The Vermont Rain Garden Manual

“Gardening to Absorb the Storm”

Helping to protect and restore Vermont’s rivers and lakes.
What is a rain garden?

A rain garden is a bowl-shaped garden designed to capture and absorb rainfall and snowmelt (collectively referred to as “stormwater”). When stormwater runs off impervious surfaces such as parking lots, roofs, compacted soils, and roads, it accumulates pollutants and delivers them to a nearby lake or river either directly or via a storm drain. Stormwater pollutants typically include sediment; nutrients (nitrogen and phosphorus); bacteria from animal waste; and oil, grease, and heavy metals from cars. Stormwater also causes increased flooding, which erodes stream banks resulting in additional problems. However, if captured by a rain garden, stormwater soaks into the ground recharges the groundwater at a rate 30% greater than that of a typical lawn. Ultimately, if we all work together to create landscape features that absorb the stormwater, we can restore and help preserve the waterways that make Vermont so beautiful.

Choosing a Location

- If capturing roof runoff, place the garden about 10 feet away from the building to prevent potential water seepage into the basement.
- Do not place a rain garden over a septic tank or leach field.
- Do not place a rain garden near a drinking water well.
- Call Dig Safe® at 1-888-DIG-SAFE at least three days before digging to avoid underground pipes and utilities.
- Check for any private wiring or underground utilities such as driveway lights and sheds with electricity.
- Select a flat area if possible to make installation easier.
- Do not place the rain garden in a naturally wet area.
- Avoid disturbing tree roots. Trees may be injured by digging and may not tolerate the additional soil moisture.
Sizing the Rain Garden (4 Steps)

Step 1: Drainage Area
To calculate the drainage area (the area that will drain to the rain garden) from a roof, parking lot, sidewalk, or other impervious surface, multiply the length by the width.

\[(\text{Length}) \times (\text{Width}) = \text{________ ft}^2 (\text{drainage area})\]

Add together the drainage area of multiple roofs.
Combine your roof runoff with a neighbors’.

Rain gardens can capture stormwater from a drip-line just as well as from a gutter system.

Estimating the stormwater that runs off streets, sidewalks, and parking lots can be tricky. It is best to visit the impervious area during a rain event to clearly see the extent of the drainage area.

Step 2: Soil
To determine if the soil type is suitable for a rain garden, first perform a simple pit test:

1. Dig a 6” deep hole and fill with water.
2. Choose a new location if the water is still standing after 24 hours.

After conducting the pit test, identify the soil type as sand, silt, or clay. Sandy soils have the fastest infiltration; clay soils have the slowest. Since clay soils take longer to drain water, they require a larger rain garden area. You can determine your soil type by performing the ribbon test:

1. Grab a handful of moist soil and roll it into a ball in your hand.
2. 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 ¼” thick.
3. Try to keep the ribbon uniform thickness and width. Repeat the motion to lengthen the ribbon until it breaks under its own weight. Measure the ribbon and evaluate below:

The ribbon formed here depicts a clay soil because it is greater than 1.5” in length.

**SAND:** Soil does not form a ribbon at all.
**SILT:** A weak ribbon < 1.5” is formed before breaking.
**CLAY:** A ribbon > 1.5” is formed.
Step 3: Slope

Calculate the slope to determine the rain garden’s depth:
1. Place one stake at the uphill end of the rain garden and another at the downhill end as illustrated in Figure 1. 
2. Level the string between the two stakes. 
3. Measure the total length of the string and the height of the string at the downhill stake in inches. 
4. Divide the height by the length and multiply the result by 100. This is the slope. 
5. Use Table 1 to determine the recommended rain garden depth.

![Figure 1: Determine the slope of the landscape.](image)

<table>
<thead>
<tr>
<th>Slope</th>
<th>Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 4%</td>
<td>3-5 in</td>
</tr>
<tr>
<td>5-7%</td>
<td>6-7 in</td>
</tr>
<tr>
<td>8-12%</td>
<td>8 in+</td>
</tr>
</tbody>
</table>

Step 4: Size

Finally, determine the rain garden’s size:
1. Use Table 2 to determine the size factor. 
2. Multiply the size factor by the drainage area. This is the recommended rain garden size.

![Table 2](image)

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>3-5 in</th>
<th>6-7 in</th>
<th>8 in+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>0.19</td>
<td>0.15</td>
<td>0.08</td>
</tr>
<tr>
<td>Silt</td>
<td>0.34</td>
<td>0.25</td>
<td>0.16</td>
</tr>
<tr>
<td>Clay</td>
<td>0.43</td>
<td>0.32</td>
<td>0.20</td>
</tr>
</tbody>
</table>

Note: If the rain garden is > 30 ft away from the drainage area then the area of the rain garden can be a half size smaller than calculated above. This is because a large amount of stormwater will be absorbed along the pathway that leads to the rain garden.

Benefits of a Rain Garden

- Are easy and inexpensive to install and maintain
- Reduce stormwater runoff
- Recharge groundwater
- Help control flash flooding
- Provide wildlife habitat
- Improve water quality
- Help to sustain stream base flows
- Are an attractive alternative to detention ponds
- Remove Pollutants
- Can be retrofit into existing urban landscapes

The Vermont Rain Garden Manual
Designing the Rain Garden (4 Steps)

Step 1: Determine the Shape
Your rain garden can be any shape but it MUST have a level bed.

Step 2: Design the Entrance
Stabilize the area where the water enters your rain garden with stone or gravel to slow stormwater flow and prevent erosion within the garden. Place hardy plants that thrive in moist conditions where the stormwater enters the garden.

Some common methods for directing water from the drainage area to the rain garden include:

Gutter Extensions: Specifically shaped to attach to the end of your downspout.

PVC & Plastic Corrugated Piping: Can be attached to gutter extensions and buried to carry stormwater underground.

Grass-lined & Rock-lined Swales: Can be used to direct water to the rain garden. Swales should be sloped at a 2:1 ratio (1 ft rise for every 2 ft across). Ideal for heavy flows from roads or parking lots.

Step 3: Select Plants
Plants must be able to tolerate the extreme moisture conditions typical of a rain garden. When choosing plants it is important to remember that rain gardens are not wetlands. Rain gardens mimic upland forest systems. Plants that consistently require wet soils or standing water are not appropriate. Refer to The Vermont Rain Garden Plant List beginning on page 11 of this manual.

There are likely many more plants suitable for Vermont rain gardens than what is included in the plant list. To evaluate the suitability of each additional plant, use the following criteria: A suitable rain garden plant 1) is greater than 6” in height when mature and does not have low basal leaves—these plants may struggle when overcome by heavy flows; 2) can tolerate both wet and dry conditions; and 3) can survive in the local hardiness zone. Refer to the Plant Hardiness Zones in Vermont map included on the back cover.

Step 4: Final Rain Garden Design Sketch
Complete a to-scale drawing of the rain garden before breaking ground:

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The Vermont Rain Garden Manual
Installing the Rain Garden

**Step 1: Define the Borders**
Delineate the outline of the rain garden on the ground using string or spray paint. The berm or edging will go outside the string.

**Step 2: Remove the Grass**
To avoid digging through sod, kill the grass first by laying black plastic or a tarp on the lawn for several weeks. Using a herbicide is not recommended—it could harm the newly installed plants.

**Step 3: Start Digging**

*Building on a slope:* If the rain garden is built on a slope, a berm or low wall on the downhill side is required to increase the water holding capacity of the garden. Create the berm while digging the rain garden by heaping the soil around the edges where the berm will be (see figure 2). The berm height should be level with the uphill side of the garden, therefore making the entire perimeter of the garden the same height. After shaping the berm, compact the soil and cover with sod, mulch, or a groundcover. Use straw or other matting to protect the berm from erosion while the grass or groundcover takes root.

*Building on level ground:* If the rain garden is built on level ground, the profile of the garden can vary depending on available space and aesthetic preference. If space permits, the rain garden can have gently sloping sides (Figure 3). Note that soil conditions in the upper slope of this type of rain garden may be too dry for a true rain garden plant to survive, therefore a variety of upland plants might be appropriate here. If there is not a lot of space, then the profile in figure 4 might be appropriate. Only plants that can tolerate very moist soil conditions should be planted in this type of rain garden. This design is common in urban settings where a curb-cut is used to direct stormwater into the garden. A berm does not need to be constructed in a rain garden that is built on level ground because the stormwater is held in by the depression that is dug. Excavated soil therefore should be removed from the site. Landscaping stone, or other edging can be used to help hold water in the garden as well as to prevent grass from growing into the bed. Tip: Think about where stormwater will go when the rain garden overflows during a very large storm. Design a slight dip in the berm/perimeter to direct potential overflow away from the neighbors’ yard or other priority area.
Figure 2: When building a rain garden on a slope, a berm must be created to hold the water in the garden. When leveling the bed, use the dirt that you remove to build the berm.

Figure 3: Level bed with sloping edges. This design requires more space. Only plants that can thrive in drier soil conditions can be planted on the upper slope of this type of raingarden; true rain garden plants will not thrive here.

Figure 4: Level bed without sloping edges. Ideal design for tight spaces.
Step 4: Level the Bed
Dig the rain garden bed 4-6” deeper than determined earlier to allow for the addition of compost and mulch. Maintain the rain garden’s ability to absorb water by avoiding soil compaction. Work from one side to the other, or from the center to the outside. Loosen soil with a shovel if it becomes compacted. When the whole area has been dug out to the approximate depth, lay a 2x4 board in the rain garden with the carpenter’s level sitting on it. Adjust to form a flat bottom. When the rain garden is completely level, rake the soil. Tip: Avoid digging and planting under wet conditions, especially when working in clay soils—Disturbing wet soils can result in compaction.

Step 5: Improve the Soil
At least two inches of compost should be added to the rain garden and mixed into the native soil. This helps the soil retain moisture and improve plant growth. Using a rototiller to mix in the compost will make the job much easier.

Step 6: Plant
Set the plants out in the garden to match the planting plan. When removing the plants from pots, gently loosen the root ball with your fingers before placing them in the ground. Water immediately after planting.

Step 7: Mulch
Apply a 2-3” layer of mulch to help retain soil moisture and discourage weeds. A cubic yard of mulch will cover a 100 square foot area with about three inches of mulch.

Care & Maintenance

- **Water**: New plants need to be watered regularly until their roots are established, even though the rain garden catches stormwater.

- **Weed**: Frequent weeding will be necessary in the first few years before plants become established.

- **Mulch**: To maintain the bowl-shaped profile and stormwater holding capacity of the rain garden, mulching is not suggested until a few years after the initial installation. Once the rain garden is established, mulch is not necessary, unless its more formal appearance is preferred. When applying mulch, maintain a 2-3” layer.

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**Legend**
- Rhododendron canadensis
- Rhododendron maximum
- Rhododendron periclymenoides
- Rosa palustris
- Rodgersia hirta
- Rudbeckia hirta
- Salix discolor
- Salix humulis
- Salix purpurea
- Salvia verticillata
- Sambucus canadensis
- Sanguinaria canadensis
- Sanguisorba tenuifolia
- Schizachyrium scoparium
- Soldago ssp.
- Sorghastrum nutans
- Spirea latifolia
- Streptopus roseus
- Thelypteris noveboracensis
- Thuja occidentalis

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**Images**
- Level the bed
- Improve the soil
- Plant
- Mulch
- Water
Curb-Cut Rain Gardens

Rain gardens designed with a curb-cut can be effective in capturing stormwater from streets, parking lots, and other paved areas. In addition to reducing stormwater volume, curb-cut rain gardens increase urban aesthetics, reduce pollutant concentrations, and help counteract urban heat. A sample curb-cut rain garden planting plan is included on page 17 of this manual. Below are some things to consider when designing a curb-cut rain garden:

**Plant Height:** When planting in a streetscape, be sure to consider overhead conflicts (utility lines) and visibility issues, especially when planting in a median.

**Salt Tolerance:** Plants in a curb-cut rain garden must be able to tolerate road salt that accumulates in the soil and on exposed trunks and branches in the winter months. See the enclosed plant list for salt tolerant plants.

**Right-of-Way:** Anyone wishing to work within the right-of-way must obtain permission from the state or local municipality. A permit may be required.

**Pretreatment:** To prevent clogging due to excess sediment it is best to pre-treat the stormwater before it enters the curb-cut rain garden if stormwater runoff is collected from a road or parking lot. Three recommended options for pretreatment are given on page 18 of this manual.

“With green infrastructure, stormwater management is accomplished by letting the environment manage water naturally; capturing and retaining rainfall, infiltrating runoff, and trapping and absorbing pollutants.” Natural Resources Defense Council

**Common Questions**

**Does a rain garden form a pond?**
No. After most storms a properly constructed rain garden will absorb water within a period of 24 hours and not more than 48 hours for larger storms depending on the soil type.

**Do mosquitoes breed in rain gardens?**
No. Mosquitoes require 7 to 12 days of standing water to lay and hatch eggs. Standing water will only last a few hours after most storms.

**Do they require maintenance?**
Like any garden, diligent watering and watering will be needed in the first two years. As the garden matures, maintenance requirements will lessen. Plants may need to be thinned after a few years.

**How much does a rain garden cost?**
The cost varies depending on who does the work, the size of the garden, where the plants come from, and the planting density. If you purchase the plants and materials but do all the labor, the cost will be roughly $4-$6 per sq ft. If you hire a professional to design and install the garden, it will cost roughly $10-$14 per sq ft.

**Should a rain garden be placed where there is typically standing water?**
Rain gardens are designed to infiltrate water. Standing water indicates poor infiltration, and we do not recommend directing additional water to these naturally wet areas.

**What if there is a dry spell?**
Plants suitable for a rain garden can handle both wet and dry conditions. However, during a dry spell, it is best to water the rain garden.