

RAIN GARDEN

A rain garden is a sunken, flat-bottomed garden that uses soil and plants to capture, absorb, and treat stormwater. This helps to reduce stormwater runoff and recharge groundwater.



DESIGN CONSIDERATIONS

STEP 1. Site Constraints. Identify site constraints in the area that the rain garden will be located such as:

- High water table - rain gardens should not be placed in persistently wet areas or areas where puddles regularly form.
- Underground obstructions such as gas or electrical lines, other utilities, structures or bedrock. Contact DigSafe 72 hours in advance of your project.
- Property boundaries and local setbacks.

STEP 2. Setbacks. Be sure to locate the rain garden:

- At least 10 feet away from buildings with basements to prevent seepage into the basement.
- At least 15 feet away from septic tank or leach field.
- Away from tree roots and drinking water wells.

STEP 3. Infiltration test. Perform a simple perc test to determine the ability of the soil to infiltrate water. Rain gardens should only be built in areas where a simple perc test drains completely within 24 hours. To complete a simple perc test:

- a. Using a shovel or a post hole digger, dig a 1-foot deep hole.
- b. Fill the hole with water and allow it to drain completely. If the hole fills with water on its own or if water is still in the hole after 24 hours, choose a new location.
- c. Fill the hole with water a second time and place a ruler or yard stick in the hole. Note the water level and time. After 15 minutes, check the water level again and note the new water level. Multiply the change in water level by 4 to get

EQUIPMENT & MATERIALS

- ↳ Calculator
- ↳ Measuring tape
- ↳ Spray paint
- ↳ Yard stick
- ↳ 6-12 Stakes
- ↳ 2-4 long stakes (4')
- ↳ String
- ↳ Shovels
- ↳ Carpenter's level
- ↳ String level
- ↳ Rakes
- ↳ Compost/Woodchips
- ↳ Mulch
- ↳ Crushed stone
- ↳ Flat stones or pavers
- ↳ Tarp(s)
- ↳ Wheel Barrow(s)
- ↳ Plants

the number of inches of infiltration in an hour. A rate of $\frac{1}{2}$ " or more per hour indicates that it will drain within 24 hours.

SIZING

Use the following steps to determine the dimensions of the rain garden. Use Table 3 to organize the information.

STEP 1. Total drainage area. Identify the surface(s) that will drain to the rain garden. Multiply the length by the width to get the drainage area in square feet.

$$\text{DRAINAGE AREA LENGTH (ft)} \times \text{DRAINAGE AREA WIDTH (ft)} = \text{DRAINAGE AREA (ft}^2\text{)}$$

If more than one surface will contribute runoff to the rain garden, add them together. For example, if two roof areas are collected by a downspout that will drain to the rain garden, add the two roof areas together.

STEP 2. Soil type. The size of the rain garden is dependent on the soil type. Estimate your soil type by performing a ribbon test using the following steps:

- Grab a handful of moist soil and roll it into a ball in your hand.
- Place the ball of soil between your thumb and the side of your forefinger and gently push the soil forward with your thumb, squeezing it upwards to form a ribbon about 1/4 inch thick.
- Try to keep the ribbon uniform in thickness and width. Repeat the motion to lengthen the ribbon until it breaks under its own weight. Measure the ribbon and compare it to Table 1.

Table 1. Soil type based on ribbon test.

Soil Type	Ribbon Length (inches)
Sand	No ribbon will form
Silt	Weak ribbon <1.5"
Clay	>1.5"

STEP 3. Slope. Find the slope of the land where the rain garden will be located. Slopes should be less than 12%. Follow the steps below to determine slope.

- Place one stake at the uphill end of the rain garden area and another at the downhill end as illustrated in Figure 1.
- Tie a string to the uphill stake at ground level. Using a string level, level the string between the two stakes.
- Measure the length of the string between the stakes. This is the run or length.
- On the downhill stake, measure the height from the ground to the string. This is the rise or height.
- Divide the rise by the run and then multiply the result by 100. This is the slope.

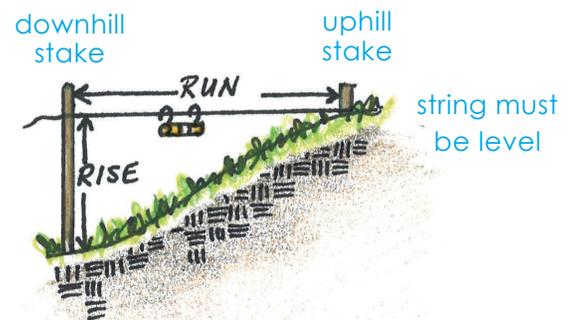


Figure 1. Determine the slope of the landscape before digging.

$$\text{SLOPE (\%)} = (\text{RISE} \div \text{RUN}) \times 100$$

STEP 4. Ponding depth. Use the slope to determine the corresponding rain garden ponding depth in Table 2. The ponding depth is the distance between the top of the mulch layer and the top of the rain garden outlet.

Table 2. Ponding Depth & Size Factor

Slope		≤ 4%	5 - 7%	8 - 12%
Ponding Depth		3-5 inches	6-7 inches	8 inches
Soil Type	Sand	0.19	0.15	0.08
	Silt	0.34	0.25	0.16
	Clay	0.43	0.32	0.20

STEP 5. Size Factor. Match the ponding depth to the appropriate soil type in Table 2 to find the rain garden size factor. For example, if your slope is 6%, the corresponding ponding depth is 6 - 7 inches. If you have a silt soil, your corresponding size factor is 0.25.

STEP 6. Rain garden area. Use the equation below to calculate the needed rain garden area in square feet. You can configure the shape and dimensions to best suit the site as long as it meets the total rain garden square footage.

$$\text{RAIN GARDEN SIZE FACTOR} \times \text{TOTAL DRAINAGE AREA (ft}^2\text{)} = \text{RAIN GARDEN AREA (ft}^2\text{)}$$

STEP 7. Total depth to dig.

a. A rain garden should have between 6" and 12" of planting bed material with 12" being ideal. The planting bed can include native soil, compost, and other soil amendments. Choose the planting bed depth for your rain garden. A 2" mulch layer is recommended to suppress weeds and prevent the soil from drying out in the first few years until the garden is established.

Table 3. Rain Garden Sizing Information

START. Infiltration test (pass/fail)	
STEP 1. Total drainage area (ft ²)	
STEP 2. Soil test (type)	
STEP 3. Slope (%)	
STEP 4. Ponding depth (inches)	
STEP 5. Size factor	
STEP 6. Rain garden area (ft ²)	
STEP 7a. Planting bed depth (inches)	
STEP 7b. Total depth to dig (inches)	

b. The total depth to dig your rain garden is the sum of the ponding depth from Step 5, the planting bed depth (anywhere between 6" and 12"), and the mulch layer depth.

$$\text{PONDING DEPTH} + \text{PLANTING BED DEPTH} + \text{MULCH LAYER DEPTH} = \text{TOTAL DEPTH TO DIG}$$

DESIGN

STEP 1. Identify staging and material disposal area(s). Identify an area on the site where delivered materials, such as stone, compost, and mulch, can be stored temporarily while the rain garden is being built. Also determine where excess materials, like sod and soil that is excavated from the rain garden, will be disposed.

TIP: To maintain the ponding depth, it is best to design the berm to be a few inches higher than the outlet. If this makes the berm taller than 12", you can increase the "depth to dig" and decrease the berm height.

STEP 2. Design the berm. If the rain garden is on a slope, a berm or low wall is needed on the downslope side of the rain garden to hold water in the garden. The berm should be the same height as the upslope edge of the garden to make the entire perimeter of the garden level. This creates the ponding area.

The berm should be no more than 12" high in order to blend with the surrounding landscape and to be easier to maintain. This can limit the length of the rain garden in the direction of the slope. Table 4 shows the recommended rain garden length based upon the slope of the ground where the rain garden will be located.

TIP: If the length of the rain garden cannot be adjusted, increase the "depth to dig" and decrease the berm height.

Table 4. Suggested Rain Garden length for a 12" berm height.

Slope	12%	11%	10%	9%	8%	7%	6%	5%	4%	3%	2%	1%	0%
Rain Garden no longer than	8.5'	9'	10'	11'	12.5'	14.5'	16.5'	20'	25'	33.5'	50'	100'	NA

STEP 3. Consider the rain garden shape. Plan the shape of the rain garden to fit the situation. The rain garden can be any shape as long as it meets the square footage determined in Design Step 6. Restrictions include the length based on the berm height (recommended) and other potential site constraints that limit the length, width, or depth of the garden.

STEP 4. Plan the inlet and outlet.

- a. Inlet.** The location where runoff enters a rain garden is called the inlet. Whether stormwater runoff enters the rain garden through a gutter downspout, a swale, or as sheet flow, the inlet is susceptible to erosion and scouring during rain storms. To reduce erosion and scouring, the inlet should be reinforced with stone or gravel. A flat rock or paver can also be placed at the inlet, directly under where runoff enters the garden to help spread out the flow.
- b. Outlet.** The location where water exits or overflows from a rain garden is called the outlet. While the rain garden is designed to contain most rain storms, the outlet provides a safe and controlled place for water to overflow during storms that produce a lot of rain. An outlet is usually created along a portion of the berm on the downslope side of a rain garden. An outlet is created by lowering a 1' to 2' wide section of the berm a couple of inches. Similar to the inlet, the outlet is susceptible to erosion and scour and needs to be reinforced with stone.

STEP 5. Select plants and create a planting plan. Rain garden plants are not the same as water loving plants. Rain gardens have fluctuating wet and dry conditions and can have extended periods of dry soils between storms. Similar to planning any perennial garden, soil, light, wind, climate, and exposure to environmental stressors like road salt, need to be considered. Consider the following recommendations when selecting plants for your rain garden.

- Refer to *Native Plants for New England Rain Gardens* on the Soak Up the Rain

NH program website at http://soaknh.org/wp-content/uploads/2016/03/Native-Plants-for-NH-Rain-Gardens_20160322.pdf.

- Choose New England native species to enhance the ecological function of the rain garden by supporting native species including birds and pollinators.
- Avoid plants with lower basal leaves that may remain under water and become more susceptible to rot.
- Use sturdy plants, such as Blue Flag Iris, where runoff enters the garden at the inlet.
- Have the soil tested to determine pH, organic content, and other soil conditions to plan for soil amendments that you may need to encourage healthy plant growth.
- Review the spacing suggestions for each plant and design your plan accordingly to give plants the space they need to grow to full maturity.
- Create a bird's eye view drawing of your planting plan to guide you when you plant and to help remind you of their placement when you inspect and maintain the rain garden.

STEP 6. Determine materials needed. Once you know the area and depth to dig of your rain garden, follow the instructions below to approximate the amount of soil, compost, mulch and other materials that you may need. If needed, convert cubic feet to cubic yards by multiplying cubic feet by 0.037.

1. Decide how thick each material (soil, compost, mulch, etc.) should be.
Material thickness: _____ inches
2. Use Table 5 to match the material thickness to the area covered per cubic yard of material.
Area covered per cubic yard of material: _____ ft²
3. Determine the area (in ft²) the material needs to cover based on your rain garden size. Use the equation below to divide the size of the area to be covered by the area covered per cubic yard. The result is the number of cubic yards you will need.

$$\text{SIZE OF AREA TO BE COVERED} \div \text{AREA COVERED PER CUBIC YARD} = \text{CUBIC YARDS NEEDED}$$

Soil Amendments: The condition of the soil, organic content, pH, and other factors will determine the type and amount of soil amendments for your rain garden. The University of New Hampshire Cooperative Extension offers soil testing and will provide soil recommendations for residential rain gardens. More information on soil testing can be found at <https://extension.unh.edu/Problem-Diagnosis-and-Testing-Services/Soil-Testing>. Be sure to indicate on the form that the test is for a residential rain garden.

Plants: The number and type of plants will be dictated by the size of the rain gardens

Table 5. Material thickness and coverage.

Material Thickness (inches)	Area Covered (in ft ²) per Cubic Yard (yd ³) of Material
1"	324 ft ²
2"	162 ft ²
3"	108 ft ²
4"	81 ft ²
5"	67 ft ²
6"	54 ft ²
7"	47 ft ²
8"	40 ft ²
9"	36 ft ²
10"	33 ft ²
11"	30 ft ²
12"	27 ft ²

and localized sun/shade, soil, and climate conditions and should be specified in your planting plan.

Stone: About a half of a yard of crushed stone is useful for securing the inlet and outlet and achieving the pitch of the inlet pipe from the gutter. Two or more 1ft² or larger flat stones or pavers are useful for placing at the inlet. The outlet can also be reinforced with stones that you find as you dig out the rain garden area.

INSTALLATION

STEP 1. Define borders. Use string or spray paint to outline the shape of the rain garden. The berm, if needed, will be built outside of the outline.

STEP 2. Remove sod. Remove the grass within the outlined area. You can either dig through the lawn or lay a tarp or sheet of black plastic within the rain garden area for several weeks to kill the grass. Herbicides are not recommended.

STEP 3. Start digging. Remove the soil from within the rain garden area. Form a gentle slope along the edges as you dig. Lay out tarps to temporarily sort and store sod, top soil, and lower soil layers to use later in building the berm and preparing the soil planting bed. Consider the following:

- a. *On a Slope:* If the rain garden is on a slope, a berm will be needed. The sod and soil material excavated from digging the garden should be reserved to build the berm (Figure 2).
- b. *On Level Ground:* If the rain garden is on level ground, no berm is necessary and the excavated soil and sod can be removed or used elsewhere on the property.



Figure 2. Where to dig and put the soil on a sloped site.

STEP 4. Set the berm height. Once you are close to having the entire garden area dug down to the “total depth to dig”, hammer stakes along the perimeter of the rain garden about 4-6 feet apart, starting with the highest edge and working around the garden. Attach a string to the base of the highest stake. Use a string level to mark the leveled height on each stake around the perimeter of the garden. This will be your berm height.

STEP 5. Level the bottom. The rain garden must have a level bottom to encourage the water to spread evenly throughout. Once all of your stakes are marked with the berm height, use a leveled string and a yard stick or measuring tape to measure the distance from the bottom of the rain garden to the string throughout the rain garden. You may find that you need to dig out additional material or rake it out to get rid of high or low spots.

STEP 6. Prepare the soil. Combine native soil, compost, and other soil amendments to

create a planting bed between 6" and 12" deep.

STEP 6. Prepare inlet. If your rain garden is capturing roof runoff from a gutter, you can dig a trench to bury your inlet pipe from the gutter downspout to the garden. Carefully remove the sod growing over the trench and set it aside to use as a cover once it is complete. Be sure to pitch the trench toward the rain garden so that the water easily drains from the gutter to the garden and doesn't back up. You can use a carpenter's level to do check the pitch.

Inside the rain garden, stabilize the inlet area with crushed stone to prevent erosion and scour of the inlet. Place one or more flat stones or pavers directly under the inlet pipe to further reduce erosion and to prevent a channel from forming.

STEP 7. Build berm and outlet. Using the marked stakes along the edge of the rain garden as a guide, use overturned sod and soil to build and shape the berm to the specified berm height. Designate a 1' to 2' section of the berm to be the outlet. The outlet should be a few inches lower than the rest of the berm height. After shaping the berm and the outlet, compact the soil. Reinforce the outlet with stone.

STEP 8. Add planting bed materials. Before adding the planting bed materials into the rain garden, hammer tall stakes into the bottom of the rain garden and mark them with the planting bed depth, which should be between 6" to 12". Use this line as a guide as you evenly distribute a mix of native soil, compost, and other amendments, as needed to create a planting bed. Mix well and be sure to place some planting bed material up the sloped sides of the rain garden so that they may also be planted. Rake the bed level. To avoid compacting the planting bed, work from the center of the garden outward.

STEP 9. Plant. Place plants while still in their pots into the garden according to the planting plan. Make adjustments for spacing as needed. When you are ready to plant, remove one plant at a time from its pot and loosen the root ball with your fingers to encourage root growth. Plant to the same depth or slightly deeper than they were in the pot.

STEP 10. Apply mulch. Apply a 2" layer of mulch over the entire rain garden to help retain moisture in the soil and to prevent weeds.

STEP 11. Water thoroughly. Water thoroughly immediately after planting. Give the plants an inch of water every week for the first growing season. Once the plants have been established, water only as needed during extended dry weather.

MAINTENANCE

Rain garden maintenance is similar to the maintenance of any perennial garden, with a few extra tasks:

INSPECT: After storms to verify the inlet and outlet are stable, no channels have formed, that plants are healthy, and that it is draining. Adjust and repair if needed.

PLANT CARE: Weed and water as needed. Replace dead plants as needed. Cut back, prune, or divide plants when appropriate to encourage growth.

CLEAN: If the rain garden is receiving runoff that contains sand or debris, such as from

a driveway or roadway, clean out accumulated materials as needed.

DESIGN REFERENCES

Winooski Natural Resources Conservation District. [*The Vermont Rain Garden Manual "Gardening to Absorb the Storm"*](#) . 2009

Wisconsin Department of Natural Resources. [*Rain Gardens: A How-to Manual for Homeowners*](#). 2003.

Figures adapted from Wisconsin Department of Natural Resources. [*Rain Gardens: A How-to Manual for Homeowners*](#). 2003.