

Stormwater Management Rain Garden Design for Homeowners

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This is one of a series of three NebGuides on designing and installing rain gardens to provide a functional and aesthetic means for reducing stormwater runoff in urban areas.

Homeowners can reduce water runoff from their yards by using a functional and aesthetic feature called a rain garden. A rain garden is a small area in a residential yard or neighborhood designed to temporarily hold and soak in rain water that comes from a house roof, driveway or other open area. A rain garden is not a pond or wetland. It is dry most of the time and holds water after a rain. Rain gardens typically are planted with a mixture of perennial flowers, ornamental grasses and woody shrubs that are adapted to wet and dry conditions. Water collected in the rain garden slowly infiltrates into the soil to support plant growth. In a properly sited and designed rain garden standing water disappears in less than 48 hours.

Benefits of Rain Gardens

Roof tops, sidewalks, driveways and patios do not allow rainfall to infiltrate into the soil. These impervious areas increase the amount of runoff from urban areas which can cause flooding and carry pollutants to surface water. Rain gardens can capture runoff from these areas and reduce the effect of flooding and runoff pollution. In addition, rain gardens provide many visual benefits, including diverse plantings of flowers, grasses and ornamental plants; berms that add height, contrast, and texture to level areas; and the potential to include landscape features such as stone, or other features for a pleasing garden view (*Figure 1*).

Rain gardens add an aesthetic and functional feature to a yard or landscape, are relatively inexpensive and can be installed by a homeowner with minimum training. This NebGuide describes designing a rain garden for your yard. Alternately, local landscape companies may have experience building rain gardens, or be willing to install one based on information in this NebGuides series.

Design Considerations

Rain gardens are placed to capture runoff from a house roof, driveway, large patio or other impervious surface. Depending on the layout of the gutter system on a home, or the size of the property, more than one rain garden may be needed to collect all runoff.

The type of soil is the key to an effective rain garden. The soil must allow rain to infiltrate fast enough when the rain garden is full so that it will drain in 24 to 48 hours. For the rain garden to work properly, the infiltration rate into the soil should be 0.25 inches per hour or greater. This is not a problem for soils containing large amounts of sand, but could be a problem for soil high in clay. If the soil does not meet this criterion, or cannot be amended to enhance infiltration, a rain garden may not be right for that site. How to determine



Figure 1. Residential rain garden

the infiltration characteristics of the soil will be described later in this NebGuide. Because rain gardens are designed to hold water temporarily they are not a breeding ground for mosquitoes or other pests. They require some routine maintenance, such as removing weeds, replacing dead plants and watering if no rainfall occurs.

Rain Garden Design

Step 1. Determine if Soil is Suitable

Not all soils are suitable for a rain garden. As a rule the infiltration rate should be greater than 0.25 inches per hour. Soils with rates less than this drain too slowly to be an effective rain garden. Soil is made up of three particle types — sand, silt and clay — each in differing amounts. Soils high in sand and silt will usually provide good drainage. Soils high in clay will not drain well and may not be suitable for a rain garden.

Soils vary dramatically from location to location and can vary within the same yard. Also, topsoil typically is removed from many home sites before construction begins. This exposes the subsoil, which in many locations has a greater clay content and a slower infiltration rate. Therefore, it is necessary to determine the soil's suitability at the site where the rain garden will be built.

Two simple methods can be used to determine a soil's suitability. For the first method dig a hole in the ground 6 inches deep and fill it with water. If the water drains away in less than 24 hours, the soil is suitable. If it takes more than 24 hours to soak in, the site is not suitable. Do this test in the spring, or in the typical rainy season, not in the middle of the summer or fall when soil is dry and cracked and may give an erroneous result.

The second method is the feel method to determine if it is a clay soil. Take about a half cup of soil and add a few drops

of water and begin kneading it into a ball. Add a few more drops if the soil is still dry. If the soil crumbles apart and will not stay together in a ball, it is suitable for a rain garden. If the soil forms a ball, then rub the soil between your thumb and index finger to squeeze out a ribbon of soil of uniform thickness. Allow the ribbon to grow out from your fingers until it breaks off. If the ribbon is longer than an inch before it breaks and the soil feels more smooth than gritty, the soil is not suitable for a rain garden.

If your soil is not suitable for a rain garden, there are alternatives you can use to improve the soil's infiltration capacity, capture runoff, or improve drainage. NebGuide G1760 *Stormwater Management: Installing Rain Gardens in Your Yard*, contains ideas for deep aeration, soil amendment, rain barrels and drainage systems that may be used for heavy clay soils.

Step 2. Selecting a Location

Place a rain garden along a gentle slope where it can capture the most runoff from the roof or other impermeable areas. Examine the layout of down spouts from the roof and determine which ones drain the most roof area. Also, look at the lay of the landscape and determine if water collects and flows to certain spots. Rain gardens can be placed near a single down spout or located away from the house to capture runoff from more than one downspout and from other impervious areas in the yard, such as a patio. Also, consider how a proposed location fits into the overall landscape features of the yard. This is a garden and should be located to complement the house and other yard features and be a source of enjoyment for the homeowner and others.

Locate rain gardens at least 10 feet away from the house to avoid water draining toward the foundation. Rain gardens should be located on gently sloping or flat ground. If the land slope is greater than 12 percent, select an alternate location. If your selected location is greater than 30 feet from the house and additional yard area will drain to the rain garden, be sure water from downspouts will reach the rain garden. Often a small swale can be constructed for this purpose. If a swale is not desirable, a buried pipe can transport water from a downspout to the rain garden.

Locate rain gardens based upon drainage patterns, slopes and aesthetic considerations. Rain gardens may be situated within turf areas or in mulched landscape beds that contain other plants and landscape features. Although rain garden "islands" surrounded by turf may be straightforward to install, gardens more effectively enhance landscape structure and space definition when they are

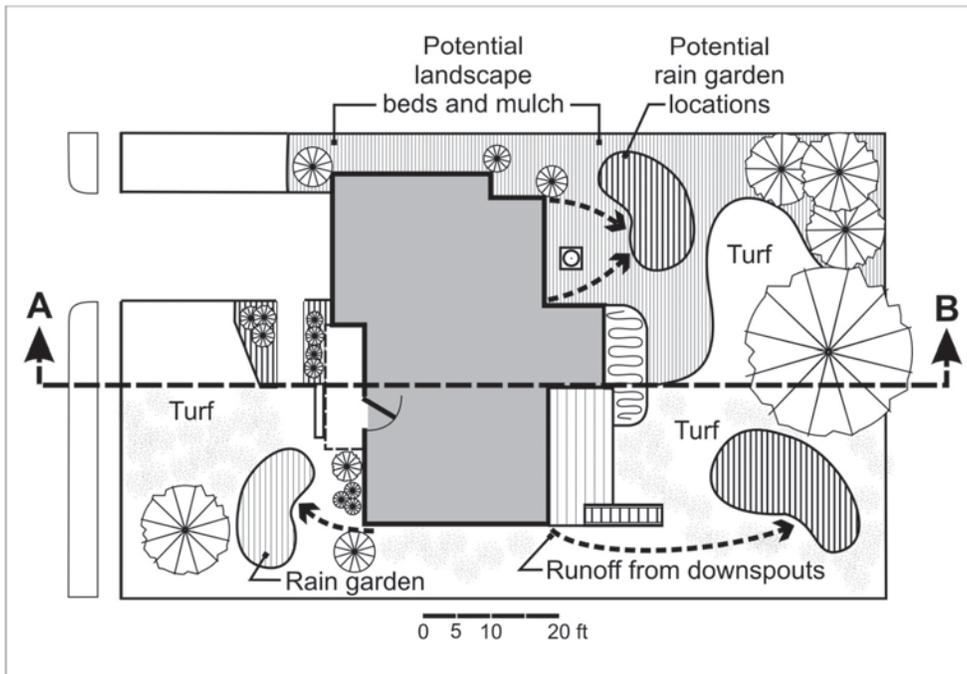


Figure 2. Comparison of rain garden "islands" in turf lawn (below AB line), with rain garden in mulch bed, non-turf area (above AB line).

located at the edge of a lawn area rather than in the middle of a turf space (Figure 2).

Step 3. Determining the Depth

The typical depth for a rain garden is 4 to 8 inches, not to exceed 8 inches, depending on the slope of the landscape. A rain garden greater than 8 inches deep will take too long to drain. A rain garden that is too shallow will need to be excessively large to provide enough water storage. The bottom of the rain garden should be approximately level, which will ensure good water distribution. For steeper locations, earth berms will need to be constructed to hold rainwater and to create a level bottom. Typically, soil dug from the upslope side of the site is used to create a downslope soil berm. Soil may need to be imported if enough is not available.

To determine the ground slope at the site place a stake vertically in the ground at the uphill location of the proposed rain garden. Place a second vertical stake 100 inches directly down slope from the first stake. Next tie a string to the first stake at the ground surface. Then attach the other end of the string to the second stake so that it is level. Use a mason's string level or a carpenter's level to make sure the string is level, not parallel to the ground. Finally, measure the length in inches along the second stake from the ground to the string. This measurement is the slope of the ground surface in percent. For example, if you measure 6 inches from the ground to the string then the slope of the ground between the stakes is 6 percent.

Key points for locating a rain garden

- At least 10 feet from house foundation
- Be aware of rights of way, underground service lines and utilities
- Not directly beneath a tree canopy
- Not directly over septic system (locate at least 25 feet away)
- 25 feet from a wellhead
- Water table at least 2 feet below soil
- Not where water tends to pool
- Flattest part of yard (< 12 percent slope)

For shallow sloped locations less than 4 percent the rain garden depth should range from 3 to 5 inches. For locations sloped from 5 percent to 7 percent a depth of 6 to 7 inches is recommended. For locations sloped 8 percent to 12 percent the depth should be 8 inches. If the slope is greater than 12 percent, select a different site for the rain garden.

Step 4. Size and Shape

The shape of the rain garden should be dictated by the context of the garden location and the eye of the homeowner. Shapes such as a crescent, oval, teardrop, or kidney are generally more appealing than a rectangle. Shapes that contain curves also better fit with the flow of curvilinear bed lines and plant groupings found in many residential landscapes. A general rule is to keep the ratio of length to width at least 2:1, with the longer length dimension running perpendicular to the water entering the rain garden. This orientation maximizes

the amount of water the rain garden can hold. The maximum width should not exceed 15 feet in landscapes with a slope of 8 percent or more.

A typical size for a residential rain garden is 100 to 300 feet². The size is based on the amount of roof and lawn area draining to the rain garden. The size selection recommendations provided here are designed to control 100 percent of the average rainfall. However, you may reduce the size if it seems too big for your location. Reducing the size up to 30 percent will still control 90 percent of average runoff.

University of Wisconsin-Extension recommends using a rain garden size factor that is based on the soil type, depth of the rain garden and the location relative to the house. The size factors are given in Table I. The first step in the sizing process is to estimate the footprint area of the home. This can be done with a tape measure or by pacing with a known pace length to estimate the length and width of the structure. Or, if you know the square footage of the first floor rooms, and the attached garage, etc., these can be added together to estimate the total footprint.

Table I. Rain Garden Sizing Factors. Multiply the drainage area by the size factor for the soil type and location of the rain garden. If the recommended size is greater than 300 square feet, divide it into smaller rain gardens.

Soil Type	For locations less than 30 feet from downspout			For locations more than 30 feet from downspout
	3-5 in. Deep	6-7 in. Deep	8 in. Deep	For all depths
Sandy soil	0.19	0.15	0.08	0.03
Silty soil	0.34	0.25	0.16	0.06
Clayey soil	0.43	0.32	0.20	0.10

The next step is to estimate the percentage of the roof area draining to each downspout that will contribute water to the rain garden. For example, if the house has four downspouts and each drains one fourth of the roof, then each receives drainage from 25 percent of the footprint area. Divide the estimated percentages by 100, then multiply this fraction by the footprint area to get the area contributing to the rain garden. If the rain garden is greater than 30 feet from the house, estimate the patio or lawn area that will drain to the rain garden. This will require an estimate of the length and width of the area draining to the rain garden. Multiply the length and width and add this area to that drained from the roof to get the total drainage area.

Multiply the total drainage area by the size factor for the design depth and soil type (Table I). This value is the design area of the rain garden. Note that a single size factor is used for rain gardens located more than 30 feet from the house. It also is recommended that if this area is more than 300 square feet, it should be divided into smaller rain gardens.

Step 5. Plant Selection and Placement

A rain garden planted with a variety of plants adaptable to rain garden conditions will provide years of enjoyment to homeowners. Since rain gardens typically include low exca-

vated areas as well as mounded areas, growing conditions can vary dramatically within each rain garden. Regionally native or adapted plants found in natural landscapes with variable soil moisture often are well-suited for rain gardens since they tolerate the wet and dry soil conditions found in rain gardens. Many of these plants also enhance water percolation and soil structure over time by growing deep roots and continually replacing old roots with roots in new locations. Non-native plants also may be considered, especially if recommended native/adapted plants are not readily available. Regardless of plant source and type, adaptability to the specific conditions found in the garden is one of the most important considerations for aesthetic and functional rain garden success.

Consider variety and seasonality when selecting plants for your rain garden. The most aesthetically pleasing gardens have plants and flowers with a variety of shapes, textures, heights and colors, as well as plants that bloom at various times of the year to provide season-long interest. In most cases, avoid using trees. Future shading and root competition may limit plant vigor, and a tree likely will grow out of scale in a small to medium-sized rain garden design.

In addition, consider your comfort level for the naturalistic character of most rain garden plantings, especially when compared to an otherwise well-manicured landscape. Selecting relatively short plants and plants that do not seed or root aggressively can help keep a rain garden from looking unkempt or “weedy.” In addition, repeating rain garden plants in other landscape locations can visually unify the character of the entire landscape and minimize the potentially harsh contrast between manicured and naturalistic plantings. NebGuide G1759 *Stormwater Management: Plant Selection For Rain Gardens in Nebraska*, provides additional selection information and a list of flowers, grasses and other plantings suitable for rain gardens in Nebraska. Local nurseries also may be able to give some guidance on plant selection.

When laying out your plantings, consider the following guidelines:

- Many plant species look best when grouped in small to large masses; the massing provides a stronger visual impact than individual plants and helps reinforce a sense of structure for the garden. Masses should vary in width and length, curve to create strokes or drifts of color and texture, and be interlaced (planted in front of or behind other groups with ends of masses overlapped) to help unify the garden.
- Plants with unique or striking forms, colors or textures can be planted individually to create garden focal points and highlight unique plant characteristics.

- Create landscape depth by planting taller plants toward the middle of the garden, with gradually shorter plants toward the outside of the garden. Depending on the view point, this combination also helps to visually and physically “hold up” the taller plants.
- Selected plants should be repeated in several locations throughout the garden to visually unify it through similar colors, textures and bloom times.
- Consider working with a nursery or landscape designer for optimizing plant selection and placement.

Step 6. Adding Enhancements

Incorporating landscape enhancements such as rock, stonework, fences or other garden ornaments can create additional interest in the rain garden for year round enjoyment. Adding stone, fencing or other garden elements should be considered in combination with plant selection so that the landscape character as a whole appears unified. Use care when selecting and locating enhancements — they can be strong visual elements that dominate landscape views. They should serve functional as well as aesthetic purposes when possible; for example, use stonework to reinforce the visual edge of the garden, add a fence to direct a garden path or provide a location to grow a vine. Finally, enhancements should blend well with the overall garden character for example, use a naturalistic fence in a native plant garden.

Additional Resources

Home Landscape: Understanding the Basics of Landscape Design. University of Nebraska–Lincoln Extension, Extension Circular (EC1254), 32 pp.

Rain Gardens: A how-to manual for homeowners. University of Wisconsin Extension. UWEX Publication GWQ037, 31 pp.

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