program is to promote healthy watersheds, increase understanding of potential causes of water pollution and resource degradation, and provide the knowledge and tools needed to prevent and resolve water quality problems.

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HOW TO INSTALL A RAIN GARDEN

AN ALABAMA WATERSHED STEWARDS PROGRAM PUBLICATION

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How to Install a Rain Garden

WHAT IS A RAIN GARDEN?

Rain gardens are part of stormwater management systems that are both beautiful and functional. Rain gardens are shallow, vegetated landscape depressions that slow water for a short time to provide stormwater infiltration, pollutant filtration, native plant habitat, and effective stormwater treatment for small-scale residential or commercial drainage areas.

Rain gardens come in various shapes and sizes and can be an attractive landscape feature if managed appropriately. They are considered part of **green infrastructure** and **low-impact development (LID)** initiatives in urban areas. If multiple rain gardens are spread out across a city, they can play a larger role in preventing polluted water runoff from entering rivers and streams.

> Green infrastructure captures the rain where it falls. It mimics natural hydrological processes and uses natural elements such as soil and plants to turn rainfall into a resource instead of waste. Green infrastructure includes water management practices such as vegetated rooftops, roadside plantings, absorbent gardens, and other measures that capture, filter, and reduce stormwater pollution.

WHY BUILD A RAIN GARDEN?

When it rains, do you ever think about where that rainwater goes? Forested and urban environments respond differently to rain events. As our cities and neighborhoods increase development, more impervious surfaces (concrete, asphalt, rooftops) are covering what once was vegetated ground. Impervious surfaces and compacted soils prevent stormwater infiltration and cause runoff of pollutants, such as oil, grease, metals, and fertilizers, from our landscapes. These pollutants often run into storm drains, which then run directly into local rivers and streams. The result? Too much water flowing in a short amount of time, carrying pollutants that negatively affect the health of our streams, lakes, and estuaries.

Figure 1. Donald E. Davis Arboretum rain garden between two paths

Reducing runoff helps to restore a more stable, functional hydrologic cycle. You can learn more about water hydrology, watersheds, and water health in chapter 4 of the *Alabama Watershed Stewards Handbook* available at **www.aces.edu**.

Rain gardens provide the following benefits:

- **Manage stormwater at its source**
- **Promote infiltration**
- **Decrease velocity of water flowing from impervious surfaces**
- **Reduce nutrients, heavy metals, sediment, and pathogens before water enters a storm drain**
- **Are cost effective (average $2.00 to $5.00 per square foot)**

Did you know?

- Because of impervious surfaces, such as pavement, rooftops, and roadways, a typical city block generates five times more runoff than a woodland area of the same size.

Figure 2. Paint is washed into a storm drain, depositing chemicals directly into local waterways.

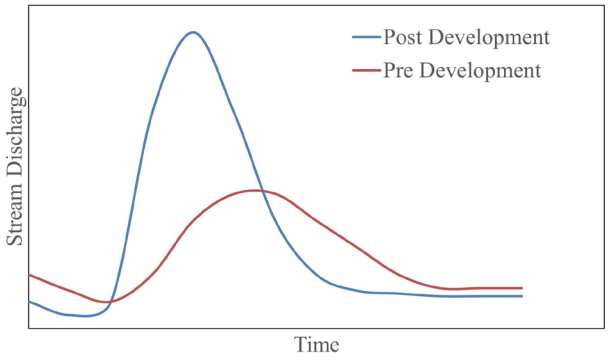


Figure 4. Stormwater runoff hydrograph example showing the difference in water discharge after a storm event on developed (urbanized) versus. undeveloped lands. Water flows are more spread out and less "flashy" if the land surface is more vegetated.

HOW MUCH WATER DOES A STORM DELIVER?

Have you ever wondered how much water falls onto your yard during a rainstorm? In Alabama, we receive an average of 56 inches per year. This means that an acre of land in Alabama will receive an average of 1,520,624 gallons of rain in a single year! That's enough water to fill 380 tanker trucks and more than 50 swimming pools. These high volumes of water delivered through storm drains into a local waterway can cause flashy flows or extremely high flows during a rain event followed by low flows after the rain. This increases erosion, which supplies sediment to stream flows.

> Evapotranspiration is the process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants.

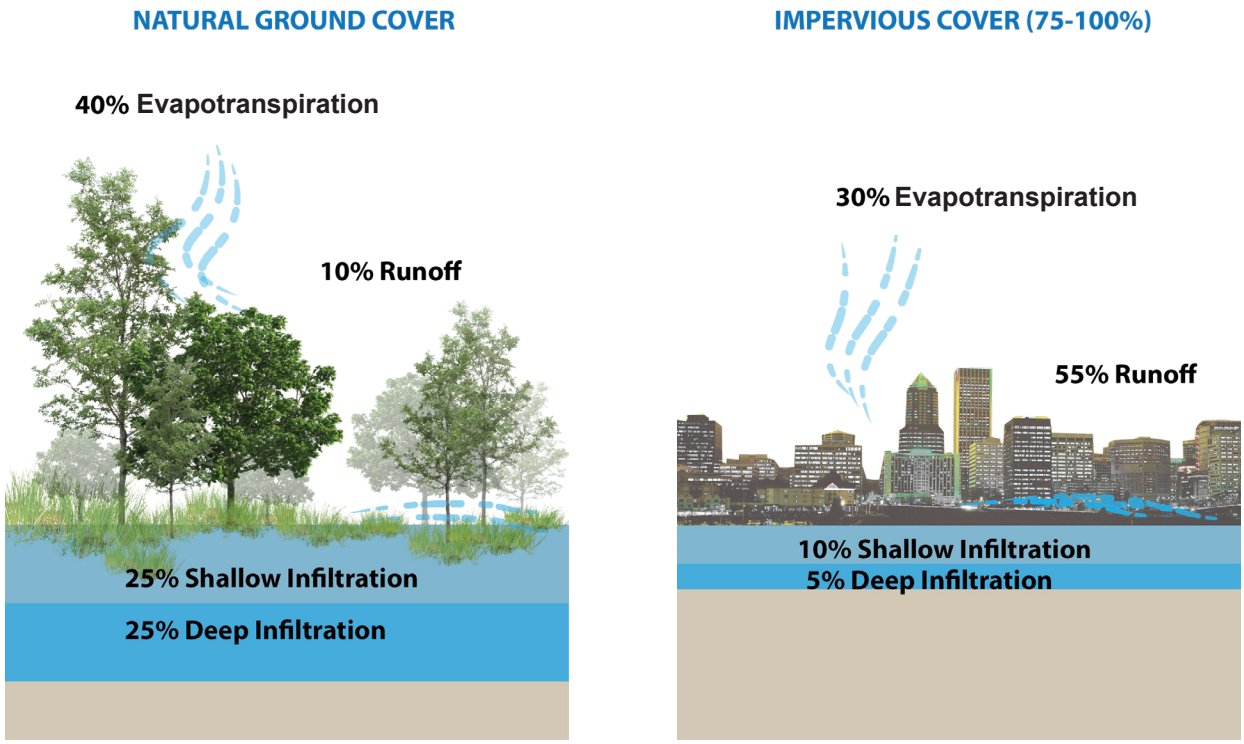


Figure 3. Stormwater runoff on natural vegetation versus stormwater runoff on urban impervious surfaces.

Figure 5. Flashy flows can cause severe erosion in urban streams.

Storm volume = area × rainfall

Ex 1: A 40 ft. × 70 ft. roof receives 1 in.

(40 ft. × 70 ft.) × 1 in. (1 ft. ÷ 12 in.)

2,800 ft.^{2} × 0.083 ft. = 232.4 ft.^{3}

232.4 ft.^{3} × 7.48 gal./ft.^{3} = **1,738 gal.**

Ex 2: An acre of land receives 0.5 in.

43,560 ft.^{2} × 0.5 in. (1 ft. ÷ 12 in.)

43,560 ft.^{2} × 0.042 ft. = 1,815 ft.^{3}

1,815 ft.^{3} × 7.48 gal./ft.^{3} = **13,576 gal.**

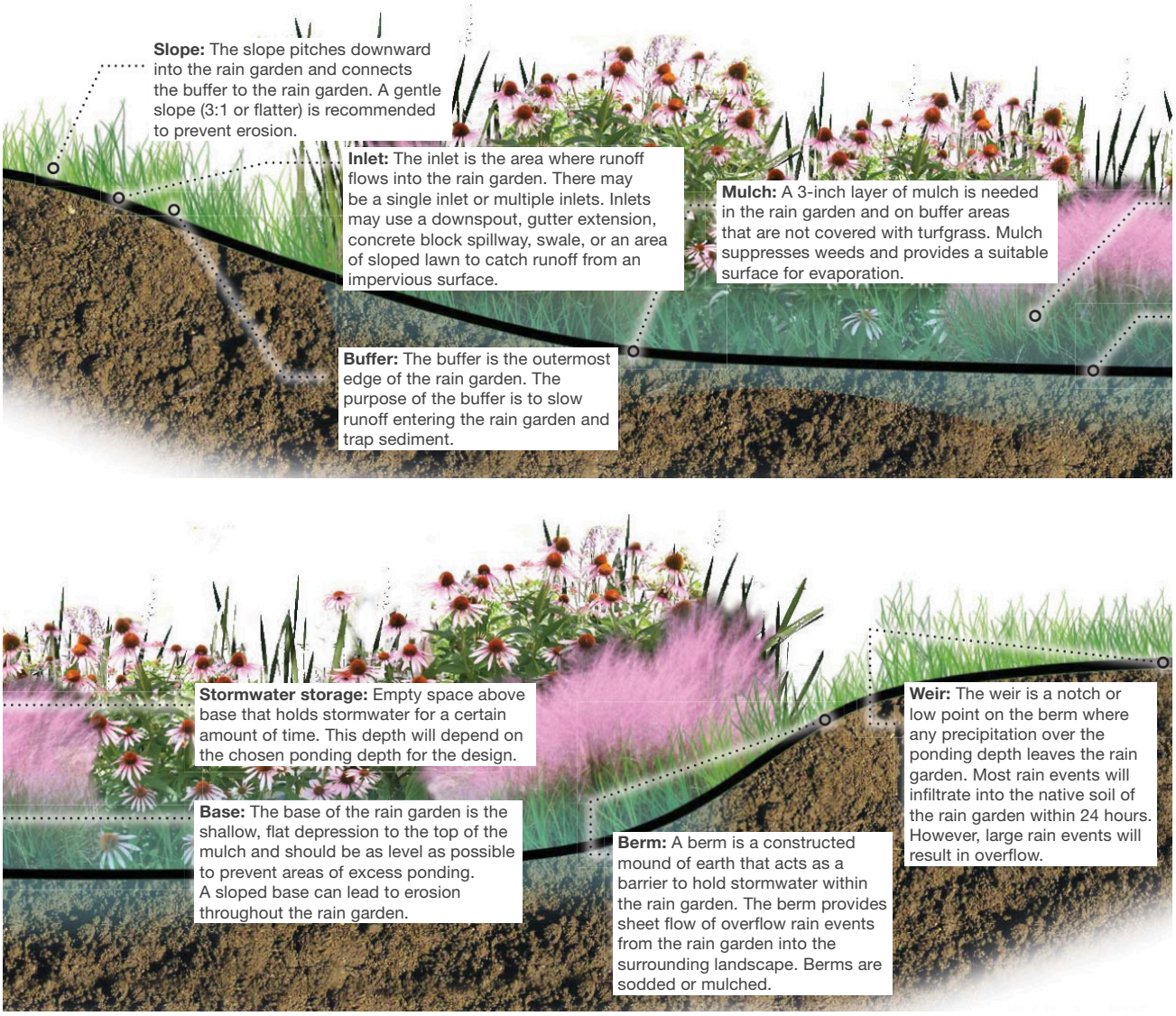


Figure 6. Design components of a rain garden.

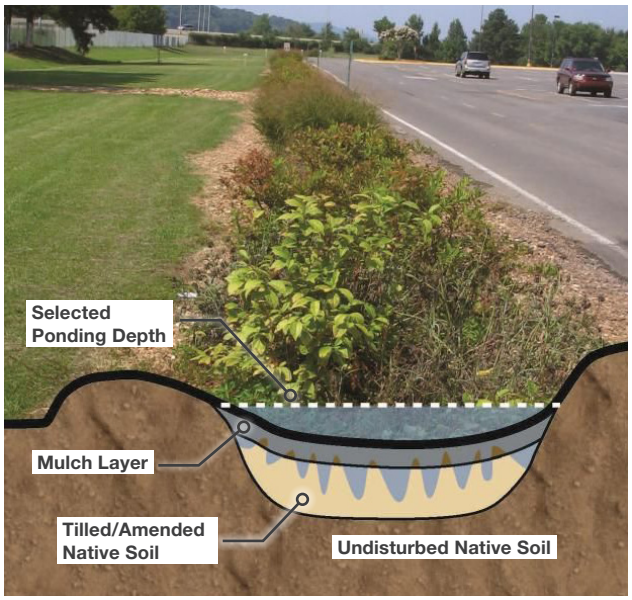


Figure 7. Rain gardens can be designed in various shapes and sizes. This image illustrates how rain gardens capture and infiltrate water running off impervious surfaces.

Alabama, a Unique Situation

- Alabama is one of the most biodiverse places in the world because of its warm, moist climate, evolutionary past, and great geologic diversity. With more than 4,533 documented species, Alabama ranks fifth among states in overall species diversity and is first among states east of the Mississippi River. Keeping our waterways clean helps preserve this biodiversity.

Shortcut approximation equation:

Storm volume = square footage of area × inches of rain × 0.62

Revisiting the problems above:

Ex 1: 2,800 ft.^{2} × 1 × 0.62 ≈ **1,730 gal.**

Ex 2: 43,560 ft.^{2} × 0.5 × 0.62 ≈ **13,500 gal.**

What do rain gardens have to do with it? Rain gardens help us restore the natural water cycle in developed areas by encouraging stormwater infiltration. This helps improve stormwater quality and promotes healthy streams in both small towns and large cities.

COMMON QUESTIONS

DO RAIN GARDENS ATTRACT MOSQUITOES?

If built correctly, your rain garden should not host mosquitoes. Mosquito larvae require 2 to 3 days of standing water. Ideally, a rain garden should drain so that water will not be standing in it for more than 48 hours. Learn more about the mosquito life cycle from the Environmental Protection Agency.

ARE RAIN GARDENS EXPENSIVE?

Rain gardens can be expensive or affordable depending on the aesthetic you want, the size of the plants installed, the size of the rain garden, and the amount of work required to excavate.

DO RAIN GARDENS WORK IN THE WINTER?

Because plants are dormant, their activity is reduced, but the rain garden will still help slow stormwater and encourage infiltration in the winter.

CAN I BUILD A RAIN GARDEN MYSELF?

Although rain gardens may require more work than your traditional perennial garden, the difficulty level is about the same. Many resources cover the planning, design, and construction of rain gardens.

I'M AFRAID THAT MY NEIGHBORS WON'T APPROVE OF A RAIN GARDEN. ARE THERE STRATEGIES FOR MAKING A RAIN GARDEN LOOK NICE AND GETTING MY NEIGHBORHOOD ON BOARD?

Rain gardens can be designed to fit into your neighborhood aesthetic. With proper maintenance and enough time for the plants to establish, they can be both attractive landscape features and tools to help educate others about preventing stormwater pollution.

Figure 8. In this example site at West Forest Intermediate, you can see how the topography may drive stormwater to a pointed location. Consider your site's topography and drainage patterns.

HOW MUCH MAINTENANCE WILL MY RAIN GARDEN REQUIRE?

Rain gardens require less maintenance than a traditional garden if native plants are installed, but they do require some maintenance like any other landscape feature. Native plants will thrive in their natural surroundings and should not need much fertilizer or pesticide. After your plants are established, you should need to water them only during dry periods.

BUILDING A RAIN GARDEN: A STEP-BY-STEP APPROACH

Rain gardens are relatively easy features to install in your landscape, but it is well worth considering all the steps and factors involved before beginning your own project.

Before starting, be sure you cover all your bases:

- Consider regulations, permits, and design modifications. Some cities and counties have specific regulations regarding disconnecting downspouts, routing or piping water off-site, and securing setbacks to structures, steep slopes, and property lines. They may also require a permit. Always check with your city's building or planning department if you live within city limits; otherwise, check with your county government.
- Can you dig safely? Make sure you are not going to compromise any of your utilities by digging your rain garden. Alabama law requires that everyone, including homeowners, contact Alabama 811 at least 2 working days before the start of any excavation project (no matter how large or how small). If you are unsure whether you need to notify Alabama 811 before starting your job, it is always best to call first. Calling 811 is free; if you are calling from outside of Alabama, the toll-free number is 800-292-8525. You can also use their Internet web portal or mobile application.

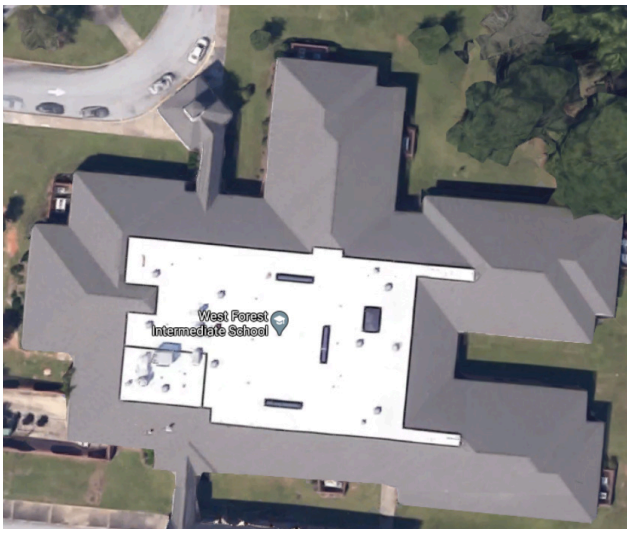


Figure 9. Getting an aerial view of your site before an in-person visit can help you identify which impervious surfaces might drain to your rain garden site.

Figure 10. An aerial view of a building from Google Earth combined with in-person site analysis will help you to observe water flows and topography.

Figure 11. Flowing water in a landscape gives you clues for where to place your rain garden to intercept water.

STEP 1: OBSERVE AND MAP YOUR SITE

Take time to create a simple bird's-eye view of how water flows on your landscape. This will help you identify where to install a rain garden. Assess how water moves across your property and create a map with structures and the direction of water flow.

STEP 2: DETERMINE THE LOCATION OF THE RAIN GARDEN

- Walk through your yard and identify potential locations. Note any strong slopes or low spots. It is helpful to watch water flow patterns on the landscape during a rainy day.
- Avoid areas with poorly drained soils. Rain gardens should not be constructed in locations that stay wet throughout the rainy season. Sediment deposits may reveal where water frequently ponds.
- Note soil color. The presence of water modifies soil color by affecting the oxidation rate, making soil color a helpful indicator of a soil's ability to drain water. Higher water content in the soil leaves less room for air, specifically less oxygen.
    - In well-drained (and therefore oxygen-rich) soils, red and brown colors caused by oxidation are more common. These are good soils for rain gardens.
    - Wet (low-oxygen) soils usually appear gray or greenish due to the presence of reduced (ferrous) iron oxide (figure 12). Avoid these sites for your rain garden.
- Note areas where water might drain to your neighbors' or public property. You don't want to inadvertently harm adjacent property with rain garden overflow.

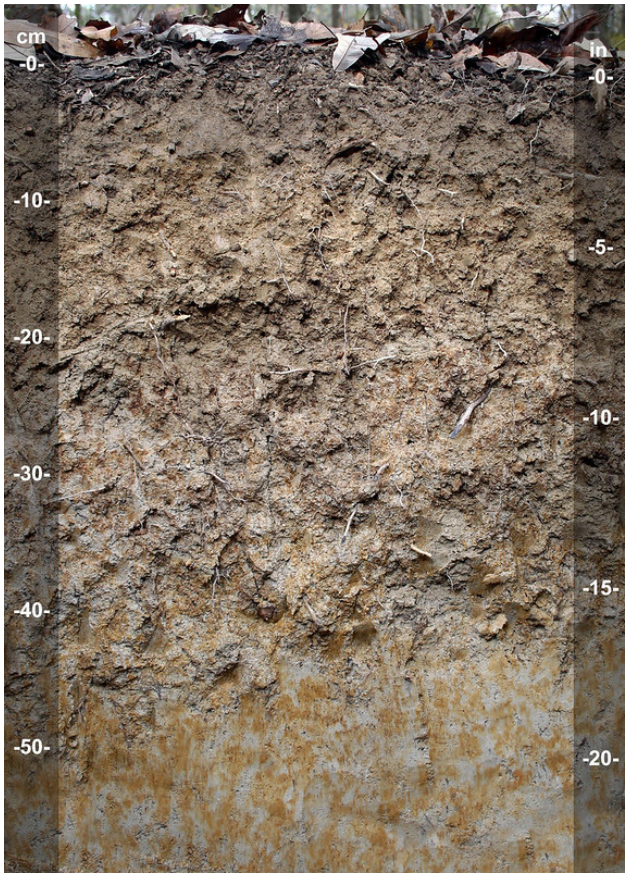


Figure 12. Gray soils may indicate the presence of standing water, as indicated at the bottom of this soil profile. (Photo credit: John A. Kelley, USDA Natural Resources Conservation Service)

- Identify potential locations about 10 feet away from your downspouts where water tends to flow (figure 13). Keep in mind that you can redirect water from your downspouts toward a rain garden site (figure 14).
- Gutters and other topographical features will sometimes push water toward a pinch point or an area where most of the water is directed. Consider this a potential area for a rain garden (figure 15).
- Avoid placing your rain garden in a location higher than your yard's water collection points.
- Look for areas nearby where overflow from a rain garden can be absorbed or safely directed into an approved stormwater collection point, such as a street-side gutter or storm drain. Place your garden between the runoff source and its destination—your rain garden.

Where Not to Place Your Rain Garden

- Do not place your rain garden on top of a septic system drain field. When uphill from a septic system, allow at least 50 feet between a rain garden and the septic system.
- If capturing roof water runoff, place your rain garden at least 10 feet downslope of a roof downspout to avoid impacting existing structures. You can direct water from your downspout to a rain garden by creating a swale or by using rocks or tiles. Avoid placing rain gardens uphill of a house.

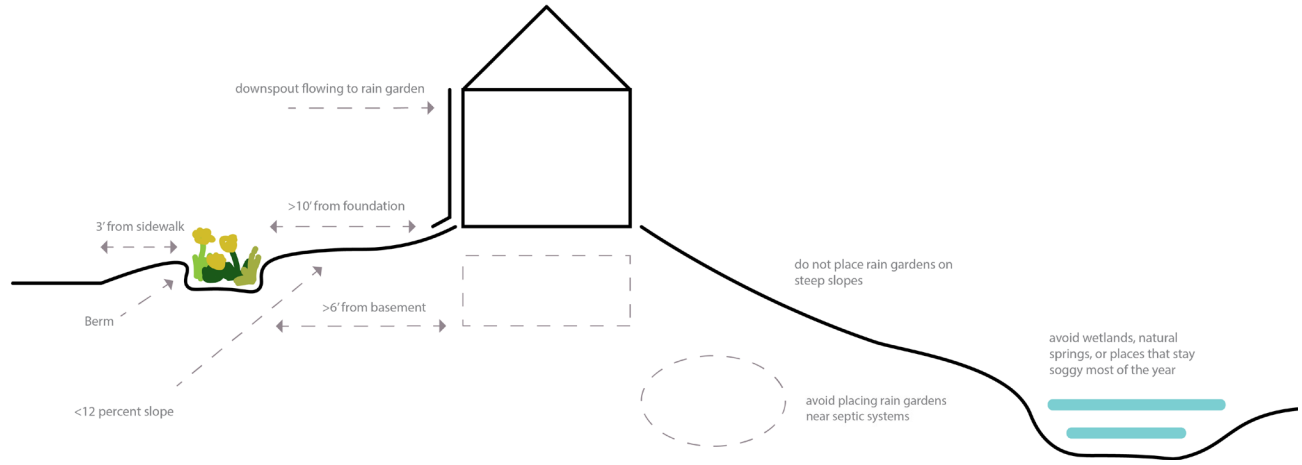


Figure 13. Rain garden locations with site considerations.

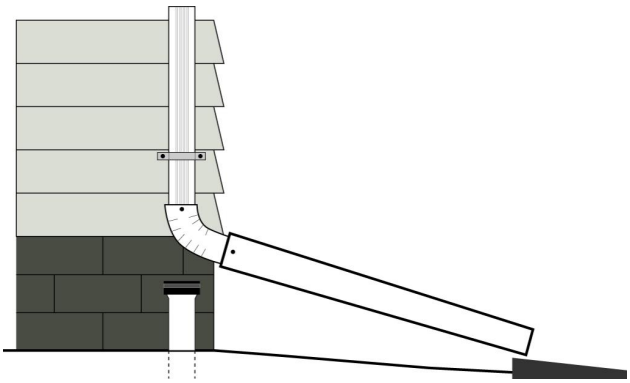


Figure 14. Using a simple pipe to redirect water to a rain garden.

- A rain garden should be the final feature installed as part of a larger landscape or architectural project. Sediment flowing into your rain garden from construction or loose soil may limit infiltration.
- To prevent slumping and to protect concrete structures, make sure the outer edge of your rain garden is at least the following distance from a structure:
  - 3 feet from a sidewalk
  - 6 feet from a basement
  - 2 feet from a crawl space or slab
  - 10 feet from a retaining wall
- Just because there is ponding water in your yard does not mean it is a good place for a rain garden. Your soils need to have good percolation rates to avoid standing water for more than 2 or 3 days.
- Avoid areas such as wetlands, natural springs, or seeps that stay wet during the rainy season.
- Avoid placing a rain garden under large trees. The tree roots can be damaged by the excavation and may also be overwhelmed by the amount of water that pools beneath them.
- Avoid soils that have been contaminated by chemicals or other toxic substances.
- To prevent surface erosion, do not place rain gardens on slopes steeper than 10 percent. If you have sloped property, consider contacting a licensed landscape professional or engineer to design site-specific safe ways to store and route water off-site without damage.
- Don't make your neighbors angry! During large storms, it is normal for rain gardens to overflow. Make sure to route the overflow to a safe location away from steep slopes, structures, and neighbors' properties.

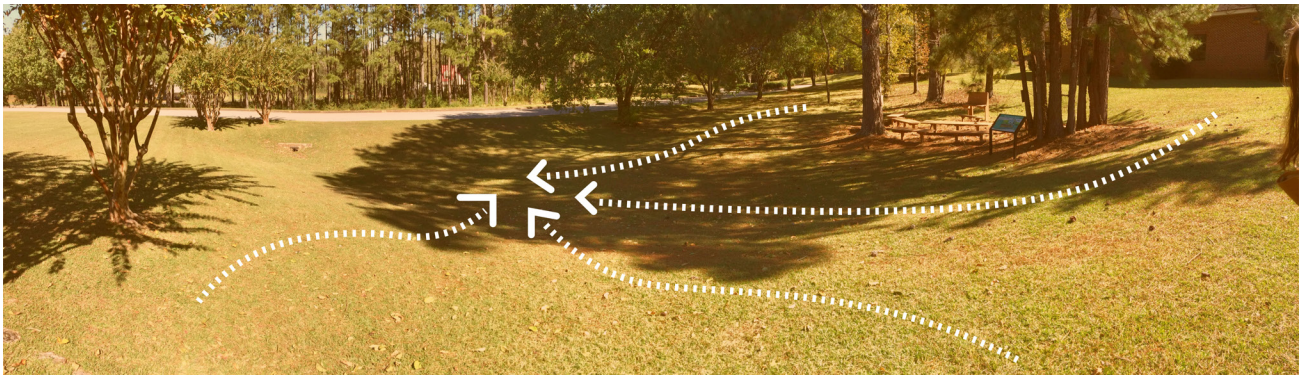


Figure 15. Topographical pinch points could be a good location for a rain garden.

Figures 16. Digging a hole 1 foot deep to conduct an infiltration test.

Figures 17. Filling the hole with water to determine infiltration rate.

Figures 18. Measuring the amount of time it takes water to drain.

STEP 3: ASSESS YOUR SOIL

To ensure that the site you have selected will work for a rain garden, perform an infiltration test. Spring is a great time for this, as the soil should not be frozen and the groundwater table should be high.

1. Dig a 1-foot-deep test hole in the area where the rain garden will be built.
2. Fill the hole with water just below the rim. Record the exact time you stop filling the hole and the time it takes to drain completely. Add water to the rim and record the drainage time twice more. The third test will give the best measure of how your soil will perform when fully saturated.
3. Divide the distance that the water drains by the amount of time it takes to drain.

   For example, if the water drops 6 inches in 12 hours, then divide 6 by 12 for an infiltration rate of ½ inch per hour. If the slowest infiltration rate measured of the three trials is less than ½ inch per hour, then dig another 3 to 6 inches deeper and repeat the above steps. Repeat this process at various depths down to 2 feet or until you have at least ½ inch per hour infiltration.

To save time, monitor how much water infiltrates in 10 minutes. If the water drops 1 inch in 10 minutes, divide 1 by 10 to get the inches per minute then multiply that by 60 to get inches per hour:
1 × 60 = 6 inches/hour

STEP 4: DETERMINE THE SIZE AND DEPTH OF THE RAIN GARDEN

With your location decided and design constraints considered, you can begin sizing your rain garden. Generally, rain gardens are sized as 10 percent of the impervious surface area draining to the garden.

Calculating the Size of Your Rain Garden

The size of a rain garden refers to the volume of water it can hold before the water overflows at the exit point. This volume is described in terms of ponding depth and square feet of surface area (depth × width × length). The more impervious area you want to treat, the bigger your garden needs to be. If you don't have enough space, you can build multiple rain gardens or build a smaller one and plan for it to overflow more often.

Determining the Drainage Area

Measure the area in square feet of impervious surfaces that will contribute runoff to your rain garden. If you are collecting water from a downspout, measure the length and width of the roof that drains to that downspout (figure 19). Alternatively, you can estimate rooftop area by using Google Earth's measurement tool (figures 20 and 21) or by estimating the area with a tape measure or by pacing on the ground. Use table 1 to help you think through the impervious surfaces on your property that might flow directly into your rain garden.

Sizing Your Rain Garden with Ponding Depth

The size of the rain garden depends on the percolation rates you have and the depth of the rain garden. Ideally, you want a percolation rate of at least 1 inch per hour.

Ponding depth is the depth that water can pond before it flows out of the rain garden. It is measured from the lowest point of the rain garden surface to the elevation of the outlet.

Extra depth may be added below the weir to prevent ponding over the desired depth. You want at least 3 inches of depth for clay soils with drainage rates of less

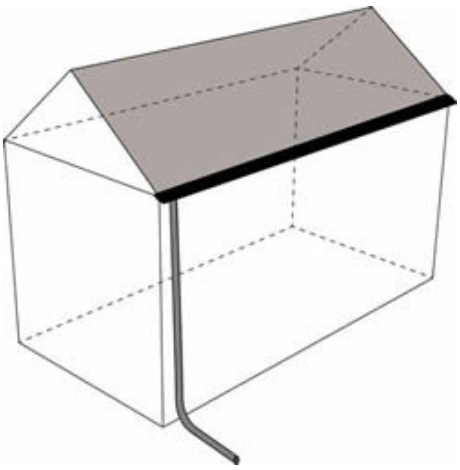


Figure 19. In this image, you can see that half of the rooftop drains to a gutter system leading to one downspout.

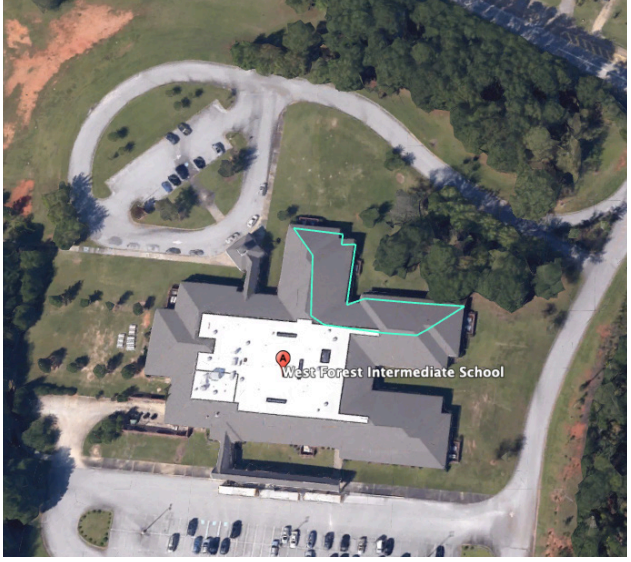


Figure 20. Google Earth was used to outline the portion of a rooftop draining to a proposed rain garden site. Google Earth's measuring tool will also help you estimate the square footage of a particular portion of the roof.

than 1 inch per hour and 3 to 6 inches of depth for sandy soils with greater than 1 inch per hour of drainage.

Because clay soils drain slower, you should make the rain garden shallower to ensure that you won't have standing water for longer than 48 hours.

For quick and simple calculations, use the 10/20 rule:

- For a 3-inch ponding depth, the rain garden size equals the impervious area to be treated divided by 10.
- For a 6-inch ponding depth, the rain garden size equals the impervious area to be treated divided by 20.
- Example: 30 ft. × 12 ft. (rooftop area) = 360 ft.² (your impervious rooftop surface area) × .10 = 36 ft.² of rain garden

Example: The rooftop draining to a proposed rain garden at West Forest Intermediate School in Opelika, Alabama, is 7,881 square feet. We can calculate the size that our rain garden should be by dividing the area by 20 for a 6-inch ponding depth.

7,881 ft.² ÷ 20 = 394 ft.² rain garden

The final area of your rain garden does not need to be exact but can be flexible to meet your site needs. The square root of 394 is 19.84, so we can estimate that a 20-foot by 20-foot rain garden might suit your needs.

Compare the result of your soil infiltration test with the information in table 2 to get a good idea of how your soil influences the size of the rain garden. Read on for more specific calculations.

> Remember, these are only guidelines. The size of the rain garden also depends on how much money you want to spend, how much room you have in your yard, and how much runoff you want to control. You can reduce the size of your rain garden by as much as 30 percent and still control almost 90 percent of the runoff.

Figure 21. Image highlighting the portion of the rooftop that will drain to the rain garden site. The estimated square footage of this portion of the roof is 7,881 square feet.

Table 1. Measuring Impervious Surfaces Flowing into the Rain Garden Site

Drainage Area	Area (Square Feet)
Roof Downspout*	
Second Roof Downspout*	
Driveway	
Sidewalk	
Other	
Total Impervious Drainage Area	

**Remember, you may need to redirect some downspouts to your site if necessary.*

Table 2. Suggested Rain Garden Ponding Depth Based on Infiltration Test	
Drainage Rate	**Suggested Rain Garden Depth**
Between ½ and 1 inch per hour	12 to 24 inches
Between 1 and 2 inches per hour	6 to 8 inches
Faster than 2 inches per hour	6 inches

Adapted from the *Oregon Rain Garden Handbook*

Example: At the West Forest rain garden site, the rate of infiltration is roughly 7 inches per hour; therefore, select a 6-inch ponding depth and dig down 9 inches to add a mulch layer.

> Remember to account for the addition of mulch when you plan for your finished depth. For example, if you want to add 3 inches of mulch to your final planted garden and it needs to be at least 12 inches deep, you must excavate to a depth of 15 inches from grade.

- Remember, safe digging is everyone's responsibility and is required by law in Alabama. Call 811 at least 2 days in advance to make sure your site will not harm any infrastructure.

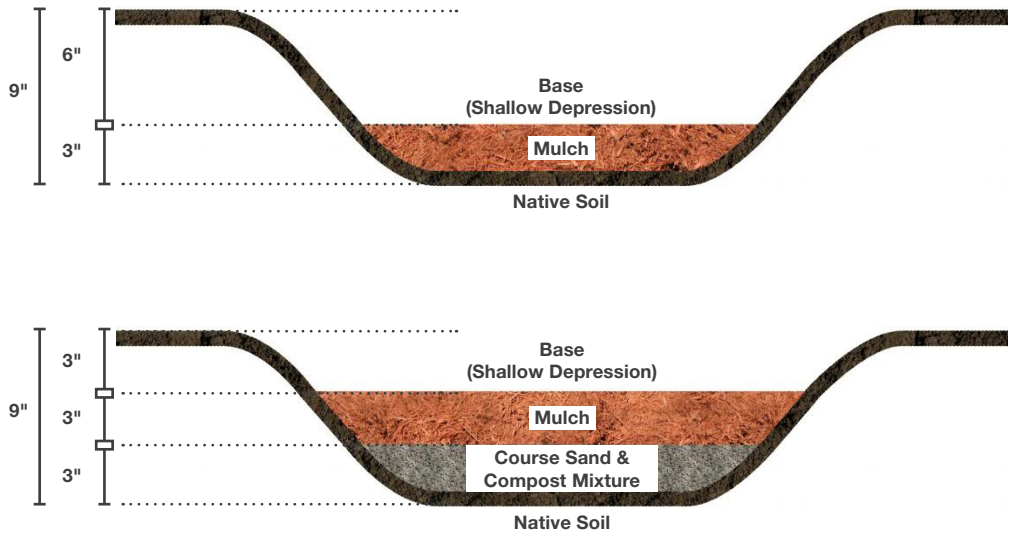
POSSIBLE RAIN GARDEN SHAPES

Is your area 100 square feet? You can do a 10-foot by 10-foot rain garden or a 5-foot by 20-foot rain garden.

Is it 50 square feet? Consider a 5-foot by 10-foot or a 7-foot by 7-foot rain garden.

Example: *At West Forest, we planned a 394-square-foot rain garden. The square root of 394 is 19.84, so we could design a roughly 20-foot by 20-foot rain garden or a 14-foot by 28-foot rain garden to meet our needs.*

Rain gardens should be a minimum of 5 feet wide to accommodate gentle side slopes that will host plants and minimize soil erosion. The design of your rain garden should work with topography to move water across more vegetation. Make the long sides lay across the slope and have the narrow ends run up and down the slope.



Figures 22 and 23. Both rain gardens were excavated to a 9-inch depth, but they have different final ponding depths due to the mulch and soil amendments added.

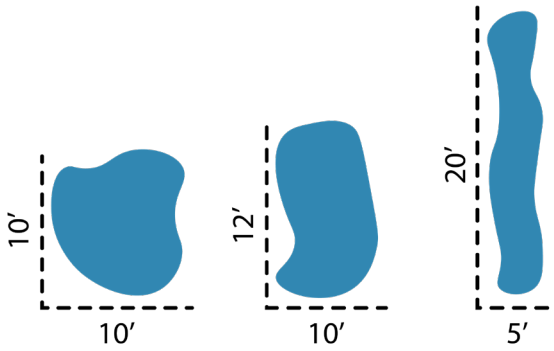


Figure 24. Rain gardens can be arranged in different shapes while still treating roughly the same amount of stormwater runoff.

Supply List

- Backhoe, shovels, rakes, tiller, soil tamper
- Wheelbarrow, stakes, string, tarps, spray paint, clean bucket
- Sight level, level, line level, ruler
- Mulch, soil test kit, soil amendments
- Volunteers, snacks, water

MY RAIN GARDEN SIZE WORKSHEET

Walk through the following steps to calculate the size of your rain garden.

1. Calculate total rooftop area.

   ____ ft. × ____ ft. = _____**ft.² rooftop**

2. Calculate rooftop area that will actually run off to rain garden.

   You can calculate rooftop area in two ways: (1) use Google Earth's measuring tool to outline and automatically calculate the square footage of the area of rooftop that drains to your proposed site, or (2) use the following equation to calculate the percentage of total rooftop that runs to the rain garden:

   Rooftop total × percentage of rooftop that runs off to rain garden

   (This doesn't have to be an exact percentage, but try to make it close.)

   _____ ft.² (roof area) × _____ (percentage) = _____ **ft.² rooftop to be treated**

   Note: To calculate percent on a calculator, move the decimal two places to the left and multiply (example: to calculate 25 percent or a number, multiply that number by .25).

3. Add any additional impervious area in square feet.

   Example:

   _____ ft.² (rooftop area) + _____ ft.² (parking lot area to be treated)

   = _____ **ft.² total impervious area to be treated**

4. Set ponding depth to either 3 or 6 inches (remember the 10/20 rule).

   _____ ft.2 rooftop to be treated ÷ _____ (divide by 10 for 3 inches of depth or 20 for 6 inches of depth) = _____ ft.² total rain garden area

   At 3 inches, ponding depth = _____ ft.² total rain garden area (round up or down)

   At 6 inches, ponding depth = _____ ft.² total rain garden area (round up or down)

   Add additional inches to ponding depth if you are adding mulch.

   If you are going to add mulch to your rain garden, your ponding depth needs to be in addition to that mulch. For example, if ponding depth is 6 inches but you want to add 3 inches of mulch, dig down 9 inches.

5. Now that you have the total area of your rain garden, set the length times width dimensions of your design.

Note: An easy way to get started is to take the square root of your total rain garden area, which will give you the length times width as a square. From there, you can easily adapt your design to fit other shapes.

Length of my rain garden _____

Width of my rain garden _____

Draft drawing of rain garden shape

STEP 5: CONSTRUCT THE RAIN GARDEN

DEFINING RAIN GARDEN BOUNDARIES

The first step is to outline (with string or spray paint) the parameter of your rain garden. This is also a good time to make sure that any utilities outlined from your 811 call are visibly marked.

GETTING WATER TO THE RAIN GARDEN

Although your rain garden may be in a location near a downspout or downhill from a downspout, you may still need to do some work to make sure the water will be routed into your rain garden. Digging slight trenches or building artificial rock-lined swales can work.

MANAGING WATER OVERFLOW

Your rain garden should be able to manage the majority of the water falling on your impervious surface area, but it also needs an overflow plan for Alabama's extreme rain events. This may include a notch or a pipe in the berm at least 2 inches lower than the berm. Berms should be built to have at least 2 inches of height above the elevation of the outlet.

Figure 25. A clear visual outline helps volunteers identify where to dig. Note that utilities are also marked and flagged ahead of time.

Figure 26. Can water get in and out without problems? Notice the berm on the right side.

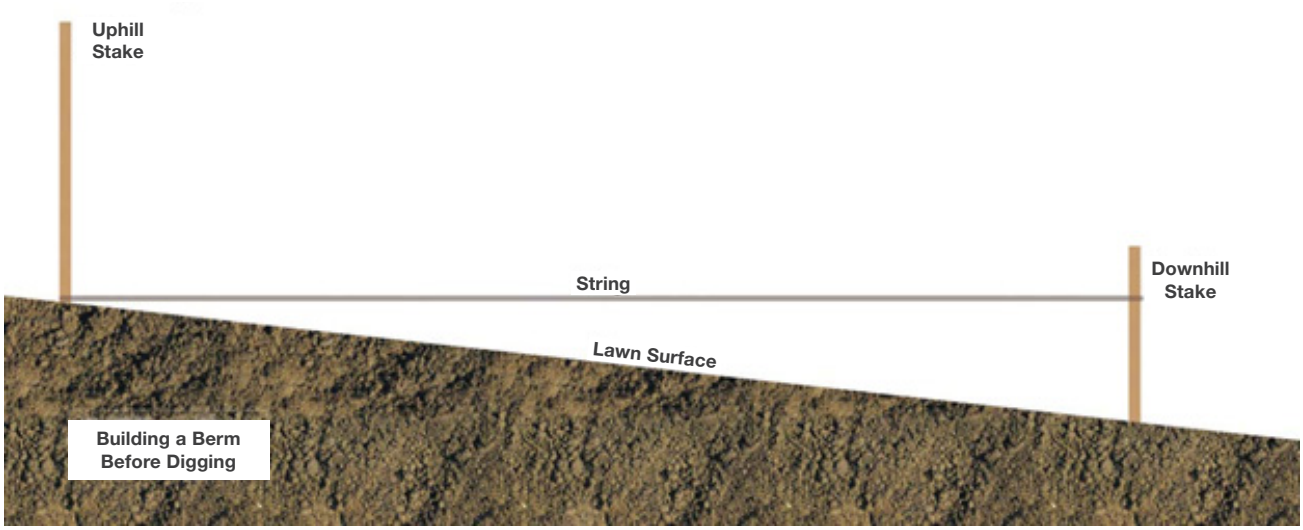


Figure 27. Before digging, tie a level rope to two stakes at the upper and lower ends of your rain garden.

Consider directing your overflow into the following:

- A flat area in your home landscape where water can be safely absorbed or directed to another rain garden
- A french drain or rock-filled soakage trench, a swale or drainage ditch, a storm drain, a street gutter, or pipes and catch basin that return stormwater to its original destination before the rain garden was built

Note: If you live in an urban area, first check with your local planning department to see if a permit is required for draining the overflow off-site.

EXCAVATING, GRADING, AND BERMS

Before excavating, create a level depressional area in your rain garden. Ideally, the rain garden will be level from side to side and end to end so the water infiltrates uniformly across the bottom of the rain garden. But if you have a slight center depression, that is okay too.

When excavating, set aside the topsoil (or top 4 to 6 inches of soil) for incorporation with other soils and soil-quality amendments. Excess soil excavated from deeper areas can be used to create a berm around the final receiving end of the rain garden. Try to minimize compaction of soils in the rain garden during the digging process.

Once the rain garden is excavated to the desired depth, work the sides of the bowl to create a gentle slope that connects the rain garden to the existing grade or ground level of the landscape.

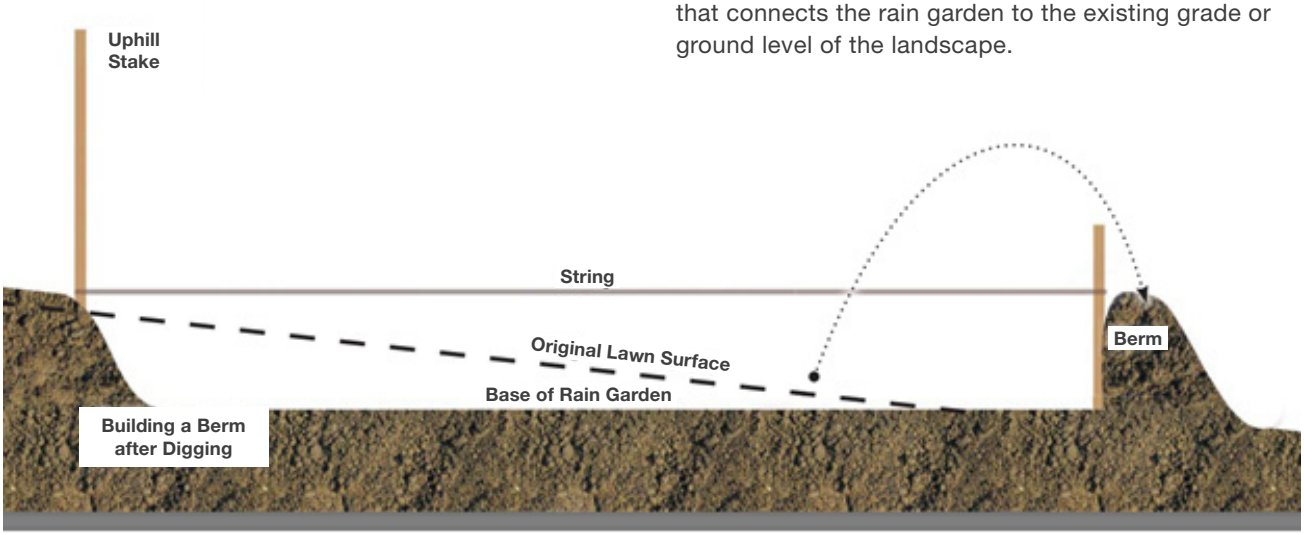


Figure 28. After digging, use a measuring stick to measure how far down you have dug and try to keep your ground level. Use additional soil for berm construction.

SOIL PREPARATION

Soil-quality amendments. Soil amendments may be necessary to improve the soil's infiltration and plant nutrient supply. Lime or fertilizer may be recommended in soil test results. Finished compost (compost that has completely transformed into a dark-colored and earthy-smelling material) can enrich the soil, increase water retention, suppress plant diseases, and reduce the need for chemical fertilizer. Avoid using unfinished compost or chicken litter.

For every 100 square feet of a rain garden, a cubic yard or a 3-inch layer of soil texture amendments is recommended. Infiltration rates of 1.5 inches per hour or greater do not require any soil amendments to improve infiltration.

> Compost can be spread before planting time in the spring or under mulch in the fall. You can buy bagged compost or make your own in your backyard. For more information on how to compost, read the "Alabama Smart Yards Handbook" or articles on composting from Alabama Extension.

Backfill. Use a rake, shovel, or rototiller to break up the topsoil that was set aside. This topsoil is mixed with soil amendments (if necessary) and placed back in the rain garden. Begin by mixing in 1 inch of soil amendments with topsoil to create a mix that is about 50/50 topsoil and amendments.

If topsoil is of poor quality on-site, reduce the amount of topsoil added to the amendments for rain garden backfill. Work this soil mixture back into the existing soil in the rain garden until approximately 2 to 3 inches have been added. At this point, the empty space should be equal to the desired ponding depth plus a mulch depth of 3 inches.

Mulch. A general rule is to add 0.5 cubic yards of mulch for every 50 square feet of rain garden. Small, tender perennial plants can be protected during mulch placement by placing containers over plants to ensure that the mulch layer does not unintentionally cover plants. Mulches will wash and float, but standard single- or double-shredded hardwood mulch that is well-aged is less likely to wash out easily.

Inlet. To prevent erosion at the inlet, a 1-foot-wide strip of gravel, rock, or concrete splash pad can be added to slow down and evenly disperse the flow of water into the rain garden. This is especially helpful when there are no gutters or a gutter extension cannot be incorporated. More rocks can always be added later if erosion occurs.

Berm. The berm is placed on the downhill side of the rain garden where the overflow exits. It should be mounded as high as the uphill grade of the rain garden. Native grasses or turfgrass sod can be grown (or repurposed) on the berm to provide cover and stabilize berm soil. A berm is not usually necessary when a rain garden is installed on a level landscape.

Overflow. A low spot or notch (weir) about a foot wide can be created on the berm to minimize erosion. The weir should be filled with 3 to 6 inches of stone, and landscape fabric can be used to deter weed growth in the overflow. Be sure that the weir directs water leaving the rain garden to a vegetated overflow area away from any structures.

STEP 6: CHOOSE THE RIGHT TIME, RIGHT PLANT, RIGHT PLACE

Plants play an important role in rain garden function:

- Provide wildlife habitat and seasonal aesthetic appeal
- Take up nutrients and some heavy metals present in stormwater runoff
- Stabilize soil and enhance infiltration rates

Know Your Plant Hardiness Zone

- When selecting plants, be aware of your area's hardiness zone so you know what temperatures your garden will need to tolerate as well as what time of year is best for planting. Alabama is located in Zones 7b to 8b in the Southeast region of the map.

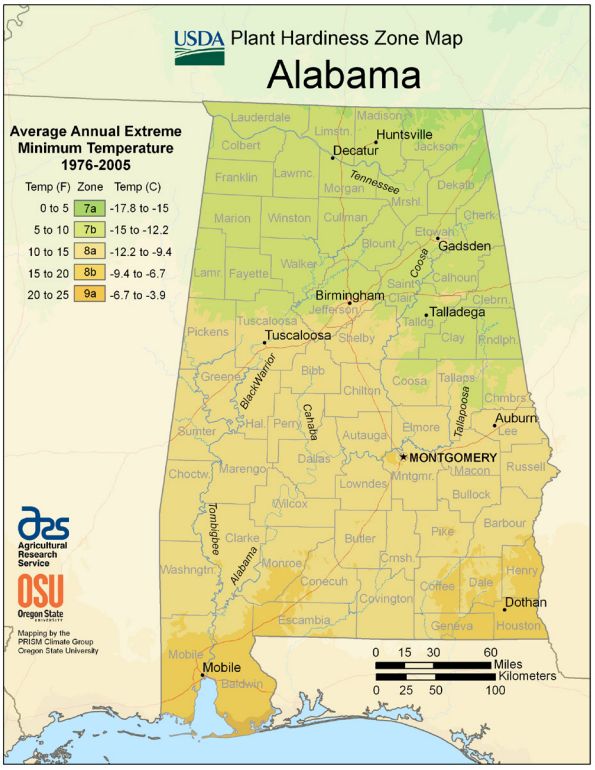


Figure 29. USDA Alabama plant hardiness zones

Figure 30. Plant rain gardens according to wetness zones.

PLANTING BY WETNESS ZONES

Plants used in rain gardens must be able to tolerate both wet and dry conditions. Plants more suited for wet conditions should be placed in the center of the rain garden, or wherever the garden holds water the longest. Plants that prefer drier conditions should be placed on the slope of the rain garden.

Water zone. This is the deepest part of the rain garden and will stay wet the longest, while the edges will be drier. Plants that are suited for substantial runoff for long periods belong here.

Bottom zone. This area experiences frequent pooling and is the coolest area of the garden (cool night air tends to circulate in this low spot). This zone supports plant species that can tolerate frequent pooling water.

Sloped zone. These are the sloped sides of the rain garden. This zone is intermittently wet from runoff but does not collect water for a long time. Plants here should be suited to occasional saturation and be resistant to drought.

Edge zone. This includes the outer edges and surrounding area. Wetness depends on site conditions. This is the driest and warmest area of the garden. It is beneficial to plant ground cover to prevent erosion.

> In your rain garden, avoid planting trees (they typically take up root space and can shade out other plants), plants with aggressive root systems, and plants that cannot tolerate having "wet feet" (they are susceptible to root rot).

CREATING A PLANTING PLAN

Creating a rain garden planting design makes installation much easier by helping you determine how many plants to buy and where to place specific plants.

When creating a plan, consider the following details:

- **Water tolerance.** Which plants will grow best in different zones of the rain garden?
- **Aesthetics.** Consider how your rain garden will look from different views. By using plants in scale with the garden size, you can place taller plants in the middle of the garden and help maintain well-defined edges by using attractive plant groupings and sedges or stones around the outside of the garden.
- **Plant growth.** Plan to plant according to how large the plants will be at full maturity. They may look small and widely spaced when you first plant, but they will need room to grow into full maturity.
- **Seasonal interest.** Include plants that bloom at various times of the year. Consider including species that are evergreen or have showy fall color.

For information on suggested plants to use in your rain garden, see table 3.

General Planting Guide

- Measure distance from the center of plants.
- Space 1 foot apart for perennials.
- Space 2 to 3 feet apart for most grasses.
- Space 3 to 5 feet apart for most small to medium shrubs.
- Space 6 to 8 feet apart for larger shrubs.
- Space trees based on their mature size.

  Note: read plant label for spacing.

DETERMINING HOW MANY PLANTS YOU NEED

Creating a landscape drawing is best, but an equation can also be used to calculate plant quantity based on the selected spacing pattern.

quantity = area (ft.^{2}) ÷ square feet needed per plant

Example: for a 100-square-foot rain garden planted with herbaceous perennials on 2-foot spacing in a rectangular spacing pattern, how many plants would be needed?

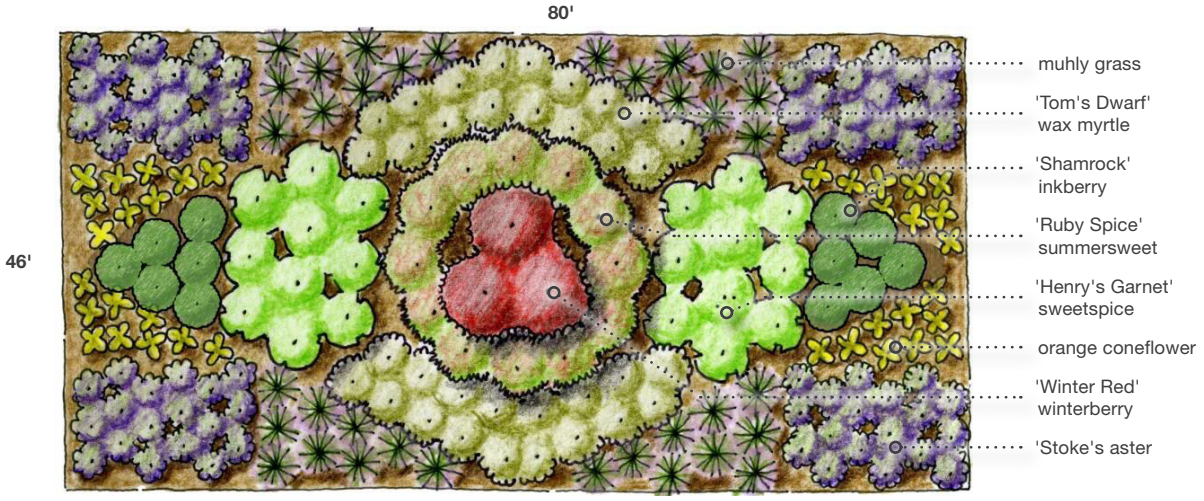


Figure 31. Example of a symmetrical planting plan; best for locations seen from above or an aerial view.

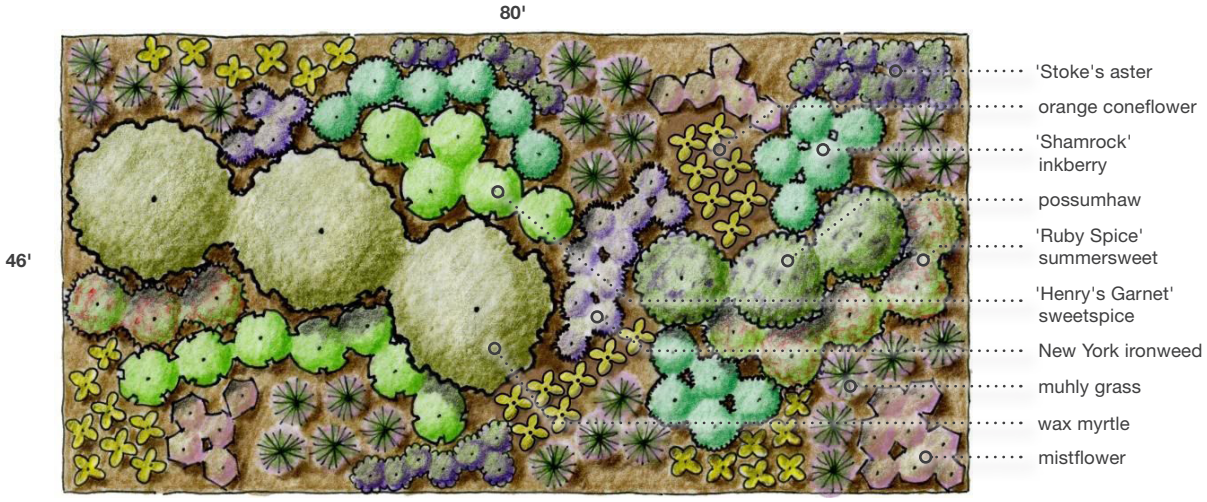


Figure 32. Example of a more natural planting plan, with plants grouped for color and arranged by height so that most plants and their colors are visible.

Figure 33. Stokes' aster (*Stokesia laevis*); native, herbaceous perennial evergreen with bright purple flowers, 1 to 2 feet tall. (Photo credit: "Stokes' aster NC Botantical Garden Chapel Hill 3361" by bobistraveling licensed under CC BY 2.0)

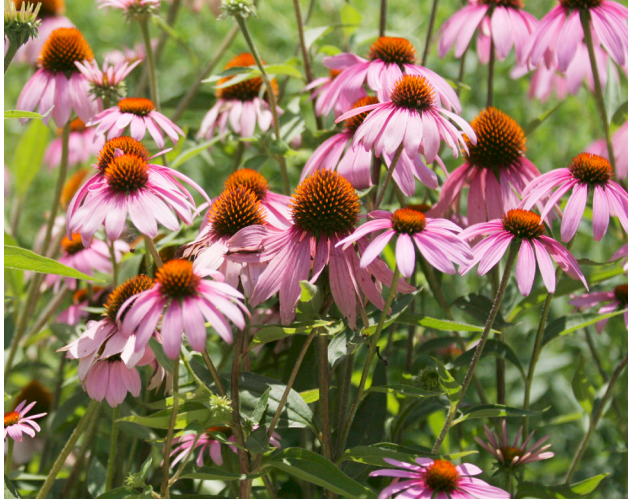


Figure 34. Purple coneflower (*Echinacea purpurea*); herbaceous perennial, 3 to 4 feet tall with pink-purple flowers that mature in early summer through mid-fall; pollinator attractor

Spacing Equation

$ft.^2/plant = (X)(X) = X^2$

$ft.^2/plant = (2)(2) = 4$

$$\text{Quantity} = \frac{100\ ft.^2}{4\ ft.^2/plant} = 25\ plants$$

Triangular Spacing Equation

$ft.^2/plant = YX = [X \times 0.866(X)]$

$ft.^2/plant = [2 \times 0.866(2)] = 3.4$

$$\text{Quantity} = \frac{100\ ft.^2}{3.4\ ft.^2/plant} = 29\ plants$$

AVOID PLANTING INVASIVE SPECIES

Invasive species are plants that are alien to the ecosystem and whose introduction is likely to cause environmental harm without providing an equal or greater benefit. Plants that are native to your region are the best options for sustaining your naturally occurring ecosystem. Sometimes invasive plants are sold at big box stores, so do your homework before you buy.

Harm Inflicted by Invasive Species

- Inhibit the growth of surrounding plants
- Are unable to support native wildlife at critical life stages
- Use excessive resources
- Clog waterways
- Decrease soil stability

Signs of an Invasive Species

- High rate of reproduction
- High dispersal rate
- Thrive on disturbed soil
- Aggressive root systems
- Produce growth-inhibiting chemicals

Figure 35. Sweet pepperbush (*Clethra alnifolia*); native, 4 to 6 feet tall and wide; cultivars: 'Hummingbird', 'Sixteen Candles' dwarf white 3 × 6 feet, or 'Ruby Spice' upright pink 8 × 5 feet; very fragrant. (Photo credit: "Clethra alnifolia (coastal sweet pepperbush), Charlestown, RI" by Doug McGrady licensed under CC BY 2.0)

Figure 36. Buttonbush (*Cephalanthus occidentalis*); native, 6 × 6 feet, standard wetland; cut back to 1 foot each year in March or it will grow to be 12 feet; white flowers in summer, late to leaf in spring. (Photo credit: Gabriel Hurley licensed under CC BY-SA 3.0)

Figure 37. Muhly grass (*Muhlenbergia capillaris*); common native favorite in rain garden designs; 4 feet tall in bloom, 3 × 3 foot mound; dry to average; semievergreen, best if cut back in winter.

MULCHING[1]

Mulch is a protective layer of a material that is spread on top of the soil. Mulches can be either organic (such as straw, bark chips, and similar materials) or inorganic (such as stones or brick chips). Organic mulches are much preferred, as they break down to return nutrients to the soil.

Benefits of Mulch

- Protects the soil from erosion and reduces compaction from the impact of heavy rains
- Conserves moisture, reducing the need for frequent watering
- Maintains a more even soil temperature
- Prevents weed growth and provides a finished look to the garden

Figure 38. Winterberry holly (*Ilex verticillata*); gives rain gardens a pop of color in the winter; native, standard and wetland, 6 to 8 feet tall and wide; compact cultivars: 'Berry Poppins', 'Red Sprite'; must plant a male pollinator ('Mr. Poppins', 'Jim Dandy')

Figure 39. Spicebush (*Lindera benzoin*); native, 4 to 6 feet tall and wide; small yellow flowers in early spring, red berries in fall on female plants; standard wetland. (Photo credit: Dan Keck)

Alabama Invasive Species to Avoid Planting

- nandina domestica (sacred bamboo)
- autumn olive
- bamboo
- English ivy
- Chinese privet
- cogon grass
- Japanese climbing fern
- Japanese privet
- kudzu
- silk tree mimosa
- tallow tree
- tropical soda apple
- wisteria

Figure 40. Inkberry (*Ilex glabra*); native, 4 to 5 feet × 3 to 4 feet evergreen bush; quick draining; 'Shamrock' cultivar is small and nice for borders. (Photo credit: David Stang licensed under CC BY-SA 4.0)

MULCH MATERIALS AND APPLICATION

General Guidelines

- Avoid using small-sized mulches because they tend to float away. Cypress mulch is not recommended as it is harvested from cypress wetlands and not sustainable.
- Use mulch that is aged at least 6 months so that it does not rob nitrogen from establishing plants.
- Remember that application time depends on what you hope to achieve by mulching. A mulched soil in the summer will be cooler than an adjacent unmulched soil; in the winter, the mulched soil may not freeze as deeply.
- When applying mulch, leave an inch of space around the plants to help prevent diseases that flourish in excessive humidity.
- Remove weeds before spreading mulch.

Figure 41. Blue flag iris (*Iris virginica*); native, 2 to 3 feet tall; standard or wetland. Note: Do not plant yellow flag iris; it's not a native plant and is potentially invasive. (Photo credit: Rusty Clark licensed under CC BY 2.0)

Figure 42. Swamp milkweed (*Asclepias incarnata*); native, 3 to 4 feet tall and wide; flowers in spring and early summer with pink or white flowers; full sun to partial shade, standard and wetland; attracts many pollinators. (Photo credit: U S Forestry and Wildlife Service Midwest Region)

WATERING A RAIN GARDEN

Water the garden during initial planting and extended dry periods. Otherwise, the water from frequent rainfall should be sufficient to maintain plant life.

STEP 7: MAINTAIN YOUR RAIN GARDEN

ROUTINE WEEDING, PRUNING, AND MULCHING

Sediment and debris removal. Periodically, remove sediment and other debris that build up in your rain garden.

Mulch replacement. Mulch should be maintained at a 3-inch depth, and bare areas should be replaced as needed. Full mulch removal and replacement should occur every 2 to 3 years or when mulch has become matted and prevents adequate infiltration of stormwater.

Pruning. Shrubs will benefit from annual pruning to encourage bud break and help maintain plant shape and form.

AVOID OVERWATERING

Drought-tolerant plants need to establish deep roots during the first few years to withstand dry conditions. Overwatering might discourage this crucial development. When consistent heavy rain events occur, you may experience flooding or extended periods of standing water in your garden. If this happens frequently, you may want to consider expanding your garden or amending your soil (especially heavy clay soils characteristic of Alabama).

- Rain gardens don't have to be the only design in your landscape that helps capture, filter, and infiltrate stormwater. You can make many small changes in your home landscape to make a difference (figure 43). Read more about those options in the *Low Impact Design Handbook for Alabama* or in the *Alabama Watershed Stewards Handbook.*

Figure 43. Example of the multiple practices that could be installed around your home to improve water quality: (1) rain garden site, (2) rain barrel, (3) permeable pavement, and (4) more trees and vegetation.

Table 3. Rain Garden Plants				
Botanical Name	**Common Name**	**Type**	**Soil Comments**	**Prefers**
Acorus calamus	sweetflag	herbaceous grass	acidic, wet	sun to part shade (2, 3)
Asceplias incarnata*	swamp milkweed	herbaceous perennial	any	sun or part shade (3)
Amsonia tabernaemontana	Eastern bluestar	herbaceous perennial	sandy	part shade (3)
Baptisia alba	white wild indigo	herbaceous perennial	sandy to rocky, tolerates clay	sun (1, 2)
Carex crinita	fringed sedge	grasslike	any	part shade to shade (2, 3)
Carex comosa	bottlebrush sedge	grasslike	any	part shade (3)
Carex lurida	lurid sedge	grasslike	any	part shade (3)
Carex tribuloides	bristlebract sedge	grasslike	any	part shade (2, 3)
Chasmanthium latifolium	river oats	herbaceous perennial	any	part shade (2)
Conoclinium coelestinum*	blue mistflower	herbaceous perennial	any	sun to part shade (2)
Clethra alnifolia*	summersweet	shrub	any	sun or part shade (2, 3)
Coreopsis auriculata*	lobed tickseed	herbaceous perennial	rich, acidic	part shade (2)
Coreopsis lanceolata*	tickseed	herbaceous perennial	any	sun (1, 2)
Coreopsis nudata	Georgia tickseed	herbaceous perennial	rich, acidic	part shade (2, 3)
Echinacea purpurea*	coneflower	herbaceous perennial	sandy	sun to part shade (1, 2)
Eupatoriadelphus fistulosus*	Joe Pye weed	herbaceous perennial	acidic, moist, or wet	sun (2, 3)
Helianthus angustifolius	swamp sunflower	herbaceous perennial	any	sun to part shade (2, 3)
Helianthus angustifolius	scarlet rose mallow	herbaceous perennial	any, wet	sun (3)
Hibiscus moscheutos*	crimson eye rose mallow	herbaceous perennial	moist, alkaline	sun to part shade (2, 3)
Ilex glabra	inkberry	shrub	sandy, acidic, peaty	sun or part shade (1, 2)
Ilex verticillata*	winterberry	small tree	any, acidic	sun or part shade (1, 2)
Itea virginica	sweetspire	shrub	any, acidic	sun or part shade (1, 2, 3)
Juncus effusus	common rush	grasslike	any wet	sun or part shade (2, 3)
Lobelia cardinalis*	cardinal flower	herbaceous perennial	any, will tolerate limestone based soils	sun to part shade (2, 3)

Table 3. Rain Garden Plants (cont.)

Botanical Name	Common Name	Type	Soil Comments	Prefers
Muhlenbergia capillaris	muhly grass	herbaceous grass	sandy or sandy loam	sun or part shade (2, 3)
Phlox carolina*	Carolina phlox	herbaceous perennial	sandy, loam, acid, will tolerate some lime	sun to part shade (2)
Phlox divaricata*	blue woodland phlox	herbaceous perennial	any	part shade (2)
Physostegia virginiana*	obedient plant	herbaceous perennial	humus-rich soils	sun to shade (1, 2, 3)
Pontederia cordata	pickerelweed	herbaceous perennial	any	sun to part shade (3)
Rudbeckia fulgida	orange coneflower	herbaceous perennial	sandy	sun or part shade (1, 2)
Sisyrinchium angustifolium	blue-eyed grass	grass	poor to average moist soils	sun to part shade (2, 3)
Stokesia laevis*	Stoke's aster	herbaceous perennial	well-drained acid sand preferred	sun or part shade (1, 2)
Vernonia noveboracensis*	Ironweed	herbaceous perennial	tolerates clay and acidic soils	sun (1, 2)
Viburnum nudum	possomhaw	shrub	prefers acid mucky soils but is adaptable	adaptable (1, 2, 3)

* Attracts butterflies, hummingbirds, or both

1. Prefers dry conditions and can tolerate drought; to be used on buffer, slope, or berm of a standard rain garden and wet rain gardens with zoned topography.
2. Prefers moderate or moist conditions and can tolerate occasional inundation. Plants labeled 2 are appropriate for the center of standard rain garden designs or wet rain gardens with zoned typography.
3. Prefers wet conditions and are appropriate for wet rain gardens and deep pools of wet rain gardens zoned typography.

Sun: At least 6 hours of full sun per day

Part Shade: 3 to 5 hours without direct sunlight per day.

Shade: 0 less than 2 hours of direct sunlight per day.

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