Wild Geranium
Geranium maculatum

PLANT NOTES
Common throughout Iowa, but more prevalent in eastern counties. Prefers partial shade and slightly damp sandy or loamy soils. When not flowering, Wild Geranium leaves may be mistaken for Canada Anemone. Flower is 1 1/4” diameter with upward facing saucer-shaped petals with rounded tips. Foliage remains all season. Blooms in the summer to early fall.

Photos: Shutterstock
Determining Drainage Areas

The first step in designing a rain garden is to determine what areas flow to the rain garden. Typically, rain gardens manage rainfall from roofs and lawns. The plan is to direct one or several of the home’s downspouts to the rain garden and determine the specific area of the roof that drains to each downspout.

An easy way to determine the surface area of a roof is to place a tape measure on the ground and mimic the outline of the roof. Measure the length and width of the roof. Another option is to use Google Maps on the Internet. Locate the property and use the “Measure Distance” tool by right-clicking on the map. Draw the outline of each roof section and note the area. Add the roof sections together to find the impervious drainage area in square feet.

All surface area calculations should be measured in "plan view", which is the two-dimensional area of the roof. When measuring the roof, be sure to include overhangs, eaves, and all roof areas contributing to each gutter.

Next, measure the approximate lawn area that will contribute runoff to the rain garden. This area is known as the pervious drainage area. Some rainfall that falls on pervious areas will soak into the ground and not contribute runoff to the rain garden. Therefore, the entire pervious area may not need to be included in the total drainage area. The pervious area can be entirely eliminated from the total drainage area if soil quality restoration (SQR) has been completed. SQR is a combination of removing pollutants from the soil and reestablishing plant cover to reduce the amount of runoff.
Calculating Size and Selecting a Shape

The majority, 90 percent, of rainfall events in Iowa generate less than 1.25 inches of rainfall in 24 hours. Design calculations will ensure that rain gardens handle runoff from 1.25 inches of rain. This amount of rainfall is called the Water Quality Volume (WQv). In order to effectively manage the WQv, a rain garden must have enough surface area and be deep enough for stormwater to be stored without overtopping. Follow the instructions on page 30 to determine the appropriate size and depth for the rain garden. The instructions will yield the square feet of rain garden surface area needed to impound the WQv. Rain gardens can be built with a surface area greater than what is required by the WQv to manage more rainfall.

Next, determine the appropriate depth for the rain garden. This guide offers three options: six, nine, and 12 inches. Most residential rain gardens in Iowa have a six-inch or nine-inch depth. The 12-inch option is only recommended for large sites, such as commercial areas or parks, as it may be too deep for a small residential application. A common rule of thumb is to use a six-inch ponding depth if the rain garden is estimated to be less than 200 square feet.

A key design and installation decision is determining the rain garden's correct elevation in the landscape. Rain gardens in flat areas can be created with a ponding depth below the surrounding area that overflows into the yard. Selecting a shape that conforms to the existing landscape, and at the ideal elevation, can help avoid unnecessary labor and material costs. An ideal elevation for a rain garden is where either the upslope or downslope side of the rain garden is level with the nearby landscape. A rain garden may require the use of a berm to create ponding depth. Retaining walls can be used on steeper slopes.

Once the surface area is determined, consider various dimensions (lengths and widths) that yield the required square footage. Long and narrow rain gardens are often preferred so installation and maintenance can be done from the side of the garden. Common rain garden shapes are rectangular, kidney, oblong, and L-shaped.
After calculating the depth and dimensions of the rain garden, the next step is to determine a method or combination of methods for getting rainwater to the rain garden. Consider the options shown below. Whichever method(s) is selected, ensure there is an adequate slope to allow gravity to move rainwater to the rain garden.

- Gutter extension added to downspout to move rainwater to rain garden.
- Buried drain pipe connected to downspout that discharges to the surface of a garden.
### How To Calculate the Size of Basic and Enhanced Rain Gardens

<table>
<thead>
<tr>
<th>Step 1: Estimate Impervious Drainage Area</th>
<th>Estimate the impervious drainage area in square feet of the contributing roof section(s). If applicable, add the total area of other impervious surfaces that would contribute runoff (e.g. driveway, sidewalk, patio). <em>The result of this step is total impervious surface area in square feet.</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 2: Estimate Pervious Drainage Area</td>
<td>Estimate the pervious drainage area of lawn that would contribute runoff to the rain garden. Refer to the site drawing to determine the areas of the lawn that will shed runoff to the rain garden. <em>The result of this step is total pervious surface area in square feet.</em></td>
</tr>
<tr>
<td>Step 3: Calculate the Total Drainage Area</td>
<td>On lawns that have not had SQR completed: ( \text{Total Drainage Area} = \text{Impervious Drainage Area} + \frac{1}{2} \text{the Pervious Drainage Area} ). For lawns that have completed SQR: ( \text{Total Drainage Area} = \text{Impervious Drainage Area} ). <em>The result of this step is the total drainage area required for the rain garden to manage the Water Quality Volume (WQv).</em></td>
</tr>
<tr>
<td>Step 4: Select Footprint Area Percentage</td>
<td>Select desired ponding depth of 6, 9, or 12 inches. Refer to the Rain Garden Sizing Guidelines table on page 31 to determine the required footprint area percentage, which is based on the selected ponding depth and the calculated percolation rate in Chapter 2.</td>
</tr>
<tr>
<td>Step 5: Calculate Footprint of Rain Garden Area</td>
<td>Using the following formula, calculate the required footprint of the rain garden: ( \text{Rain Garden Footprint} = (\text{Total Drainage Area}) \times (\text{Footprint Area Percentage from the table on page 31}) ). <em>The result of this step is the surface area of the proposed rain garden in square feet.</em></td>
</tr>
<tr>
<td>Step 6: Select Shape and Calculate Surface Area Dimensions</td>
<td>Select a basic shape for the rain garden based on site constraints and preferences. Determine the length(s) and width(s) of the rain garden that is roughly equal to or slightly larger than the area calculated in Step 5.</td>
</tr>
</tbody>
</table>
## Rain Garden Sizing Guidelines

<table>
<thead>
<tr>
<th>Percolation Rate</th>
<th>Appropriate BMP for Site and Ponding Depths for Rain Gardens</th>
<th>Footprint Area Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 0.5 inches per hour</td>
<td>Enhanced Rain Garden</td>
<td>5%</td>
</tr>
<tr>
<td>&gt;= 1.0 inch per hour</td>
<td>Basic Rain Garden with 6” Ponding Depth ^1</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td>Basic Rain Garden with 9” Ponding Depth ^1</td>
<td>7%</td>
</tr>
<tr>
<td></td>
<td>Basic Rain Garden with 12” Ponding Depth ^2</td>
<td>5%</td>
</tr>
<tr>
<td>0.5 - 0.99 inch per hour</td>
<td>Basic Rain Garden with 6” Ponding Depth ^1</td>
<td>21%</td>
</tr>
<tr>
<td></td>
<td>Basic Rain Garden with 9” Ponding Depth ^1</td>
<td>14%</td>
</tr>
<tr>
<td></td>
<td>Basic Rain Garden with 12” Ponding Depth ^2</td>
<td>10%</td>
</tr>
<tr>
<td>&lt; 0.5 inch per hour</td>
<td>Bioretention Cell ^3</td>
<td>~3% - 4% ^4</td>
</tr>
</tbody>
</table>

^1 Appropriate for drainage from one home. Not applicable for managing runoff from numerous sites.

^2 For use on large sites only.

^3 Where soils drain less than 0.5 inches per hour, it is recommended that a bioretention cell be installed rather than an enhanced rain garden. Bioretention cells are typically installed in parking lots or along roadways. They typically treat runoff from large watershed areas and are often used in tandem with pre-treatment practices to provide added sediment capture. Refer to Chapter 5, Section 4 of the Iowa Stormwater Management Manual (ISWMM) for full design guidelines. The ISWMM can be accessed online via the Iowa DNR’s website.

^4 General rule of thumb. Actual square footage must be calculated using the bioretention cell calculation in the ISWMM.
Rain Garden Sizing Example

**Step 1: Estimate Impervious Drainage Area**

What is the total surface area of the contributing roof section(s)?

What is the total surface area of the contributing driveway, sidewalk, patio, or other impervious area?

$$\text{Total Impervious Surface Area} = 652 \text{ ft}^2 + 0 \text{ ft}^2 = 652 \text{ ft}^2$$

**Step 2: Estimate Pervious Drainage Area**

What is the contributing area of lawn upslope of the rain garden?

$$\text{Total Pervious Surface Area} = 1,137 \text{ ft}^2$$

**Step 3: Calculate the Total Drainage Area**

In this example, soil quality restoration (SQR) has not been completed. Soil organic matter content of site soils is less than 5 percent.

$$\text{Impervious Drainage Area} + (0.5 \times \text{Pervious Drainage Area}) = \text{Total Drainage Area}$$

$$\frac{652 \text{ ft}^2}{\text{Step 1}} + \left( \frac{0.5 \times 1,137 \text{ ft}^2}{\text{Step 2}} \right) = 1,221 \text{ ft}^2$$
Step 4: Select Ponding Depth

Previous percolation tests determined an average percolation rate of 0.8 inches per hour. The homeowner selects a ponding depth of 6 inches. This allows them to build a rain garden that has a larger footprint that doesn't appear too deep and provides more space to plant grasses and flowers.

Percolation Rate = \( 0.8 \) inches /hour

Desired Ponding Depth = 6" or 9" or 12"

Percent of Total Drainage Area (Per Sizing Guidelines Table on Page 31) = \( 21\% \)

Step 5: Calculate Footprint of Rain Garden Area

\[
\left( \frac{1,221}{ft^2} \right) \times \left( \frac{0.21}{} \right) = \frac{256}{ft^2}
\]

(Total Drainage Area) \times (\% of Total Drainage Area) = Footprint of Rain Garden

\( \text{Step 3} \times \text{Step 4} \)

Step 6: Select Shape and Calculate Surface Area Dimensions

The homeowner selected an "L"-shaped rain garden, which was based on site constraints and preference. The total surface area of the "L"-shape should be approximately 256 square feet.

\[
\left( \frac{8}{ft} \times \frac{7}{ft\ of\ Square} \right) + \left( \frac{20}{ft} \times \frac{10}{ft\ of\ Rectangle} \right) = \frac{256}{ft^2}
\]

(Length \times Width of Square) + (Length \times Width of Rectangle) = Surface Area of "L"-shaped Rain Garden

\[
\begin{align*}
8\ ft & \quad 7\ ft \\
10\ ft & \quad 20\ ft
\end{align*}
\]

\[
\begin{align*}
200\ sq\ ft & \quad + \quad 56\ sq\ ft \\
& \quad = \quad 256\ sq\ ft
\end{align*}
\]
In some cases, a home’s gutter system and downspouts will be directly connected to the storm sewer system. If rainwater will discharge directly to a rain garden via one or multiple downspouts and the home’s system is tied directly to the storm sewer, check with the local community to find out if there are any disconnection requirements.

### Inlets and Outlets

Rainwater typically enters the rain garden from a downspout, subdrain, or swale. The inlet is the opening where most of the rainwater enters the rain garden. Keep in mind that water comes from impervious and pervious areas and may enter the rain garden from a variety of places.

To prevent scour and erosion of soil in the bottom of the rain garden, armor the inlets and outlets with washed, three to four-inch diameter rocks, flagstones, or other protective products. Optionally, place landscaping fabric over the soil before placing rock so erosion does not occur right below the rocks. *This is the only location in the rain garden where limited use of landscaping fabric may be used.*

Rain gardens also need a designated outlet to allow excess water to leave the rain garden safely without causing damage to the garden. Outlets typically are notched out areas in a berm where excess rainwater can pass through. They should be reinforced with vegetation or rock. The outlet should be level to prevent scour at the discharge point.

If installing an enhanced rain garden, an overflow pipe is often used in combination with the notched out area in a berm. The height of the overflow pipe is set at six, nine, or 12 inches (the ponding depth) above the base of the rain garden. The notch in the berm can be set at the same elevation as the overflow pipe or a little higher as a backup in case the overflow cannot handle all the water. Make sure that where the base of the overflow pipe daylights back onto the lawn, water is conveyed in a manner that does not damage downslope property or infrastructure.
Berms and Retaining Walls

Rain gardens must be level from end to end and side to side. One option to create a level bottom in sloped areas is to use berms and/or retaining walls. Berms can provide a natural edge for the rain garden and allow for rainwater to pond and soak into the soil.

If berms are used, ensure that the berm located on the downslope edge of the rain garden is higher than the upslope berm. The back slope of the berm should be gradual. A 5:1 slope is recommended and means that for every one foot of vertical height, the berm should extend out five feet horizontally. This will allow water during larger rainfall events to flow slowly to an area stabilized with vegetation, rocks, or other types of stabilization. If the site is flat, berms are not always necessary. Simply excavate to get to the designed ponding depth.

If steep slopes exist at the site of a proposed rain garden, a retaining wall may be needed. A retaining wall can be built up to create a level depression on a sloping site. An alternative is to cut into a slope to create a level depression and have the retaining wall as a backdrop that holds the cut slope soil in place. Retaining walls can be used for decorative purposes even if there are no steep slopes.

Pre-Treatment Areas

Some rain gardens, primarily enhanced rain gardens designed to manage larger drainage areas, feature pre-treatment areas. These areas are used to filter out debris and sediment before stormwater runoff reaches the rain garden. Pre-treatment areas can extend the longevity of the stormwater BMP and reduce annual maintenance. Rain gardens located along streets or driveways typically include a curb cut to allow stormwater runoff to enter into the rain garden. A grass filter strip between the curb and rain garden is a simple pre-treatment practice that could be used in this scenario. Sod should be placed two inches lower than the inlet to accommodate sediment deposition. Another option for pre-treatment could be stone steps.