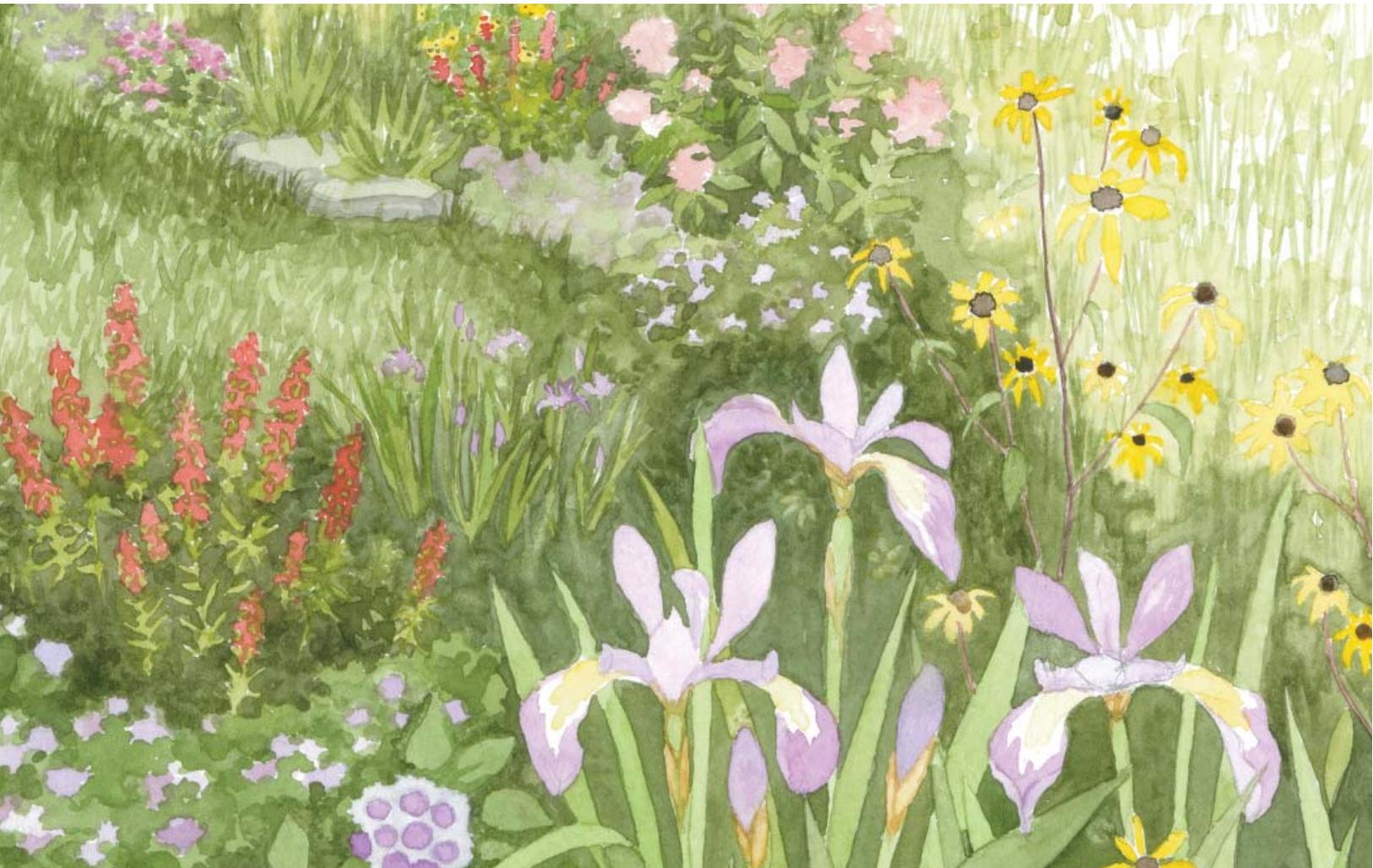




AN INTRODUCTORY GUIDE TO
PROTECTING AND IMPROVING WATER QUALITY

RAIN GARDENS

PROVIDED BY THE KNOX COUNTY STORMWATER DEPARTMENT 2015



ACKNOWLEDGEMENTS

THANK YOU TO THE FOLLOWING CONTRIBUTORS

Tim Hill

Amy Mann

Parci Gibson

Martin Pleasant

Leah Gardner



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Rain Garden Overview

What is a Rain Garden?

A rain garden is a shallow, planted depression that is designed to hold and infiltrate stormwater runoff from impervious surfaces such as roofs, streets, driveways, parking lots and compacted soil areas.

Why Install a Rain Garden in my Yard?

Rain gardens are a beautiful, functional way to improve drainage on your property. By capturing and infiltrating stormwater, rain gardens help slow down stormwater runoff and filter out any pollutants contained within stormwater, like fertilizers, sediment, and pathogens. In this way, rain gardens can mitigate actively eroding areas in your yard while enhancing its visual appeal.

Rain gardens not only reduce erosion and localized flooding, they also enrich the charm and attractiveness of your yard or neighborhood. Rain gardens are a landscaping amenity that often add not only beauty, but also value to a property. By populating your rain garden with native shrubs and flowers, you will attract local pollinators and wildlife that use native plants for food sources and habitat. Native plants will generally tolerate local climate conditions better than non-native species and can be selected for your specific site conditions (shady v. sunny; water-loving v. water-averse).

Will Knox County help me install a Rain Garden?

The mission of Knox County Stormwater Management is to improve and maintain the health of Knox County water resources by mitigating the effects of urban development. The Knox County Stormwater Department created the Environmental Stewardship Program (ESP) in 2001 to provide Knox County citizens with solutions for off Right-Of-Way (ROW) requests addressing erosion and nuisance flooding.

The ESP program is a voluntary cost-share program that funds engineered and bioengineered sustainable approaches to the age old public works method of pipe and rip-rap. This low impact approach improves filtration and reduces stormwater runoff on privately owned properties located within Knox County.

Knox County partners with the Tennessee Smart Yards Program (TNSY) to offer rain garden installation workshops for Knox County residents and neighborhood associations. The workshops prepare participants on how to site, size, install and maintain a rain garden. <https://ag.tennessee.edu/tnyards>

To learn more about the ESP & TNSY programs, contact Knox County Stormwater at Stormwater@knoxcounty.org or at (865) 215-5540.



Large back yard rain garden in Knox County



Back yard rain garden with permeable paver patio

Planning for Your Rain Garden

DIY or Involve a Professional?

Creating a rain garden is an iterative process that will likely require adjustments along the way. One of the first things to consider is whether or not to involve a designer or landscape professional...in this case, size matters as well as complexity.

Any amount of rain water that can be captured and infiltrated will help improve water quality, so there are no set minimums or maximums for size. Many homeowners install small rain gardens by hand, while larger rain gardens requiring earthwork and soil amendments may be better left to a professional. It is highly recommended that you consult a professional to help design and install your rain garden if your site has a high water table, shallow depth to bedrock, steep slopes, or sink holes.

Selecting the Best Location

Like any other garden feature, it is important to consider how your rain garden will fit into the existing landscape. Here are some questions that may help guide your site selection:

- Where will a rain garden be most effective at capturing runoff?
- Are there existing trees, shrubs, or structures in or adjacent to this area?
- Are there nearby above/underground utilities ?
- Is there a septic system on the property?
- How will my rain garden installation affect my neighbor's property?

Tree roots, building foundations, underground utilities, and septic systems can all affect where you ultimately decide to build your rain garden. Some underground utilities can be located by calling **TN811** or visiting online at: www.tenn811.com. **(Note: This service does not locate utilities that are maintained by the property owner such as irrigation lines, sewer connections from your residence, added electrical lines, and other systems that may have been added to your property by you or a previous owner).** Some homes currently use septic systems or have discontinued septic systems that need to be marked. You can contact the **Knox County Health Department (865) 215-5000** to check if they have a map of the septic system.

Additional factors to consider when selecting the best location for your rain garden include aesthetics, sunlight, habitat, and soil type.

Visualizing a Size That's Just Right For You

Now that you've picked a great spot for your rain garden, it's time to decide on the size. First, estimate how much impervious surface (rooftop, driveway, concrete slab, etc.) is on your site. Then, check out Table 1 below to see how large your rain garden should be to capture the first inch of runoff from these surfaces during a storm event. The suggested dimensions are based on a rain garden with an average 6" pooling depth.

Table 1

Impervious Area (square feet)	Rain Garden (square feet)	Possible dimensions (feet x feet)
250	42	9x5
500	83	12x7
750	125	14x9
1000	167	17x10
1250	208	19x11



Considering Your Soil

When planning the construction of a rain garden for your property, knowing the basic physical characteristics of your soils is important to help guide the design. To ensure a healthy, functional rain garden, your soil must provide the following:

- Water
- Minerals
- Nutrients
- Aeration
- Structural Support

Soil characteristics determine the rate at which water seeps into the ground. The size of your rain garden should be adjusted to coincide with the infiltration rate of the soil at your chosen site.

Determining your Soils Infiltration Rate

Ideally you would like for your rain garden to drain in 72 hours. There are a couple different ways to estimate how fast water will infiltrate into your soil:

1. Direct Test. Dig a hole in the ground about a foot deep. It can be between 6 to 12 inches in diameter. Fill it with water under dry conditions and allow the ground to saturate. Then refill the hole and time how long it takes to drain. If it takes longer than 72 hours to drain, you may need to add soil amendments or consult a professional on improving the infiltration rate.

2. Look up your soil type using the KGIS online map tool (www.kgis.org). Search for your address and then turn on the soil map layer. The soil map will show you a soil type that will have a Hydrologic Soil Group Letter A-D. **Table 2** shows the average infiltration rate for the Hydrologic Soil Group with a maximum pool depth if you want the rain garden to drain in 72 hours.



Benefits of Soil Amendments

Soil amendments may be required to address compaction, buried rubble, contamination or nutrient depletion. Soil amendments can also improve water holding capacity of soil, reducing the need to water your rain garden.

Another benefit of using a soil amendment is to increase your water storage capacity by adding an amendment with a high porosity, such as sand. Below, **Table 3** calculates your Rain Garden area based upon a soil amendment with a 50/50 soil and sand mixture. The soil needs to be rich in nutrients with 3 to 5 percent clay content.

For a more detailed explanation of sizing your rain garden using soil amendments see Knox County Stormwater Manual Volume 3.

Table 2

Soil Group	I = Rate (inch/hour)	D = Max Depth (feet)
A	0.38	2.3 use 2.0
B	0.23	1.4
C	0.10	0.6

Table 3

Impervious Area (square feet)	Rain Garden (square feet)	Possible dimensions (feet x feet)
250	17	3x6
500	35	4x9
750	52	5x11
1000	69	6x12
1250	87	7x13

Designing Your Rain Garden

The Environmental Landscape Design Approach

Environmental Landscape Design is a way of designing and managing aesthetically and ecologically rich landscapes that reflect a sense of stewardship and care towards our environment. This approach promotes finding creative design solutions for common landscape challenges that will improve both the environmental and aesthetic quality of our community. Catching and filtering stormwater runoff with a rain garden is a perfect example of Environmental Landscape Design.

We can further increase environmental and aesthetic value by preserving, protecting, and integrating native plant communities as much as possible. So, by shifting the way we view, shape, and manage our landscapes towards promoting Environmental Landscape Design with native plants, we can:

- Improve Water Quality
- Improve Stormwater Management
- Increase Biodiversity (habitat, wildlife, plants)
- Conserve Energy and Natural Resources
- Protect Visual & Cultural Context of our Unique Region

Choosing Your Shape & Style

Rain gardens can take on all kinds of shapes and styles. Once you've determined where your rain garden will go and how large it will be (section II.), you can have fun deciding how you want it to look. Do you prefer a rectilinear or curved edge? Symmetrical or asymmetrical organization? Somewhat manicured or totally wild? The possibilities are endless, but here are a few basic tips to consider:

1. **Choose a shape that makes sense in your existing landscape.** A circle, an oval, or a bean shape might look great standing alone, where as a linear rectangle might look better along a fence.
2. **Embrace well-organized chaos.** One way to enhance the wild beauty of your native wildflowers and grasses is to let them be wild, while maintaining a clean mulched edge or mow-line around your rain garden. This can give the garden a groomed but not quite manicured look that is quite pleasing.
3. **Create visual layers.** Whether your rain garden is round or square, in the middle of your lawn or along the back fence...it would be nice to see all the plants from where you're viewing them. So, if you can see it from all sides, put taller plants in the middle and tier down towards the edge. If only seen from the front, put the taller plants in the back.
4. **Make it beautiful AND manageable.** Be honest about your level of commitment when it comes to maintenance and plan accordingly. There are many plants that require very little care and have a naturally tidy appearance...and many that don't. Do your research.

Choosing Your Plants

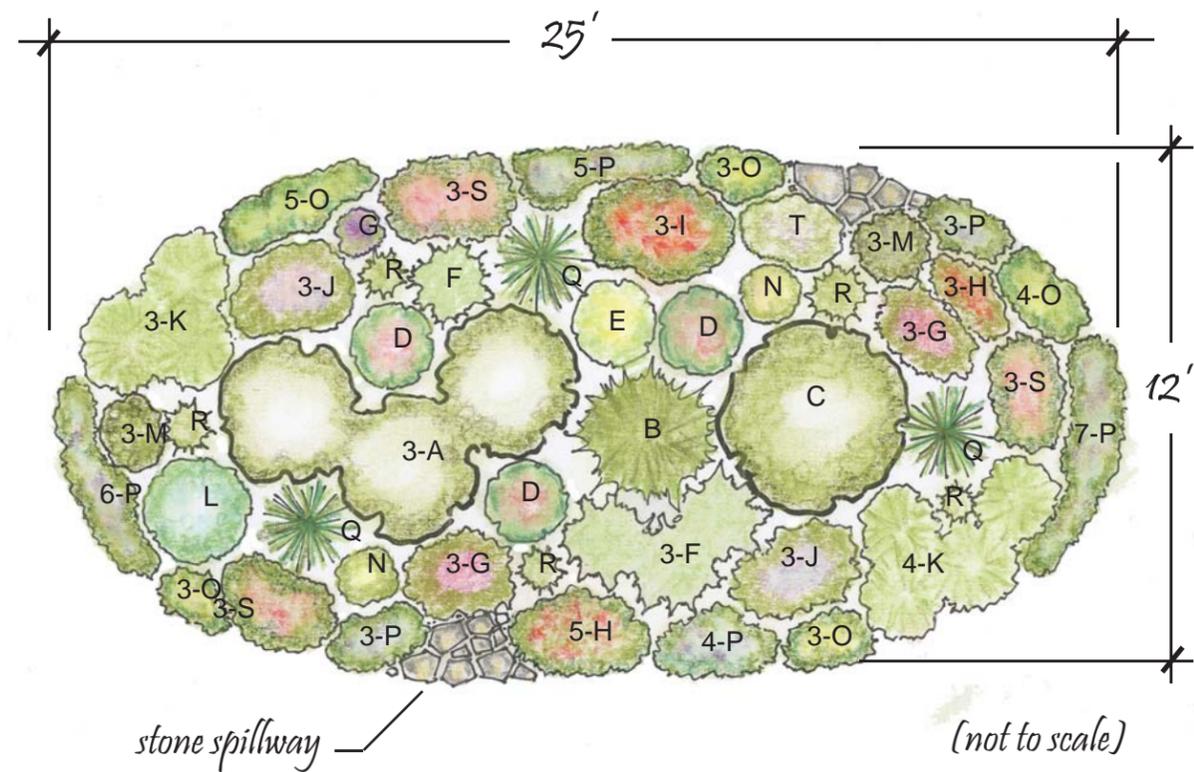
As mentioned before, integrating native plants into our landscapes is a great way to improve our environment (including water quality) in so many ways. A group of species (trees, shrubs, and ground covers) growing in a particular ecosystem together is called a plant community. We can look to nature for design tips by paying attention to what plants naturally grow together depending on things like soil moisture and sun/shade.

Selecting the right plants for your rain garden is very important if you want them to live. If built properly, most rain gardens will fill with water during rain events and will drain within 72 hours. This means the plants you choose must be able to withstand alternating periods of flood and drought. They must also be well-suited to thrive in the amount of sun your chosen area receives.

See the following pages for two basic rain garden design examples...one for sun and one for shade.

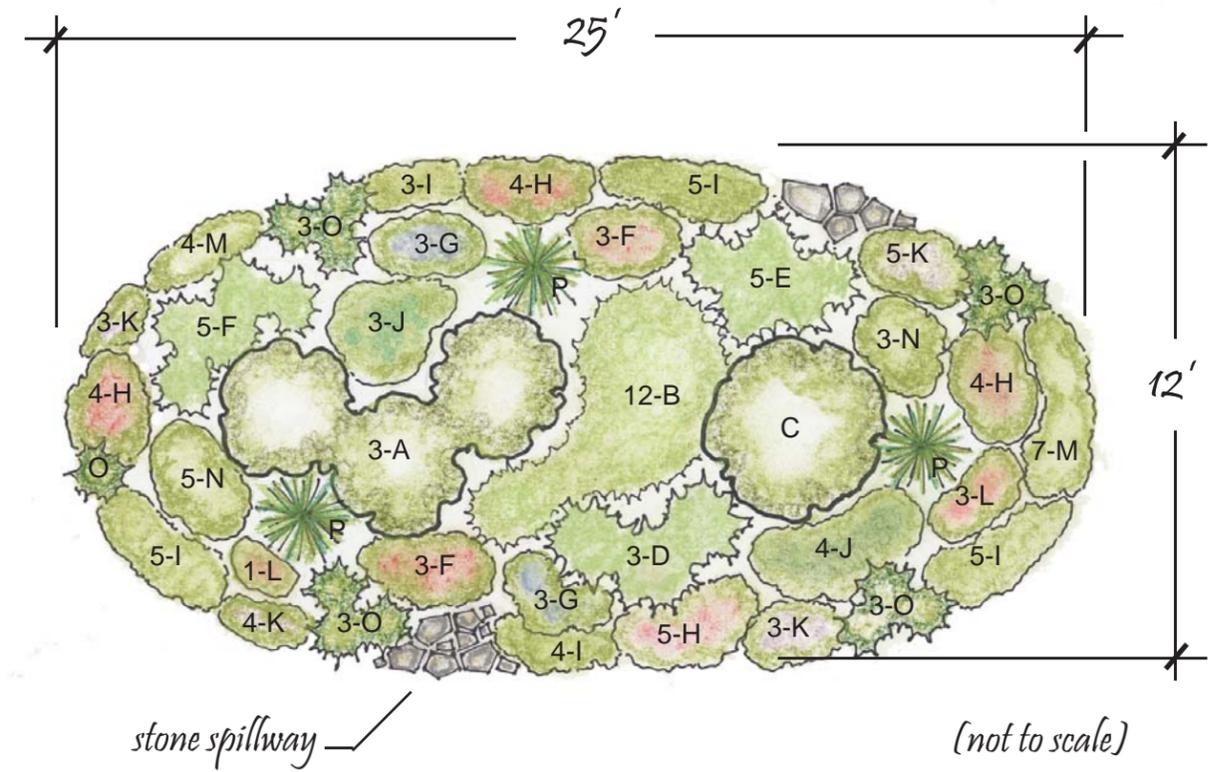
See section **VI. Plant Palettes** for comprehensive lists of native plants recommended for rain gardens in Knox County.





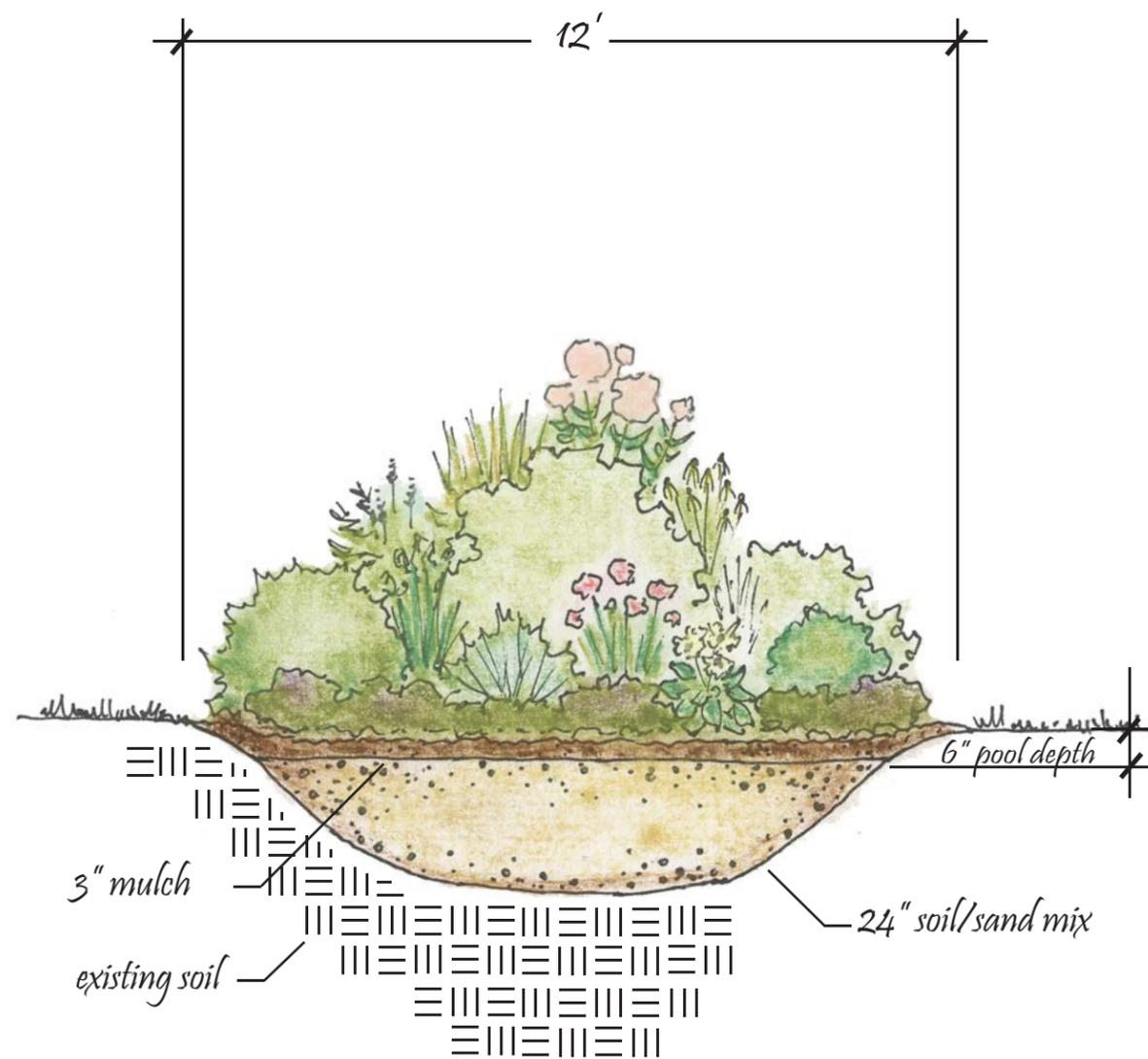
- | | | |
|---|------------------------------------|---------------------|
| A | <i>Clethra alnifolia</i> | Summersweet |
| B | <i>Tripsachum dactyloides</i> | Eastern Gamma Grass |
| C | <i>Cephalanthus occidentalis</i> | Buttonbush |
| D | <i>Eupatoriadelphus fistulosus</i> | Joe-pye Weed |
| E | <i>Helianthus angustifolius</i> | Swamp Sunflower |
| F | <i>Osmunda regalis</i> | Royal Fern |
| G | <i>Liatris spicata</i> | Dense Blazingstar |
| H | <i>Lobelia cardinalis</i> | Cardinal Flower |
| I | <i>Monarda didyma</i> | Beebalm |
| J | <i>Echinacea pallida</i> | Pale Coneflower |
| K | <i>Amsonia hubrichtii</i> | Threadleaf Bluestar |
| L | <i>Baptisia australis</i> | Blue False Indigo |
| M | <i>Iris virginica</i> | Blue Flag Iris |
| N | <i>Rudbeckia triloba</i> | Brown-eyed Susan |
| O | <i>Rudbeckia fulgida</i> | Black-eyed Susan |
| P | <i>Conoclinium coelestinum</i> | Wild Ageratum |
| Q | <i>Juncus effusus</i> | Soft Rush |
| R | <i>Andropogon glomeratus</i> | Wooly Broomsedge |
| S | <i>Asclepias incarnata</i> | Swamp Milkweed |
| T | <i>Aster novae-angliae</i> | New England Aster |

Full sun/partial shade Rain Garden - 300 sq ft



- | | | |
|---|-----------------------------------|---------------------|
| A | <i>Euonymus americanus</i> | Hearts-a-bustin |
| B | <i>Chasmanthium latifolium</i> | River Oats |
| C | <i>Aesculus parviflora</i> | Bottlebrush Buckeye |
| D | <i>Osmunda cinnamomea</i> | Cinnamon Fern |
| E | <i>Athyrium filix-femina</i> | Lady Fern |
| F | <i>Dicentra eximia</i> | Wild Bleeding Heart |
| G | <i>Lobelia syphilitica</i> | Big Blue Lobelia |
| H | <i>Aquilegia canadensis</i> | Wild Columbine |
| I | <i>Heuchera americana</i> | American Alumroot |
| J | <i>Polygonatum biflorum</i> | Solomon's Seal |
| K | <i>Phlox divaricata</i> | Blue Woodland Phlox |
| L | <i>Geranium maculatum</i> | Wild Geranium |
| M | <i>Asarum canadense</i> | Wild Ginger |
| N | <i>Arisaema triphyllum</i> | Jack-in-a-pulpit |
| O | <i>Polystichum acrostichoides</i> | Christmas Fern |
| P | <i>Juncus effusus</i> | Soft Rush |

Shade Rain Garden - 300 sq ft

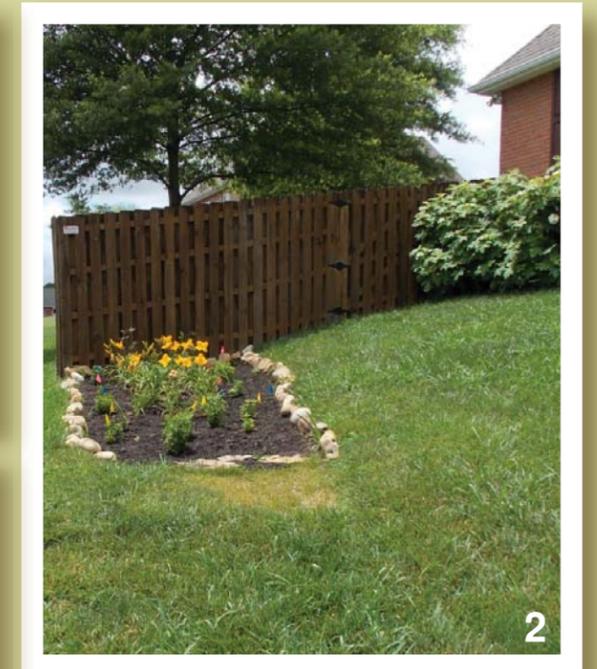


(not to scale)

Section View of Rain Garden



Front yard rain garden, newly installed (above) and after 2 years (right)



1 Back yard rain garden in a condo complex
 2 Side yard rain garden
 3 Tiered rain garden capturing gutter runoff

Rain Gardens in Knox County

Construction & Installation

Whether you decide to build your rain garden with or without soil amendments, you will have to dig. The depth of digging will be based upon your design. If you are creating a rain garden without soil amendments, you will dig down at least 9 inches to allow a pool depth of six inches plus a mulch depth of 3 inches. It is good to use heavy shredded mulch for cover because it is unlikely to wash away during a large storm event.

If your design calls for a lot of soil amendment, then heavy equipment is advisable for grading. You may need to dig down several feet. The equipment will be useful in mixing your soil media.

Once you have graded your rain garden, you can either plant and then mulch around them, or mulch first and plant into it. We recommend using containerized native plants with a good established root system instead of planting with seeds. Happy Planting!



The images above and right illustrate a rain garden installation in Knox County. Existing soil was removed with a skid-steer, soil amendments were mixed on site and added, then native perennials were planted and mulched.

Below, a stacked stone retaining wall is built to support a rain garden near the base of a slope



Maintaining Your Rain Garden

Your rain garden can be kept looking great just by doing a few simple tasks at the right time. Once established, these native plantings usually require less maintenance than conventional ornamental landscapes, but do require some care and a little expertise. See some basic guidelines below, and a simple season calendar for quick reference on the following page.

General

- Water your raingarden as needed through the hot summer months until plantings are well established.
- Remove any broken/fallen limbs, trash, or debris from rain events as needed.
- Periodically scan your rain garden for weeds, undesirable native tree/shrub saplings, and invasive exotic species and remove as soon as possible to prevent infestation

Trees

- Remove any dead or diseased material as soon as possible.
- Periodically scan all trees for broken, crossing/inward-growing, and low/obtrusive limbs and remove. Prune as close to the trunk as possible, always cutting just above a node.
- The best time to prune trees is in late fall, though it may be done sparingly throughout the year.
- Remove any suckers or sprouts from the base of the tree or from pruning cuts.
- Do not allow mulch or leaves to mound at the base of any tree (mulch volcano!). This encourages the bark to rot, leading to a decline in health and eventually death.

Shrubs

- Remove any dead or diseased material as soon as possible.
- Periodically scan all shrubs for broken, crossing/inward-growing, and obtrusive limbs and remove.

Herbaceous Plants, Grasses, Sedges, and Ferns

- Learn to identify desirable and undesirable species. Weed control is the most crucial step in maintaining a healthy native rain garden, so identifying and removing weeds promptly is key.
- Remove any dead or diseased material as soon as possible.
- Many perennials, grasses, and sedges may be dug up and divided to be planted elsewhere on site if desired, in spring or fall (preference varies among species)
- Remove all dead above-ground plant material before new growth appears in spring. Some species provide much needed cover and food for wildlife through winter, so late winter/early spring is ideal.



Seasonal Calendar

Spring

- Cut back any herbaceous material not already removed in fall or winter.
- Prune trees and shrubs before new growth (up to early March).
- Begin monitoring for weeds (especially in herbaceous plantings) and remove promptly.
- Remove invasive species before they flower if possible to prevent seed formation.
- Divide/transplant herbaceous plants, if needed, after last frost and before summer (mid-April)
- Mulch if necessary.

Summer

- Continue monitoring weeds and invasive exotic species; remove promptly.
- Water all new plantings and others as needed

Fall

- Continue to monitor and remove weeds and invasive exotic species.
- Collect seeds if desired.
- Divide and transplant herbaceous plants if needed.
- Cut back herbaceous material not needed by wildlife in winter; flag plants if needed

Winter

- Prune trees and shrubs as needed.
- Rest...then get ready for Spring!