






**A PROGRAM
OF
NORTH CAROLINA COOPERATIVE EXTENSION**



Table of Contents

-  **Common Rain Garden Questions Answered**
-  **Quick Steps to Building a Rain Garden**
-  **Further Information**

Program Team

Bill Hunt, N.C. Cooperative Extension Specialist for NCSU Biological and Agricultural Engineering Dept.

Bill Lord, N.C. Cooperative Extension Area Agent, Franklin County Center

Mitch Woodward, N.C. Cooperative Extension Area Agent, Wake County Center

Phyllis Baker Smith, Natural Resources Agent, N.C. Cooperative Extension, Forsyth County Center



Like us on Facebook

www.facebook.com/NcStateStormwaterExtension



Follow us on Twitter

[@NCSUStormwater](https://twitter.com/NCSUStormwater)

Manual by Wendi Hartup

Common Rain Garden Questions Answered

What is a rain garden? A garden shaped into a bowl-like depression in the ground to capture rainfall runoff from your rooftop and driveway and allow water to filter into the ground. The plants, mulch and soil in a rain garden combine natural processes to filter pollutants from runoff and break down in the soil over time.

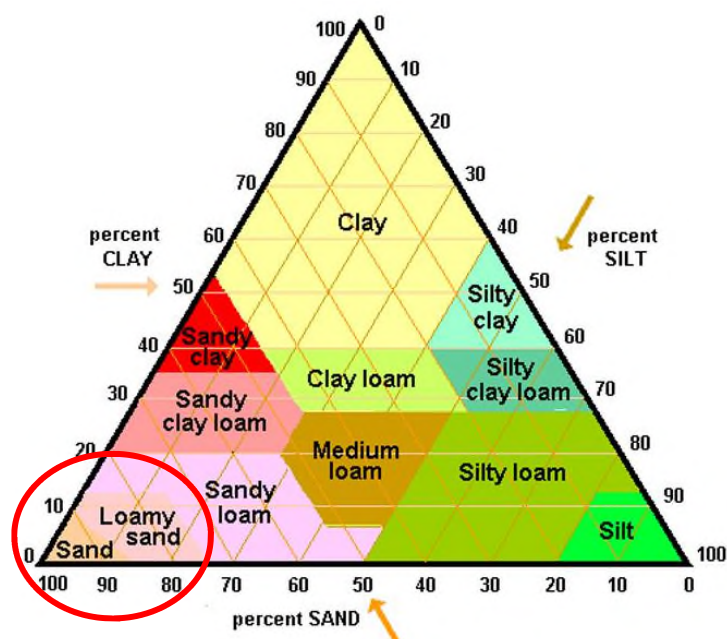


Why do we need rain gardens? Many of our forests and other vegetated areas are developed into impervious surfaces like parking lots, roads and buildings. As plants are replaced with hard, compacted surfaces, the rainwater is unable to disperse energy and gradually soak into the ground. Instead this stormwater races across pavement picking up pollutants and sediment as it moves along curbs and ditches to storm drains; which empty directly into local waterbodies.

What are the benefits of rain gardens?

- ♻️ Easy to design, install and maintain
- ♻️ Come in all shapes and color schemes
- ♻️ Provide aesthetic appeal while blending into landscape
- ♻️ Provide habitat for wildlife, butterflies and beneficial insects
- ♻️ Absorb nutrients and some heavy metals
- ♻️ Enhance infiltration, stabilize soil and minimize runoff to storm drains

What type of soil conditions are needed for a rain garden? Rain gardens are essentially a water infiltration device. Ideally the soil conditions for rain gardens should have high percentages of sand with some loam and/or clay content to support plant growth and encourage infiltration (see red circle in diagram below).



Soil Texture Diagram

Rather than trying to change your soil conditions, consider working with how your soil drains and picking plants appropriate for that soil type.

Will this work without plants or just grass? Yes, just aerating the soil reduces soil compaction but do be sure to cover with some type of mulch. It will also work with just grass but you will need to mow it at 4 inches or at the highest setting. Using plants helps the rainwater to travel more efficiently through the soil to recharge groundwater. Native perennial root systems can extend 2 feet or more if the conditions are right! Turf root systems usually only grow 4-6 inches deep.

What types of plants are suitable for a rain garden?

- ♻️ Tolerate periods of saturated soil, yet also thrive under dry conditions
- ♻️ Most natives
- ♻️ Sustainable and low maintenance

What types of plants are NOT suitable for a rain garden?

- ♻️ Trees (growth changes sun conditions and alters spacing available for other plants)
- ♻️ Heavy feeders (ex. Crape Myrtle)
- ♻️ Plants that do not like “wet feet” (ex. Asian Azalea cultivars)
- ♻️ Plants susceptible to root rot (ex. Flowering Dogwood)
- ♻️ Plants with aggressive root systems (ex. Willows)

Does a rain garden form a pond? No. Rain gardens are designed to allow a typical one-inch rainfall to soak into the ground within three days (Note: a wetland garden would allow water to pool longer than 3 days).

Will there be standing water? Yes, after a rain there will be water in your garden. It may even look flooded. THIS IS OKAY! There may be 6”-9” of standing water for up to three days. This ponding will allow for the stormwater to slowly infiltrate into the ground.

Are they a breeding ground for mosquitoes? Not if they are draining properly. Most mosquitoes need about a week to complete their entire lifecycle. Mosquitoes are more likely to lay eggs in bird baths, storm drains, corrugated pipe attached to downspouts and lawns than in a sunny rain garden. Also rain gardens attract dragonflies, which eat mosquitoes!

Will I have to water the rain garden? After planting, yes! First season, yes! In droughts, yes! In rain, no!

Is a rain garden expensive? It doesn't have to be. The main cost will be purchasing the plants (often these are already in the landscape or swap plants with your neighbor) and mulch.



Sandy Ridge Community Center Rain Garden



Apex, NC Town Hall Rain Garden









Quick Steps to Building a Rain Garden



STEP 1: LOCATE THE RAIN GARDEN

Observe your yard during a rainfall event. Determine where water begins flowing and where it is going. Rain gardens should ideally be located between the source of runoff (roofs and driveways) and the runoff destination (drains, streams, low spots, etc.). Be sure to consider the following:

-  **IMPORTANT: Do not place rain garden uphill of homes, septic systems or wellheads!**
-  Locate at least 10' away and downslope of the house foundation, if crawlspace or basement (if home is on a slab locate downslope of foundation).
-  Locate 25' away and downslope of a septic system drain field.
-  Locate 10' away and downslope of a well head.
-  Avoid underground utility lines **BEFORE** you dig (Call 1-800-632-4949 or 811 in NC).
-  The best location for the garden will be in partial to full sun (at least 4 hrs of sunlight).

STEP 2: DETERMINE DRAINAGE OF SOILS




Rain gardens work best when constructed in well-drained soils, but they can also be installed on sites with less permeable soils with more clay content. Determining how the soil drains will help determine the type of plants most likely to succeed in the rain garden.

Pick a few places and dig a one-ft-deep hole for the preliminary infiltration test; then fill with water a few times. Time how long it takes for the test pit to drain. If satisfied with drainage time, dig 2-3 more one-ft-deep holes in that area to get an average drain time. **CAUTION:** In floodplain areas or East of I-95, dig two-ft-deep holes where high water tables are probable (highest in winter). The table below summarizes what type of practice to use based on drain time.

Drain Time	Appropriate Rain Garden Type
< 12 hours	Quick Draining Rain Garden
12 - 72 hours	Standard Rain Garden
> 3 days	Wetland Garden



Signs of an impermeable, compacted and/or wetland soil.

-  The site ponds water or remains saturated for over four days after a storm event.
-  Water poured in the dug hole is still there after four days, provided it hasn't rained.
-  The soil shows signs of being a wetland soil within a foot of the surface. A wetland soil is often gray with ribbons or areas of brown color. It can also smell like rotten eggs.

Conduct drainage test at least twice at each hole! Also a good time to collect soil for testing to determine proper lime application.

STEP 3: SIZE THE RAIN GARDEN

Determine which impermeable surfaces (roof top and driveway) will be treated with the rain garden. Measure the length and width of these surfaces and multiply together to get the surface area in square feet. This will be your watershed size.

The size of the rain garden should be at least 10% of the impervious surface draining to the rain garden. Rain gardens should be designed to pond 10 inches of rainwater on top of the mulch. Rain gardens that are 10% of the watershed and have a 10" ponding depth should capture the majority of one-inch storms.

(Length of surface x Width of surface) x .10 = total rain garden area sq. ft.

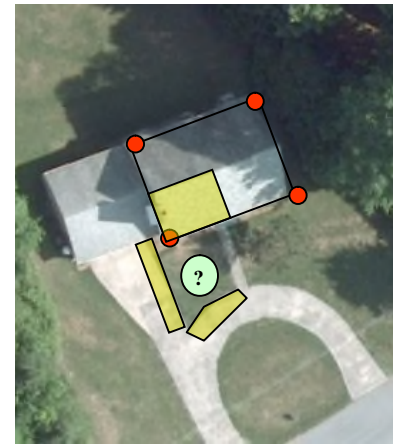
EXAMPLE: A portion of a 60' by 60' house (4 downspouts total) and 500 sq ft of driveway runs off to the rain garden location. The rain garden will capture 1 inch of rainfall, what size should the rain garden be?

$$\text{Roof area} = \frac{60 \times 60}{4} = 900\text{ft}^2$$

Roof area plus driveway: $900 + 500 = 1400$ sq ft

Divide square footage by 10: $1400/10 = 140$ sq ft

A 11'X12' or 14'X10' garden design would be sufficient.



The size of your rain garden can also depend on the space available and your budget. 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.

STEP 4: CONSTRUCT THE RAIN GARDEN

Consider how rainwater gets to your rain garden. Will the water sheet flow across the landscape from the downspout? Will the water be piped underground to daylight into the rain garden?

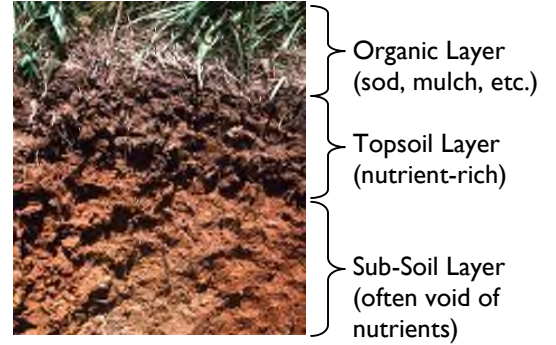
Lay out the boundary of the garden to keep a shape. You can use a rope, spray paint or even flags to outline your shape. Keep in mind how you determined the infiltration time period in Step 2.

NOTE: Always determine where utility lines are located BEFORE you start to dig. CALL 811!

Helpful Tools

- | | |
|---------------------------|----------------------------|
| ♻️ Auger | ♻️ Tamper |
| ♻️ Tape Measure | ♻️ Wheelbarrow |
| ♻️ Shovels and/or Backhoe | ♻️ Line Level and/or Ruler |
| ♻️ Rakes | ♻️ Stakes and String |
| ♻️ Pitchforks | ♻️ Tarp |
| ♻️ Trowels | ♻️ Extra Labor |

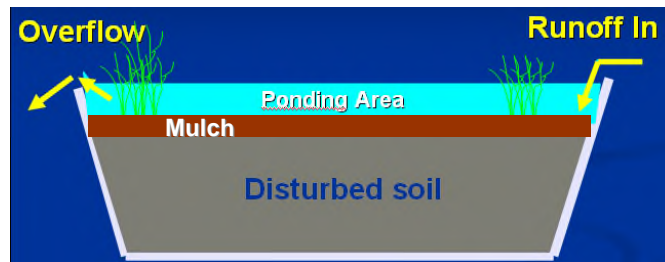
- ♻️ If present, remove and save sod for berm and weir
- ♻️ Remove any topsoil and set aside.
- ♻️ Dig to account for 10" ponding depth.
- ♻️ Dig to account for 3" of mulch.
- ♻️ Rough up 4"-6" of the bottom so it is not compacted and mix in topsoil you removed earlier. This will not only improve drainage but help plants survive. This is a good time to apply lime if you took a soil test.



NOTE: Contact your County's Cooperative Extension office for soil sampling boxes or visit <http://www.ncagr.gov/agronomi/sthome.htm/>

Forming the Berm and Overflow Weir

Your rain garden is designed to capture the first inch of rainfall. Rainfalls larger than 1" will cause the rain garden to overflow. Rain gardens should have distinct entrances and exits to prevent erosion.



Rain Garden Entrance

Establish a 1'-2' grass strip, rock border or combination along the upper edge of the rain garden to slow down the runoff water as it enters the rain garden. If piping downspouts to rain garden, make sure the pipe opens up into the rain garden and is not buried.



Rain Garden Exit

You will have lots of soil available from digging. Place extra soil on the downhill side of the rain garden to create a berm, an earthen dam or barrier that holds water inside. Most rain gardens have berms about 3” - 6” tall. Compact the soil slightly with your feet or shovel as you build the berm. Cover with turf grass sod, mulch, plants, or rocks.

You will need to design a weir or nature will do that for you. A weir is an area of the berm that allows water to gently pass over it. Typically weirs are a one-foot wide section of the berm and several inches lower than the rest of the berm. To properly size the weir, use the amount of impervious surface area (see table below). Weirs can be covered with turf grass sod or rocks; additionally they can be made of wood. Make sure the weir is level and lower than the rest of the berm.

Weir Sizing Table

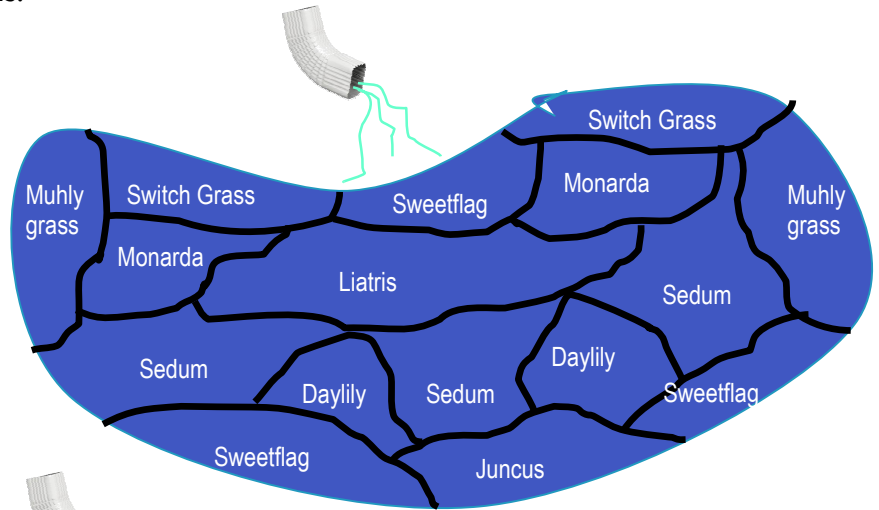
Impervious Surface Area (ft ²)	Overflow Weir Length (ft)
2000 or less	1.0
3000	1.5
4000	2.0
5000	2.5



Adding Plants

Pick your plants based on how your soil drains so you are working with nature instead of against it. Below are example rain garden plans.

Drains in <12 hrs

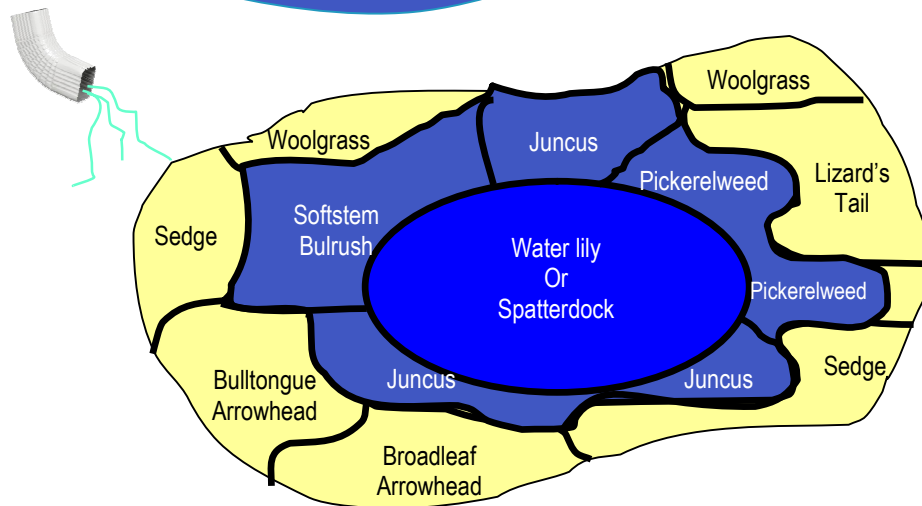


Drains in 12 hrs - 3 days



Drains in >3 days

- Deep Pool
- 1" - 6" Deep
- 1"-3" Deep



- ♻️ Add 3" double or triple shredded hardwood mulch.
- ♻️ Direct the downspout to the rain garden.

STEP 5: WATER AND WEED THE RAIN GARDEN

Make sure to water every 7-10 days without adequate rainfall (1" per week) until plants become established; usually takes the first year. Once established, plants should be watered in long periods of drought.

Fertilizers are typically not necessary.

Refresh mulch annually. Loosen existing mulch and add only if needed up to 3 inches of mulch. Best times to mulch are after 1st frost in fall or after last frost in spring, otherwise the plants could be insulated too soon. Un-mulched surfaces may develop into a hardpan, a condition in which the soil surface becomes cemented together, forming a hard, impervious layer. Make sure mulch is only 3-4 inches; too much mulch will reduce ponding and function of rain garden.

Weed regularly during plant establishment, as newly planted species may have a tough time competing with weeds. Once plants become established, less weeding will be required.

Pruning may be needed to let some of the other plants grow. In the winter, leave dormant plants standing and deadheads for bird food. Cut back in the spring.

Keep your garden healthy and clean. Rain gardens should be periodically cleared of dead vegetation and any debris that may collect. Replanting may be necessary over time. If a plant is not doing so well in one location of the garden, it may have to be moved to a wetter or dryer area.

Your garden may need a bit more maintenance than a lawn in the beginning, but in the long run it will be easier to care for and provide many added benefits!


Rain Garden Maintenance Tasks and Schedule	
TASK	SCHEDULE
Prevent Soil Erosion	Keep watch on out parcels and parking lot use
Trash removal	Weekly
Pruning	Annual
Mulch renewal	After 1st frost in fall or last frost in spring
Mulch removal	Every 3 years
Weeding and Plant replacement	As needed
Remove sediment	As needed or during mulch renewal
Perimeter Mowing	As needed, keep clippings out of rain garden

RESOURCES

Documents and websites consulted in the development of this document include:

Hunt, Bill. "How to Build Your Own Backyard Rain Garden." N.C. Cooperative Extension.
http://www.bae.ncsu.edu/topic/raingarden/Entire_handout.doc

NC State

 <http://www.bae.ncsu.edu/topic/raingarden/>

 <http://www.bae.ncsu.edu/stormwater>

 <http://plants.ces.ncsu.edu/>

National Wetland Plant List. US Army Corps of Engineers.
<http://rsgisias.crrel.usace.army.mil/NWPL/>

The Oregon Rain Garden Guide: A Step by Step Guide to Landscaping for Clean Water and Healthy Streams. Oregon State University.
<http://seagrant.oregonstate.edu/sgpubs/onlinepubs/h10001.pdf>

Rain Gardens: A How-to Manual for Homeowners. University of Wisconsin-Extension.
<http://clean-water.uwex.edu/pubs/pdf/home.rgmanual.pdf>

Rain Gardens: A Rain Garden Manual for South Carolina. Clemson University.
http://www.clemson.edu/public/carolinaclear/cc_toolbox/index.html

Ruth, Cliff. Plants for Constructed Wetlands and Rain Gardens.
<http://www.ces.ncsu.edu/copubs/env/water/018/RaingardenPlantsBrochure.pdf>

NATIVE PLANT SUPPLIERS

Many seed companies available online.

North Carolina Native Plant Society, <http://www.ncwildflower.org/natives/sources.htm>

FOR FURTHER ASSISTANCE, CONTACT YOUR LOCAL COOPERATIVE EXTENSION OFFICE

North Carolina, <http://www.ces.ncsu.edu/>

Nationally, <http://www.csrees.usda.gov/Extension/index.html>

Links to other internet locations may or may not have been provided in this article because they contain related information that may be of interest to the reader. The North Carolina Cooperative Extension does not necessarily endorse the views expressed or the facts presented on those sites. Further, N.C. Cooperative Extension does not endorse any commercial products that may be advertised or available on those sites.



NC State University and N.C. A&T State University are collectively committed to positive action to secure equal opportunity and prohibit discrimination and harassment regardless of age, color, disability, family and marital status, gender identity, genetic information, national origin, political beliefs, race, religion, sex (including pregnancy), sexual orientation and veteran status. NC State, N.C. A&T, U.S. Department of Agriculture, and local governments cooperating.”

Revised April 2018