Calculating Size and Depth

Here's the process for determining the correct surface area and depth for a rain garden:

1. Measure the size of the area that will contribute runoff to the rain garden in square feet. If you're capturing roof runoff from a downspout, measure the length and width of the roof that drains to the downspout. (Just pace it out or measure it with a tape on the ground.)

2. Sizing of the rain garden will depend on the depth of the rain garden and the percolation rates you have at the site. Remember – you should have a minimum percolation rate of 0.5"/hr.

3. With a **percolation rate of 0.5"/hr:**

a. Multiply the impervious surface area calculated above by **20%** (0.2) if the rain garden will have **6 inches of depth**.

b. Multiply the impervious surface area calculated above by **16%** (0.16) if the rain garden will have **8 inches of depth**.

c. Multiply the impervious surface area calculated above by **14%** (0.14) if the rain garden will have **9 inches of depth**.

4. With a **percolation rate of 1"/hr or more:**

a. Multiply the impervious surface area calculated above by **10%** (0.1) if the rain garden will have **6 inches of depth**.
b. Multiply the impervious surface area calculated above by **8%** (0.08) if the rain garden will have **8 inches of depth**.
c. Multiply the impervious surface area calculated above by **7%** (0.07) if the rain garden will have **9 inches of depth**.

(These calculations will yield the square feet of surface area needed to impound and infiltrate runoff from a 1.25" rain. Actually, there is a safety factor built in by following this method. The square footage calculated and the depth specified assumes you will have 100% of a 1.25 inch rain impounded in the rain garden all at once. Typically this won't happen. You'll have infiltration and percolation occurring as soon as runoff enters the rain garden and you'll typically have a small percentage of water retained in gutters. Also, there is a lag time in the runoff reaching the rain garden so it all doesn't arrive at the same point in time.)

5. Once the square footage of surface area is determined, consider various dimensions that yield a length x width that equals the square feet of surface area needed and fits the site. It is best to install long and narrow rain gardens so work can be done from the side when digging, planting, and doing maintenance.

6. Rain gardens should have a designated outlet to convey runoff away safely when a rainfall event occurs that is larger than 1.25 inches. It is guaranteed that this will happen and you don't want water flowing out of a rain garden that causes damage. Outlets will typically be an armored – or reinforced – low spot in a berm or at the end of a rain garden. Be sure that any flows from the rain garden are conveyed in a way that does not cause erosion or damage property or infrastructure below the site.

7. One other thing to consider is whether to include capacity for runoff from the lawn above a rain garden. Ideally, a lawn will have adequate soil quality so that it absorbs and infiltrates the WQv and lawn runoff will not have to be included in the design. Soil quality restoration is recommended for lawns above a rain garden if a lawn generates runoff. This will help create a combination of practices which is always better than reliance on a single practice system. Soil quality restoration guidelines are available in Chapter 2E-5 of the Iowa Storm Water Management Manual. Find it online at www.ctre.iastate.edu/PUBS/stormwater/documents/2E-5SoilQualityRestoration.pdf.

8. On small rain gardens, it is better to increase surface area and stay with the 6 inch depth. Nine inches of depth may look "too deep" in a small rain garden.

Appendix 4

Design Exercises

Exercise 1

Assume you have a 2000 sq ft house. You have 4 downspouts taking equal amounts of runoff. Therefore, 2000 sq ft divided by 4 downspouts = 500 sq ft / downspout. Measure it out to confirm. 25 ft L x 20 ft W = 500 sq ft. You can add a safety factor in and account for the slope of the roof by multiplying the measured area by 12% - or 0.12. In this example 500 sq ft x 0.12 would yield an additional 60 sq ft, making the total area to design for 560 sq ft.

Assume you have perc rates of 0.5 in/hr and want a depth of 6 inches:

560 sq ft x .20 (from text) = 112 sq ft of surface area needed for the rain garden.

Now determine the dimensions of the rain garden:

112 sq ft ÷ 10 ft W = 11 ft L x 10 ft W (Try to go longer and more narrow.)
112 sq ft ÷ 7 ft W = 16 ft L x 7 ft W (Not bad...can you comfortably work 3.5 ft in from either side to do planting, weeding, etc. without having to walk and compact the surface of the rain garden?)

Does that length fit the site? (Remember, the roof line you're managing water from is 25 ft long).

112 sq ft ÷ 5 ft W = 22 ft L x 5 ft W (Easy to work from the sides but may be getting too long for the site).

Exercise 2

Assume you have the same house dimensions but have perc rates of 1 in/hr. You want to stay with the 6" of depth for your rain garden.

Once again you'll have 560 sq ft of impervious surface to manage runoff from.

560 sq ft x 0.10 (from text) = 56 sq ft of surface area needed for the rain garden

Now determine the dimensions of the rain garden:

56 sq ft ÷ 10 ft L = 10 ft L x 6 ft W
56 sq ft ÷ 12 ft L = 12 ft L x 5 ft W

Note: Don't get too worried about going to a shorter and wider layout if it fits the site better. But do pay attention to traffic and compaction on the bottom of the rain garden. You could lay boards across the top of the garden to do planting and weeding or you can create decorative paths through the planting and confine foot traffic to the pathways. And remember, a rain garden doesn't have to be square or rectangular. It can be any shape you desire or that fits the site best. These dimensions are guidelines for sizing, so try to get this square footage even if the rain garden is an irregular shape. If you end up a little larger or a little smaller, that's fine. Remember, you can't make a rain garden too big and you have a safety factor built into the design if you end up a little smaller.

Appendix 6

Temporarily Impounded Water Calculations
(The formula on Appendix 5 covers this, but if you're curious about how much water you're managing you can calculate it with this formula):

Sq ft of impervious surface ÷ 43,560 sq ft = _______ acres of impervious surface.

______ acres of impervious surface x 27,152 gallons/ac/inch of rain = _____gallons/inch.

______ gallons/ac/inch x 1.25 inches = ________gallons/1.25 inches (WQv).

______ gallons x 0.1337 cu ft/gal = ______ cu ft of runoff to manage.

Exercise 1
From the example above we know we have 560 sq ft of impervious surface to manage. So,

560 sq ft ÷ 43,560 sq ft/ac = 0.013 ac of impervious surface

0.013ac x 27,152 gallons/ac/inch = 353 gallons of rain/inch from the downspout

349 gallons/inch x 1.25 inches = 441 gallons for the WQv

436 gallons x 0.1337 cu ft/gallon = 59 cu ft of water

With a rain garden surface area of 112 sq ft x 0.5 ft deep = ~56 cu ft of available storage. That's close enough to the 59 cu ft of water being generated. Remember, not 100 percent of the rainfall will reach the rain garden, and there will have been some infiltration before the last of the runoff arises.

Exercise 2
With perc rates of 1 inch/hr we will have about half the cu ft of temporary storage. We had a surface area of 56 sq ft x 0.5 ft of depth = about 28 cu ft of storage. We still have 59 cu ft of water to manage. So doubling the perc rate offsets the reduced storage we have, compared to what we needed above.