

The Vermont Rain Garden Manual

“Gardening to Absorb the Storm”

Helping to protect and restore Vermont’s rivers and lakes





This is the 2nd Edition of the Vermont Rain Garden Manual. The 1st Edition was printed in 2008. Minor updates were made for the 2nd Edition, published in 2009.

The Purpose of this Manual

This manual is a Vermont specific resource developed for homeowners, landscape architects, city planners, and anyone else interested in protecting local rivers and lakes through gardening. The contents of the manual will clarify the process of installing a rain garden and demonstrate that rain gardens are cost-effective stormwater management tools, which can be incorporated into a variety of landscapes. The Vermont Rain Garden Manual will also illustrate the importance of reducing the volume of stormwater runoff to improve water quality.

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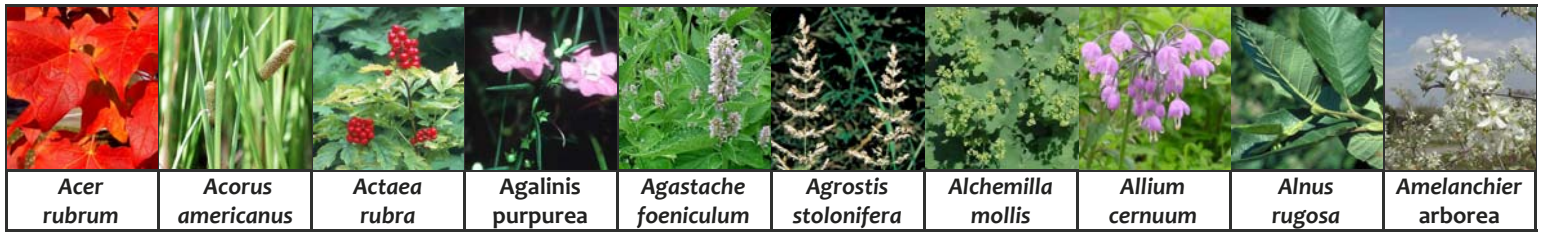
This manual is broken into sections to illustrate the step by step process of building a rain garden. The sections include:

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Photographs of species appropriate for rain gardens are arranged alphabetically, by scientific name, throughout the manual



| | | | | | | | | | |
|--------------------|--------------------------|---------------------|--------------------------|-----------------------------|-----------------------------|--------------------------|-----------------------|---------------------|----------------------------|
| <i>Acer rubrum</i> | <i>Acorus americanus</i> | <i>Actaea rubra</i> | <i>Agalinis purpurea</i> | <i>Agastache foeniculum</i> | <i>Agrostis stolonifera</i> | <i>Alchemilla mollis</i> | <i>Allium cernuum</i> | <i>Alnus rugosa</i> | <i>Amelanchier arborea</i> |
|--------------------|--------------------------|---------------------|--------------------------|-----------------------------|-----------------------------|--------------------------|-----------------------|---------------------|----------------------------|

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. Excess 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 and recharges the groundwater at a rate 30% greater than that of a typical lawn. Through allowing stormwater to infiltrate into the ground, rain gardens help to reduce the volume of stormwater runoff thus preventing excess nutrients, sediment, pollutants, and high stormwater flows from entering local waterways. Ultimately, if we all work together to create landscape features that absorb stormwater, we can help preserve the waterways that make Vermont so beautiful.

Choosing a Location

- ✓ If capturing roof runoff, place the garden at least 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.



Capture runoff from your roof



Capture runoff from a road

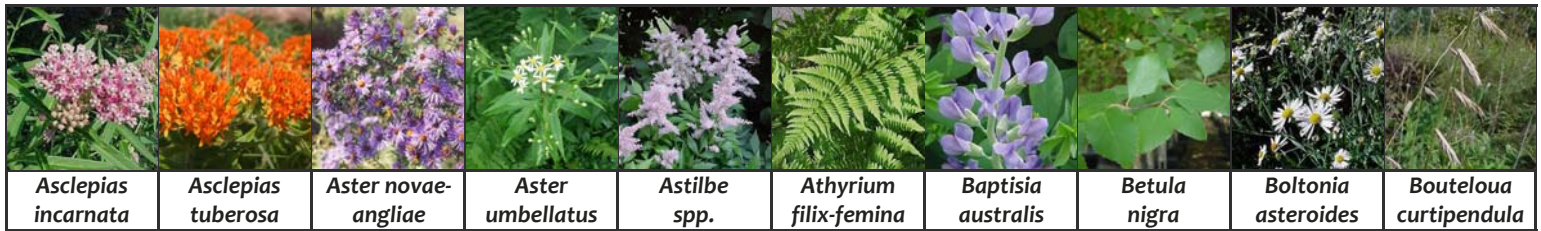


Capture runoff from a parking lot

Photo courtesy of Connecticut NEMO



| | | | | | | | | | |
|--------------------------|----------------------------|------------------------------|---------------------------|-----------------------------|---------------------------|---------------------------|----------------------------|------------------------|--------------------------|
| <i>Amorpha canescens</i> | <i>Andropogon gerardii</i> | <i>Andropogon virginicus</i> | <i>Anemone canadensis</i> | <i>Aquilegia canadensis</i> | <i>Aronia arbutifolia</i> | <i>Aronia melanocarpa</i> | <i>Arisaema triphyllum</i> | <i>Aruncus dioicus</i> | <i>Asarum canadensis</i> |
|--------------------------|----------------------------|------------------------------|---------------------------|-----------------------------|---------------------------|---------------------------|----------------------------|------------------------|--------------------------|



Sizing Your 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 areas of multiple roofs.



Combine your roof runoff with a neighbor's.



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 your 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:

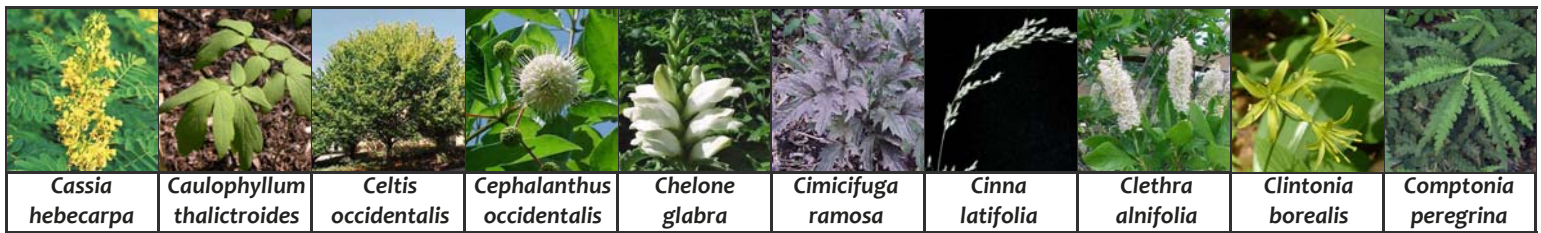
SAND: Soil does not form a ribbon at all
SILT: A weak ribbon < 1.5" is formed before breaking
CLAY: A ribbon > 1.5" is formed

Photo Courtesy of North Dakota State University



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





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 (as a %). $\text{Slope} = (\text{height}/\text{length}) \times 100$
5. Use Table 1 to determine the recommended rain garden depth.

| Slope | Depth |
|-------|--------|
| < 4% | 3-5 in |
| 5-7% | 6-7 in |
| 8-12% | 8 in+ |

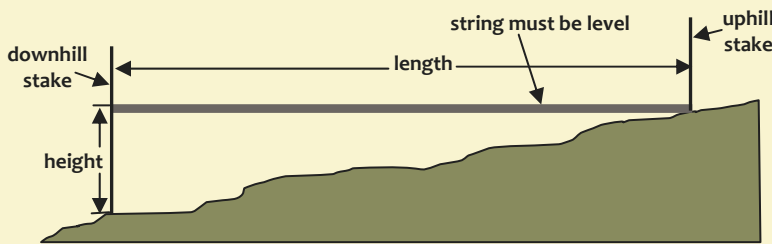


Figure 1: Determine the slope of the landscape.

Adapted from Rain Gardens: A How-to Manual for Homeowners, UMEX

Benefits of a Rain Garden

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



Step 4: Size

Finally, determine the appropriate size for your rain garden:

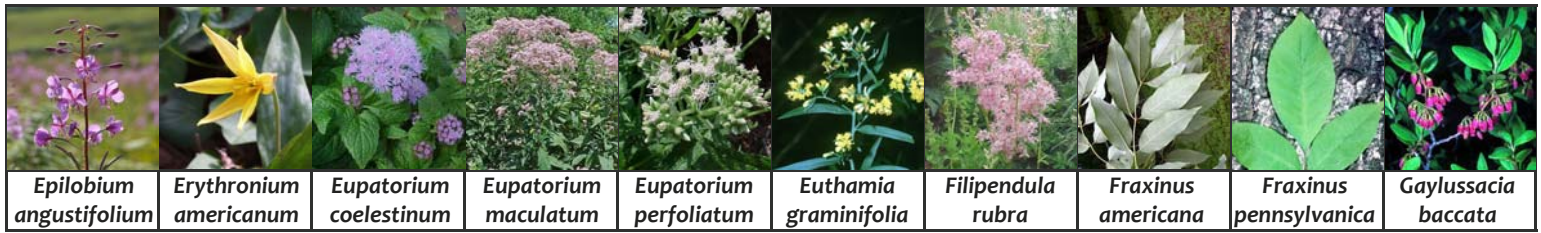
1. Use Table 2 to determine the size factor. The size factor describes how large the rain garden should be relative to the size of the drainage area.
2. Multiply the size factor by the drainage area, determined in Step 1. This is the recommended rain garden size.

| Soil Type | Depth | | |
|-----------|--------|--------|--------|
| | 3-5 in | 6-7 in | 8 in + |
| Sand | 0.19 | 0.15 | 0.08 |
| Silt | 0.34 | 0.25 | 0.16 |
| Clay | 0.43 | 0.32 | 0.20 |

$\text{Size Factor} \times \text{Drainage Area} = \text{Rain Garden Area}$

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.





| | | | | | | | | | |
|--------------------------------|-------------------------------|-------------------------------|-----------------------------|-------------------------------|------------------------------|--------------------------|---------------------------|-------------------------------|----------------------------|
| <i>Epilobium angustifolium</i> | <i>Erythronium americanum</i> | <i>Eupatorium coelestinum</i> | <i>Eupatorium maculatum</i> | <i>Eupatorium perfoliatum</i> | <i>Euthamia graminifolia</i> | <i>Filipendula rubra</i> | <i>Fraxinus americana</i> | <i>Fraxinus pennsylvanica</i> | <i>Gaylussacia baccata</i> |
|--------------------------------|-------------------------------|-------------------------------|-----------------------------|-------------------------------|------------------------------|--------------------------|---------------------------|-------------------------------|----------------------------|

Designing Your 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 runoff 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.

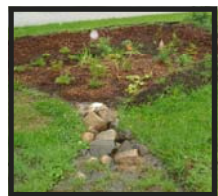
Some common methods for directing water from the drainage area to the rain garden include:



Gutter Extensions: Designed 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. Ideal for heavy flows from roads or parking lots. Swales should be sloped at a 2:1 ratio (1 ft rise for every 2 ft across).

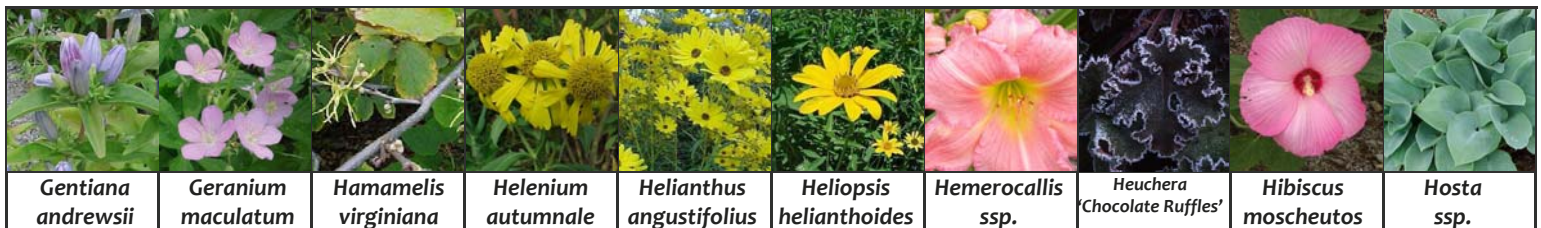
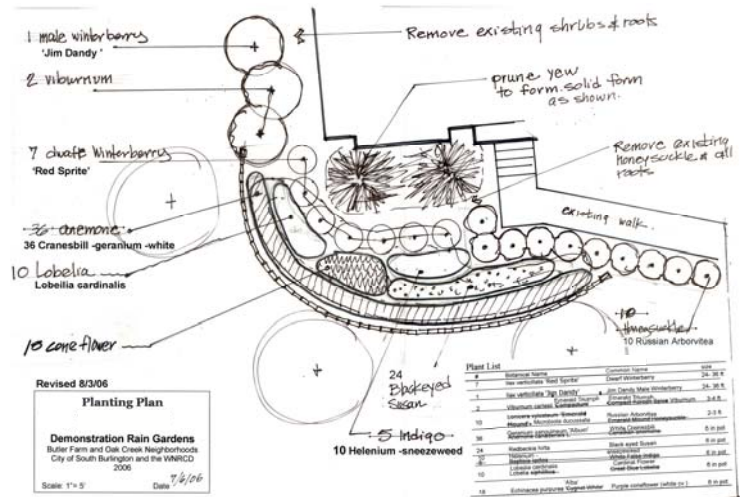
Step 3: Select Plants

Plants must be able to tolerate the moist 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 to select plants for your rain garden.

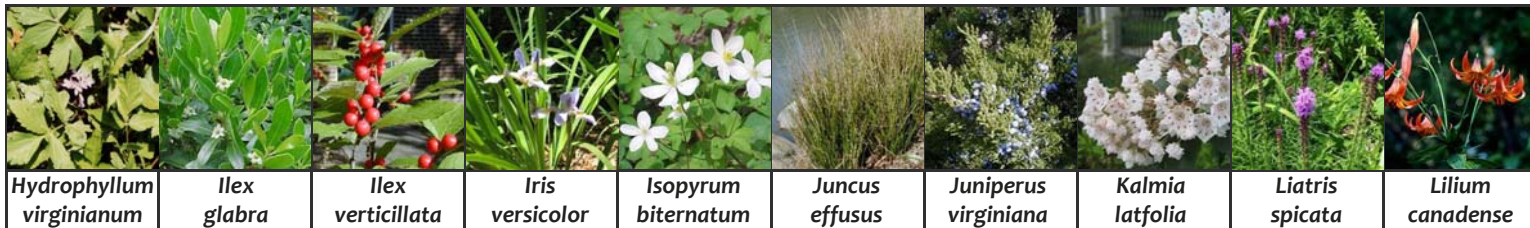
There are likely many more plants suitable for Vermont rain gardens than are not included in the plant list. To evaluate the suitability of each additional plant, use the following criteria: A suitable rain garden plant 1) is greater than 6" in height when mature and does not have low basal leaves—these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

Step 4: Final Rain Garden Design Sketch

Complete a scale drawing of the rain garden before breaking ground.



| | | | | | | | | | |
|---------------------------|---------------------------|-----------------------------|---------------------------|---------------------------------|--------------------------------|--------------------------|-------------------------------------|----------------------------|-------------------|
| <i>Gentiana andrewsii</i> | <i>Geranium maculatum</i> | <i>Hamamelis virginiana</i> | <i>Helenium autumnale</i> | <i>Helianthus angustifolius</i> | <i>Heliopsis helianthoides</i> | <i>Hemerocallis ssp.</i> | <i>Heuchera 'Chocolate Ruffles'</i> | <i>Hibiscus moscheutos</i> | <i>Hosta ssp.</i> |
|---------------------------|---------------------------|-----------------------------|---------------------------|---------------------------------|--------------------------------|--------------------------|-------------------------------------|----------------------------|-------------------|



Installing Your 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.



Build the berm with sod

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.



Borders defined by an earthen berm

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 will be needed to increase the water holding capacity of the garden. Create the berm while digging the rain garden by heaping soil around the edges where the berm will be (See Figure 2 on page 8). The berm height should be level with the uphill side of the garden, 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.



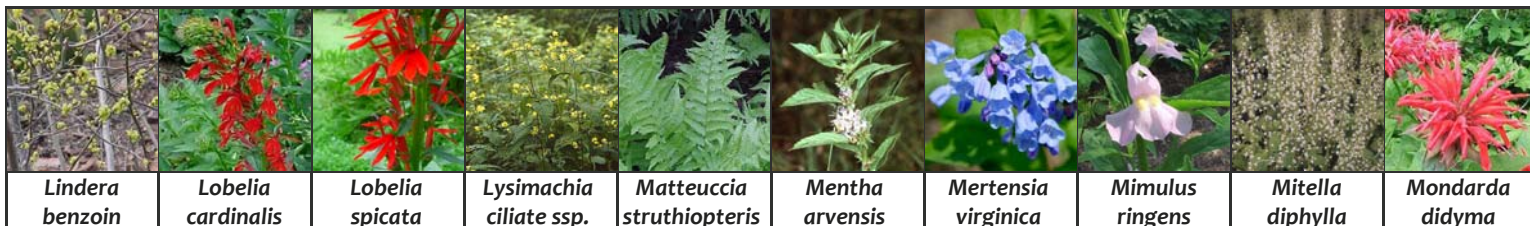
Create a berm with landscaping stone

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 (See Figure 3). Note that soil conditions in the upper slope of this type of rain garden may be too dry for a typical rain garden plant to survive; 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 material can be used to help hold water in the garden as well as to prevent grass from growing into the bed.



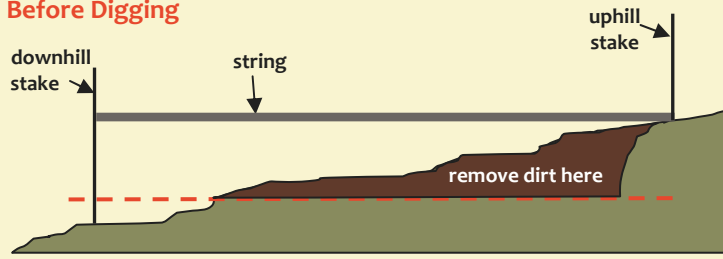
Borders defined by edging

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 your neighbor's yard or other priority areas.

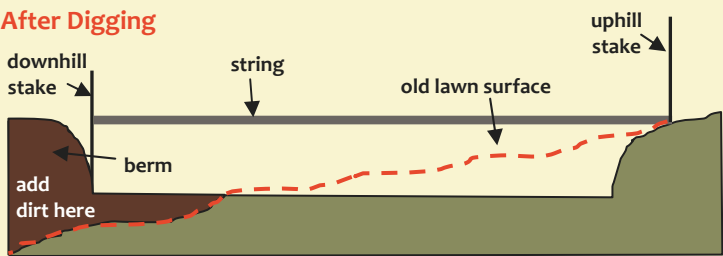




Before Digging



After Digging



Adapted from Rain Gardens: A How-to Manual for Homeowners, UWEX

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.

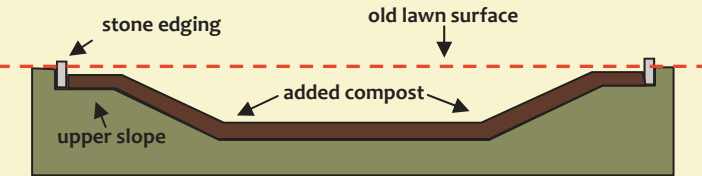


Figure 3: Level bed with sloping edges. This design requires more space. Only plants that can thrive in drier soil conditions can be planted on the upper slope of this type of rain garden; typical rain garden plants will not thrive here.

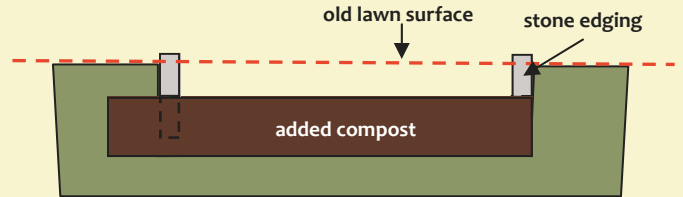
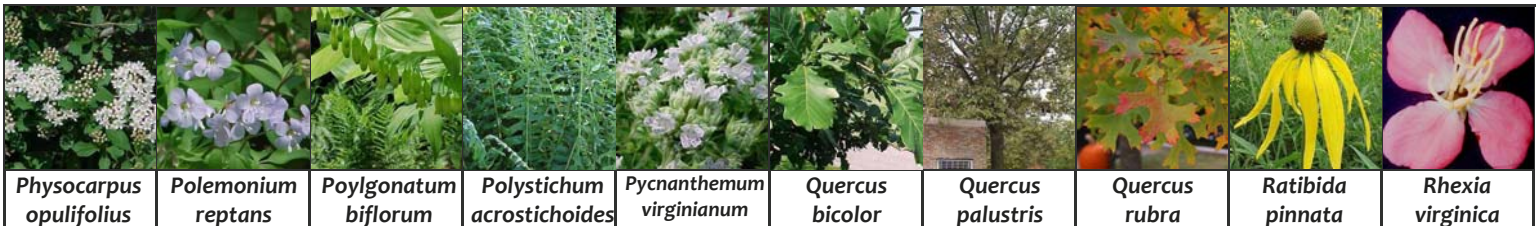


Figure 4: Level bed without sloping edges. Ideal design for tight spaces.





Level the bed

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 appropriate depth, lay a 2x4 in the rain garden and set a carpenter's level on the board. Adjust the bed 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 will help the soil retain moisture and improve plant growth. Using a ro-tor-tiller 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 plants 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.



Improve the soil



Plant



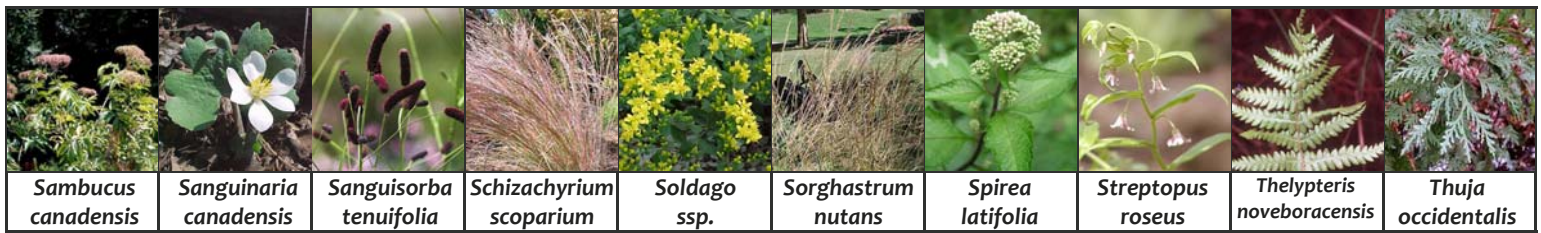
Mulch

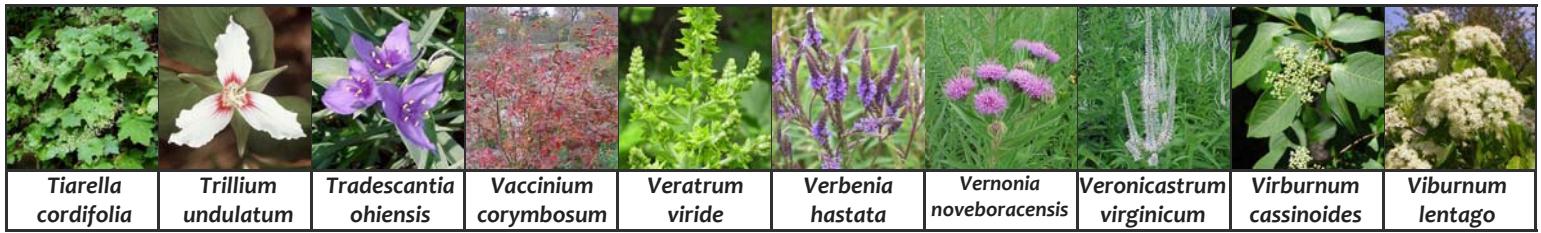


Water

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:** A 2-3" layer of mulch should be applied when you first establish the rain garden. Mulch can move during large storms; rake the garden to distribute mulch evenly after the storm. Once the garden has been established, apply mulch after a few years or "spot mulch" in areas that have lost mulch during large storms.





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 provide beauty in an urban landscape, reduce pollutant concentrations, and help counteract the urban heat island effect. 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. Contact the Vermont Agency of Transportation or your local municipality for more information.

Pretreatment: If stormwater runoff is collected from a road or parking lot it is best to pre-treat the stormwater before it enters the curb-cut rain garden to prevent clogging due to excess sediment. Examples of pretreatment include grass and gravel filters.



Photos courtesy of Bureau of Environmental Services, Portland, Oregon

“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

Frequently Asked 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, depending on the soil type. For larger storms, water should be absorbed within 48 hours.

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 weeding 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 you 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.

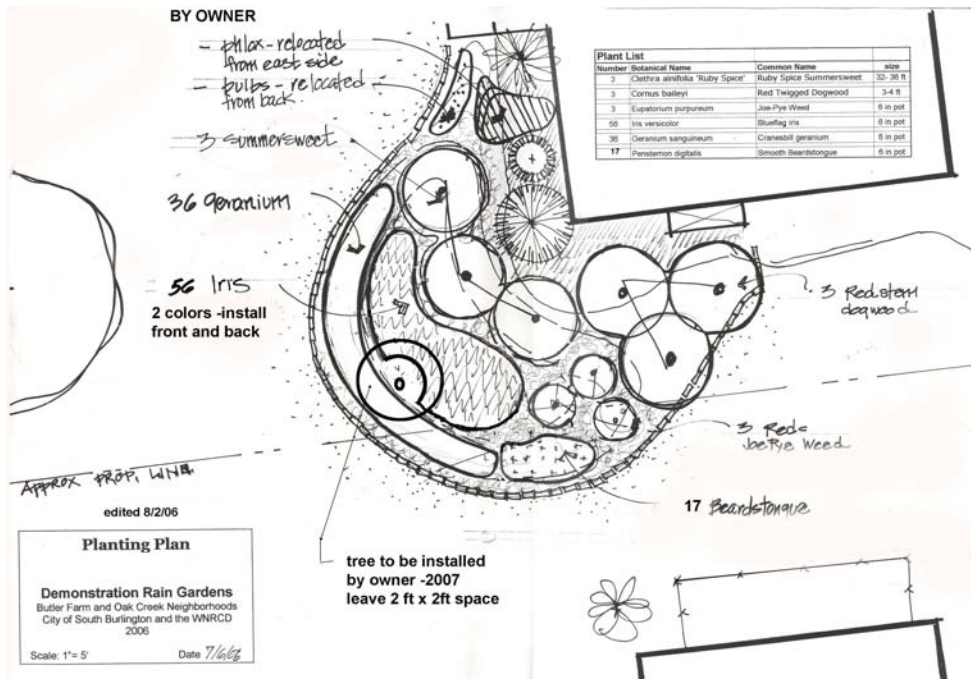
Should a rain garden be placed where there is typically standing water?
 Rain gardens are designed to infiltrate water. Standing water indicates poor infiltration, and we do not recommend directing additional water to these naturally wet areas.

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.

Do I need a permit?
 The large majority of residential rain gardens do not require a permit. See page 18 for more information.

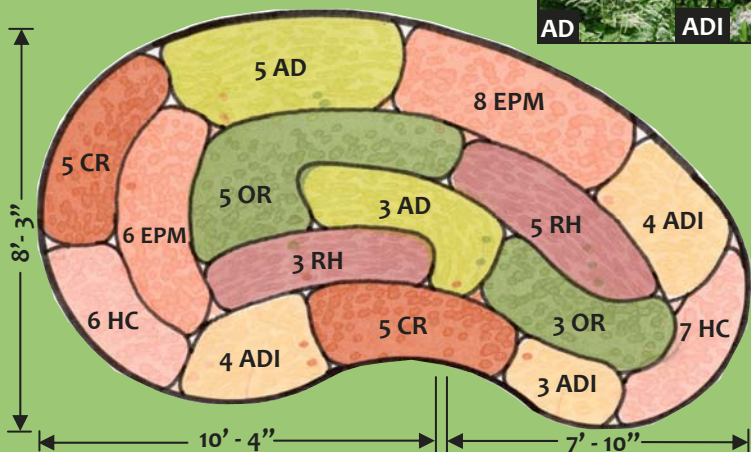
Sample Rain Garden Planting Plans

A well thought out planting plan will increase the success rate of each plant and will make installation easier. The placement of each plant should be based on a plant's moisture tolerance, height, and complimentary plant combinations. The following planting plans are designed for a 150 square foot rain garden. Each planting plan includes light exposure, a planting schedule, plant photos, a plant layout diagram, and a sizing chart. The sizing chart can be used to plan for gardens greater or less than the 150 square foot template provided. Recommended plant installation sizes indicated in the planting schedules include 1 gallon, 2 gallon, and 4" pots. Smaller plants can be installed if needed; however, increase the quantity of each plant and water and monitor the rain garden more frequently.



The Enchanted Garden - Part Shade

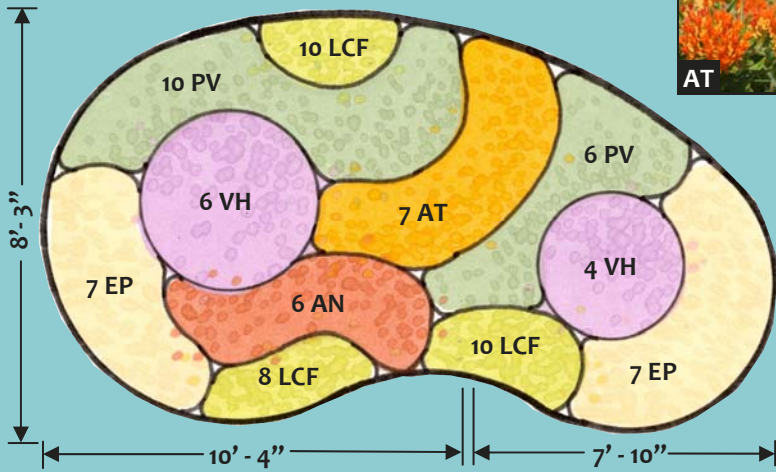
| Abr | Qty | Botanical Name | Common Name | Height | Spread | S. Interest | Spacing | Install Size |
|-----|-----|--|---------------------|--------|--------|--------------|---------|--------------|
| AD | 8 | <i>Aruncus dioicus</i> | Goatsbeard | 5' | 2-4' | Spring | 22-30" | 1-2 Gallon |
| ADI | 11 | <i>Astilbe 'Diamant'</i> | Astilbe | 30" | 1.5-2' | Summer | 22" | 1 Gallon |
| CR | 10 | <i>Cimicifuga ramosa 'Brunette'</i> | Purple-leaf Bugbane | 3-4' | 2-3' | Sp, Su, Fall | 22" | 1 Gallon |
| EPM | 14 | <i>Echinacea purpurea 'Magnus'</i> | Coneflower | 2.5-3' | 1-1.5' | Summer | 15-22" | 1 Gallon |
| HC | 13 | <i>Heuchera 'Chocolate Ruffles'</i> | Coral Bells | 1-2' | 1-1.5' | Summer | 15-22" | 1 Gallon |
| OR | 8 | <i>Osmunda Regalis</i> | Royal Fern | 3-4' | 2-3' | Sp, Su, Fall | 22-30" | 1 Gallon |
| RH | 8 | <i>Rodgersia henrici</i> Sub. <i>Rodgersia aesculifolia</i> | Rodgersia | 3-4' | 3-4' | Summer | 34-38" | 1-2 Gallon |



| Sq Ft | Qty of Diff. Species | Total Plant Qty | Ex. Garden Dimensions |
|-------|----------------------|-----------------|-----------------------|
| 50 | 3 | 24 | 6' x 4'-6" |
| 100 | 5 | 48 | 8'-6" x 6'-4" |
| 150 | 7 | 72 | 18'-2" x 8'-3" |
| 200 | 7 | 96 | 12' x 9' |
| 250 | 7 | 120 | 13'-5" x 10' |

The Bird & Butterfly Meadow - Sun

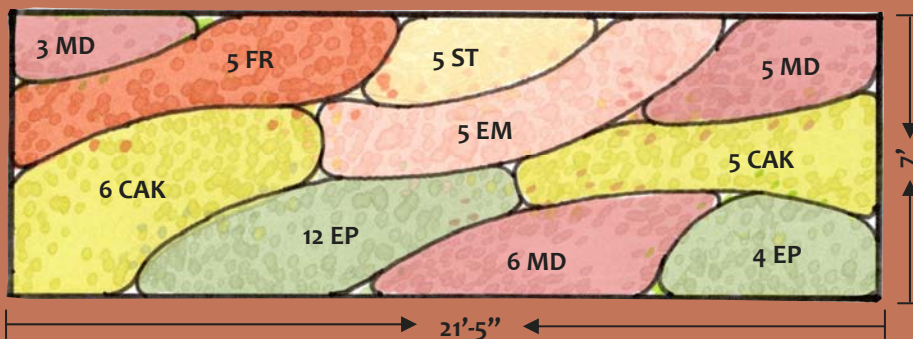
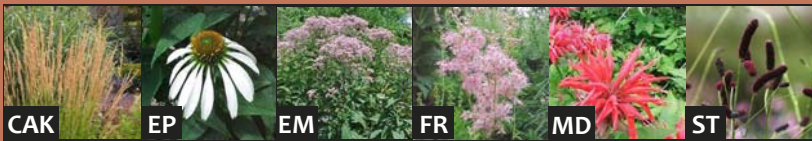
| Abr | Qty | Botanical Name | Common Name | Height | Spread | S. Interest | Spacing | Install Size |
|-----|-----|---|---------------------|--------|--------|--------------|---------|--------------|
| AT | 7 | <i>Asclepias tuberosa</i> | Butterfly Plant | 1-2.5' | 1-1.5' | Summer | 15-22" | 1 Gallon |
| AN | 6 | <i>Aster novae-angliae</i> | New England Aster | 18" | 1.5-2' | Fall | 22" | 1 Gallon |
| EP | 14 | <i>Echinacea purpurea 'Alba'</i> | Coneflower | 30" | 1-2' | Summer | 15-22" | 1 Gallon |
| LCF | 11 | <i>Lysimachia ciliate 'Firecracker'</i> | Fringed Loosestrife | 1-3' | 2-2.5' | Summer | 22-30" | 1 Gallon |
| PV | 16 | <i>Panicum virgatum</i> | Switch Grass | 3-4' | 2-3' | Sp, Su, Fall | 22-30" | 1-2 Gallon |
| VH | 10 | <i>Verbena hastate</i> | Blue Vervain | 2-6' | 1-1.5' | Su, Fall | 15-22" | 4" Pot |



| Sizing Chart | | | |
|--------------|----------------------|-----------------|-----------------------|
| Sq Ft | Qty of Diff. Species | Total Plant Qty | Ex. Garden Dimensions |
| 50 | 4 | 21 | 6' x 4'-6" |
| 100 | 4 | 42 | 8'-6" x 6'-4" |
| 150 | 6 | 64 | 18'-2" x 8'-3" |
| 200 | 6 | 85 | 12' x 9' |
| 250 | 6 | 106 | 13'-5" x 10' |

The Bold Color Garden - Sun

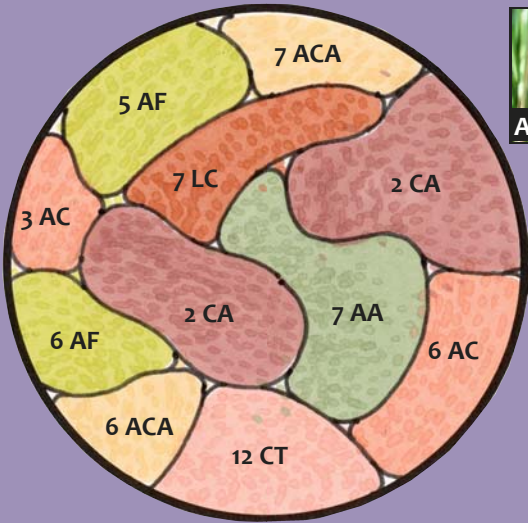
| Abr | Qty | Botanical Name | Common Name | Height | Spread | S. Interest | Spacing | Install Size |
|-----|-----|---|----------------------|--------|--------|--------------|---------|--------------|
| CAK | 11 | <i>Calamagrostis acutiflora 'Karl Foerster'</i> | Feather Reed Grass | 3-5' | 1.5-2' | Sp, Su, Fall | 22-30" | 1-2 Gallon |
| EP | 16 | <i>Echinacea purpurea 'Alba'</i> | Coneflower | 30" | 1-2' | Summer | 15-22" | 1 Gallon |
| EM | 5 | <i>Eupatorium maculatum</i> | Joe Pye Weed | 4-6' | 2-4' | Summer | 30" | 1-2 Gallon |
| FR | 5 | <i>Filipendula rubra 'Venusta'</i> | Queen of the Prairie | 4-5' | 3-4' | Sp & Su | 30" | 1 Gallon |
| MD | 14 | <i>Monarda didyma 'Jacob Cline'</i> | Bee Balm | 3' | 1-2' | Sp & Su | 15-22" | 1 Gallon |
| ST | 5 | <i>Sanguisorba tenuifolia</i> | Japanese Burnet | 4-5' | 1.5-2' | Su & Fall | 22" | 1 Gallon |



| Sizing Chart | | | |
|--------------|----------------------|-----------------|-----------------------|
| Sq Ft | Qty of Diff. Species | Total Plant Qty | Ex. Garden Dimensions |
| 50 | 3 | 19 | 5' x 10' |
| 100 | 5 | 37 | 16'-8" x 6' |
| 150 | 7 | 56 | 21'-5" x 7' |
| 200 | 7 | 75 | 25' x 8' |
| 250 | 7 | 93 | 20' x 12'-6" |

The Native Woodland & Wildlife Garden - Part Shade

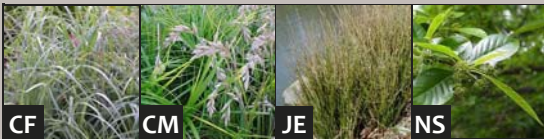
| Abr | Qty | Botanical Name | Common Name | Height | Spread | S. Interest | Spacing | Install Size |
|-----|-----|-------------------------------------|-------------------|--------|--------|--------------|---------|--------------|
| AA | 7 | <i>Acorus americanus</i> | Sweet Flag | 3' | 1.5-2' | Sp, Su, Fall | 22" | 1 Gallon |
| AC | 7 | <i>Anemone canadensis</i> | Windflower | 1-2' | 2-2.5' | Spring | 22-30" | 1 Gallon |
| ACA | 13 | <i>Aquilegia canadensis</i> | Columbine | 2-3' | 1-1.5' | Spring | 15-22" | 1 Gallon |
| AF | 11 | <i>Athyrium filix-femina</i> | Lady Fern | 2-3' | 1-1.5' | Sp, Summer | 22" | 1 Gallon |
| CT | 12 | <i>Caulophyllum thalictroides</i> | Blue Cohosh | 1-2' | 0.5-1' | Summer | 22" | 1 Gallon |
| CA | 4 | <i>Cornus sericea</i> 'Arctic Fire' | Red Osier Dogwood | 3-4' | 3-4' | Sp, Su, Fall | 4-5' | 2-3 Gallon |
| LC | 7 | <i>Lobelia cardinalis</i> | Cardinal Flower | 2-4' | 1-2' | Summer | 22" | 1 Gallon |



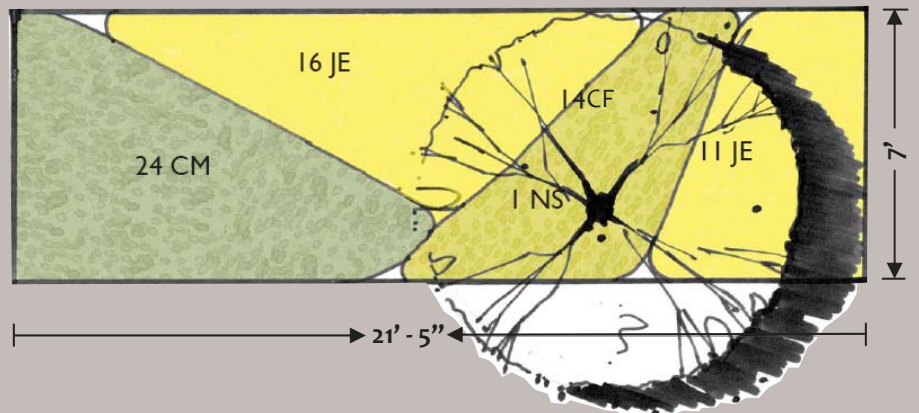
| Sizing Chart | | | |
|--------------|----------------------|-----------------|-----------------------|
| Sq Ft | Qty of Diff. Species | Total Plant Qty | Ex. Garden Dimensions |
| 50 | 3 | 20 | 8' Diameter |
| 100 | 5 | 41 | 11'-4" Diameter |
| 150 | 7 | 61 | 13'-9" Diameter |
| 200 | 7 | 82 | 16' Diameter |
| 250 | 7 | 103 | 17'-10" Diameter |

Urban Curb-Cut Rain Garden - Sun/Part Shade

| Abr | Qty | Botanical Name | Common Name | Height | Spread | S. Interest | Spacing | Install Size |
|-----|-----|-------------------------------------|------------------------|--------|--------|--------------|---------|---------------|
| CG | 14 | <i>Carex flacca</i> | Blue Sedge | 1-1.5' | 1-1.5' | Sp, Su, Fall | 18" | 1 Gallon |
| CM | 24 | <i>Carex muskingumensis</i> 'Oehme' | Variiegated Palm Sedge | 2-3' | 2-3' | Sp, Su, Fall | 18" | 1 Gallon |
| JE | 27 | <i>Juncus effusus</i> | Common Rush | 2-3' | 2-3' | Sp, Su, Fall | 18" | 1 Gallon |
| NS | 1 | <i>Nyssa sylvatica</i> | Tupelo, Black Gum | 35' | 25' | Fall | - | 2-2.5 Caliper |

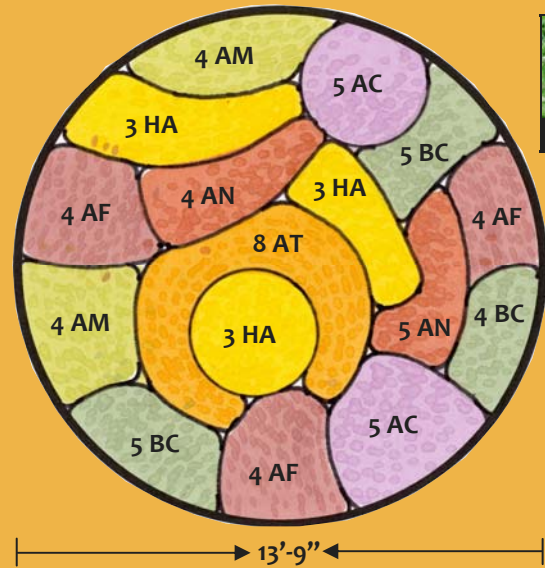


| Sizing Chart | | | |
|--------------|----------------------|-----------------|-----------------------|
| Sq Ft | Qty of Diff. Species | Total Plant Qty | Ex. Garden Dimensions |
| 50 | 2 | 19 | 5' x 10' |
| 100 | 2 to 3 | 37 | 16'-8" x 6' |
| 150 | 4 | 56 | 21'-5" x 7' |
| 200 | 4 | 75 | 25' x 8' |
| 250 | 4 | 93 | 20' x 12'-6" |



The Children's Discovery Garden - Sun

| Abr | Qty | Botanical Name | Common Name | Height | Spread | S. Interest | Spacing | Install Size |
|-----|-----|---|-----------------------|----------|----------|-------------|---------|--------------|
| AF | 12 | <i>Agastache foeniculum</i> | Lavender Hyssop | 2-4' | 1.5-2.5' | Summer | 18-24" | 1 Gallon |
| AM | 8 | <i>Alchemilla mollis</i> | Lady's Mantle | 18-30" | 1.5-2' | Spring | 15-22" | 1 Gallon |
| AC | 20 | <i>Allium cernuum</i> | Nodding Onion | 1-3' | 3-6" | Spring | 1' | 1 Gallon |
| AT | 8 | <i>Asclepias tuberosa</i> | Butterfly Plant | 1-2.5' | 1-1.5' | Summer | 15-22" | 1 Gallon |
| AN | 7 | <i>Aster novae-angliae</i> | New England Aster | 18" | 1.5-2' | Fall | 22" | 1 Gallon |
| BC | 10 | <i>Bouteloua curtipendula</i> | Side-oats Grama Grass | 1.5-2.5' | 1.5-2' | Su, Fall | 22" | 1-2 Gallon |
| HA | 9 | <i>Helenium autumnale</i> 'Moerheim Beauty' | Sneezeweed | 3-4' | 2-3' | Su, Fall | 22-30" | 1 Gallon |



| Sizing Chart | | | |
|--------------|----------------------|-----------------|-----------------------|
| Sq Ft | Qty of Diff. Species | Total Plant Qty | Ex. Garden Dimensions |
| 50 | 3 | 22 | 8' Diameter |
| 100 | 5 | 45 | 11'-4" Diameter |
| 150 | 7 | 68 | 13'-9" Diameter |
| 200 | 7 | 90 | 16' Diameter |
| 250 | 7 | 113 | 17'-10" Diameter |

Rain Gardens Plants for Shade and Clay Soils

The following list of plans can tolerate clay/shade rain gardens. Some may even thrive in these conditions.

| FERN | |
|--|-------------------------|
| <i>Dryopteris filix-mas x marginalis</i> | Vermont Wood Fern |
| <i>Matteuccia struthiopteris</i> | Ostrich Fern |
| <i>Onoclea sensibilis</i> | Sensitive Fern |
| <i>Osmunda cinnamomea</i> | Cinnamon Fern |
| GRASS | |
| <i>Calamagrostis acutiflora</i> | Feather Reed Grass |
| <i>Panicum virgatum</i> | Switch Grass |
| PERENNIALS | |
| <i>Alchemilla mollis</i> | Lady's Mantle |
| <i>Ajuga</i> | Bugleweed |
| <i>Astilbe</i> | Astilbe |
| <i>Aruncus</i> | Goatsbeard |
| <i>Bergenia</i> ssp. | Bergenia |
| <i>Caltha palustris</i> | Marsh Marigold, Cowslip |
| <i>Camassia leichtlinii</i> | Camass |
| <i>Chelone</i> ssp. | Turtlehead |
| <i>Cimicifuga</i> | Tall Bugbane |
| <i>Convallaria majalis</i> | Lily of the Valley |
| <i>Hemerocallis</i> | Daylily |
| <i>Hosta</i> ssp. | Hosta |
| <i>Iris versicolor</i> | Blue Flag Iris |

| PERENNIALS Continued... | |
|-------------------------------|-----------------------------------|
| <i>Ligularia</i> ssp. | Ligularia, Ragwort, Leopard Plant |
| <i>Lobelia spicata</i> | Spiked Lobelia |
| <i>Polemonium reptans</i> | Jacob's Ladder |
| SHRUBS | |
| <i>Rhododendron canadense</i> | Rhodora |
| <i>Salix discolor</i> | Pussy Willow |
| <i>Vaccinium corymbosum</i> | Highbush Blueberry |
| <i>Alnus rugosa</i> | Speckled Alder |
| <i>Cornus amomum</i> | Silky Dogwood |
| TREES | |
| <i>Acer rubrum</i> | Red Maple |
| <i>Carpinus caroliniana</i> | Musclewood |
| <i>Hamamelis virginiana</i> | Witch hazel |
| <i>Juniperus virginiana</i> | Red Cedar |
| <i>Quercus bicolor</i> | Swamp White Oak |

Rain Gardens & Permitting

The large majority of residential rain gardens do not require a permit. As mentioned on page 10, you must obtain permission from the state or local municipality to work within the right-of-way. Rain gardens are consistent with and supported by the Vermont Stormwater Management Manual (VSMM). For more information visit the Vermont Department of Environmental Conservation's (DEC) Web site at <http://www.anr.state.vt.us/dec/dec.htm> or the DEC, Water Quality Division, Stormwater Section at <http://www.vtwaterquality.org/stormwater.htm>.

Additional Resources

Visit the Lake Champlain Sea Grant website for rain garden educational materials as well as information about rain gardens installed in Vermont: www.uvm.edu/~seagrants

Chittenden County Regional Stormwater Education Program's (RSEP) website provides information about problems associated with stormwater runoff and a variety of resources and solutions to address runoff: <http://www.smartwaterways.org/>

Information on tree selection, site assessment, tree planting, and care of young trees is available on the Vermont Urban and Community Forestry Program's website: www.vtcommunityforestry.org

For gardening information contact the UVM Extension Master Gardener HELPLINE 1-800-639-2230 (656-5421 in Chittenden County) master.gardener@uvm.edu www.uvm.edu/mastergardener

Visit the Winooski Natural Resources Conservation District's Web site and click on "VT LID Atlas and Map" to see examples of Low Impact Development (LID) practices throughout Vermont: <http://www.vacd.org/winooski/>

References

Bannerman, R., E. Considine, and J. Horwath, *Rain Gardens: A How To Manual for Homeowners*, UWEX Publications GWQ 037. University of Wisconsin-Extension, 2003

Kloss, C., and C. Calarusse, *Rooftops to Rivers: Green strategies for controlling stormwater and combined sewer overflows*, Natural Resources Defense Council, 2006

Pellett, N. E., and M. C. Starrett, *Landscape Plants for Vermont*, University of Vermont, 2002

Wilson, L., and M. Gilbertson, *Adding a Rain Garden to Your Landscape*, bulletin 2702 of the Landscapes for Maine series. Orono, ME: University Maine Cooperative Extension, 2006

Plant Photo Credits

With permission, the rain garden plant list photos were primarily provided by the following organizations:

Missouri Botanic Garden Plantfinder: www.mobot.org/gardeninghelp/plantfinder/Alpha.asp

USDA, NRCS. The PLANTS Database, National Plant Data Center, Baton Rouge, LA 70874-4490 USA, 2007: <http://plants.usda.gov>

Knoll Gardens: <http://www.knollgardens.co.uk/>

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Emma Melvin

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Fitzgerald Environmental:
Evan Fitzgerald

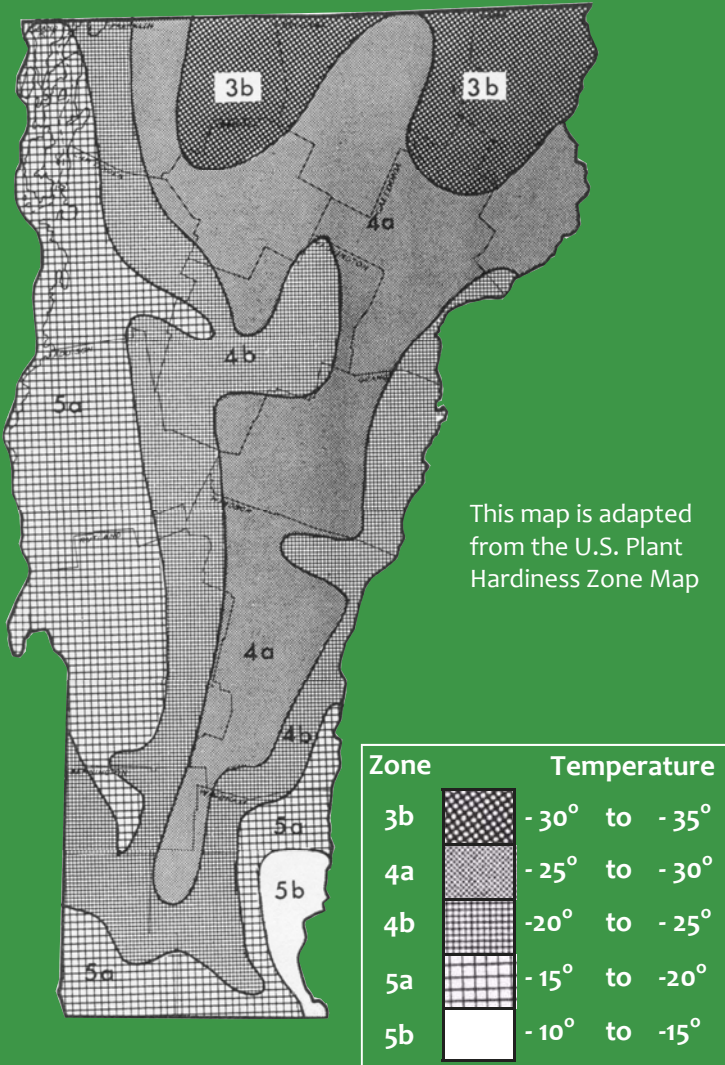
Eco Solutions:
Dave Whitney

On the Web

This manual can be viewed and downloaded for free at: www.vacd.org/winooski/winooski_raingarden.shtml

Plant Hardiness Zones in Vermont

Average annual minimum temperatures



This map is adapted from the U.S. Plant Hardiness Zone Map

The following businesses have demonstrated a commitment to protecting our local waterways by providing financial support and by committing to carry rain garden plants and supplies and/or provide technical assistance:



Round River Design, LLC.
 Michael Blazewicz
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