



HOMEOWNER'S
MAINTENANCE MANUAL
FOR ESTABLISHED RAIN GARDENS

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I. Rain Garden Refresher: Purpose and Basic Structure

A. Key performance goals of RiverSmart Homes rain gardens

1. Primary Goal: Stormwater Management
 - a. Why?
 - i. Reduce volume of water going into local waterways
 - ii. Reduce velocity (speed) of water flowing into local waterways
 - iii. Reduce pollutants and sediment flowing into local waterways
 - b. How?
 - i. Capture stormwater runoff from hard surfaces on-site
 - ii. Infiltrate water quickly into existing soils
2. Additional Performance Goals:
 - a. Support biodiversity with native plants
 - b. Reduce heat islands
 - c. Beautify neighborhoods
 - d. Reduce landscape maintenance costs
 - e. Educate residents about clean water and stormwater runoff issues

B. Generally, FOUR COMPONENTS of a rain garden need regular inspection and/or maintenance:

1. Water Entry Areas & Inlet
2. Rain Garden Basin
3. Berm & Overflow Areas
4. Rain Garden Native Plantings & Soils

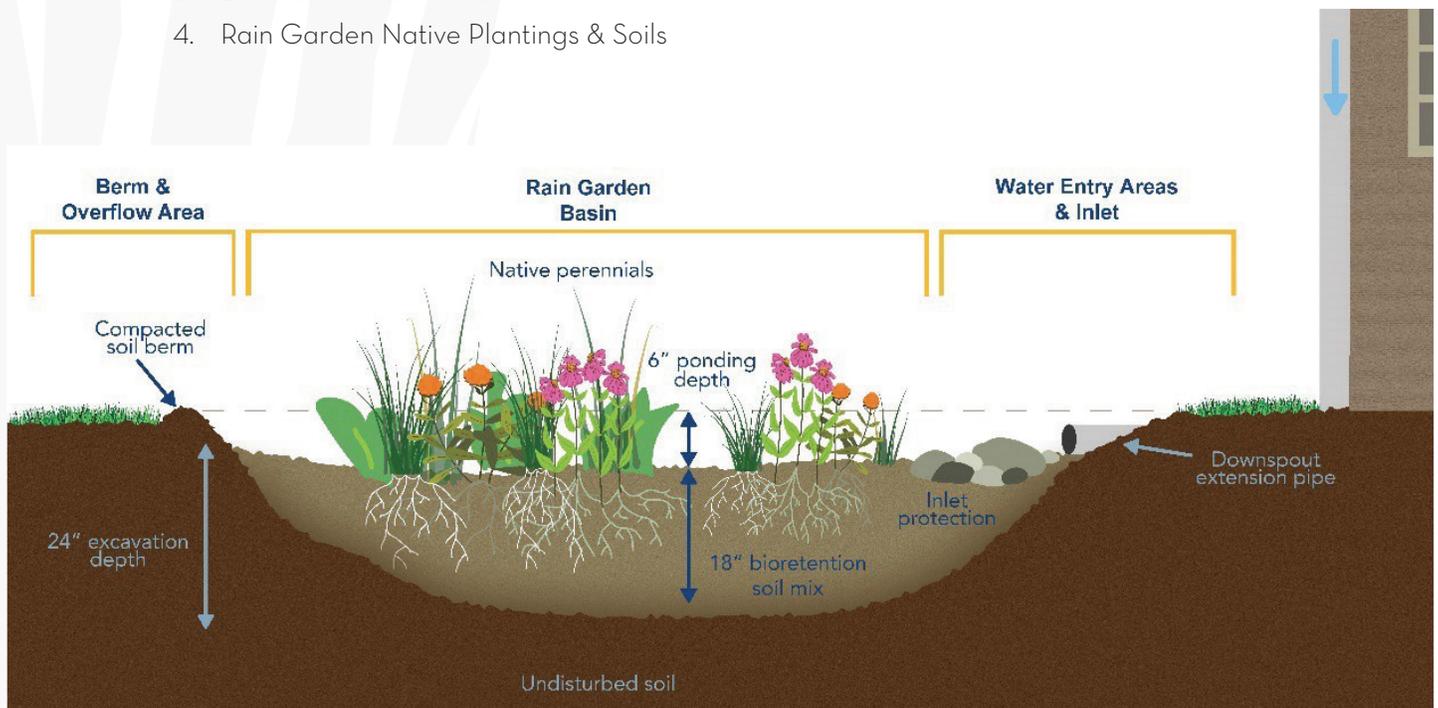


Image Credit: Alliance for the Chesapeake Bay

II. Inspection and Maintenance Details (Components 1-3)

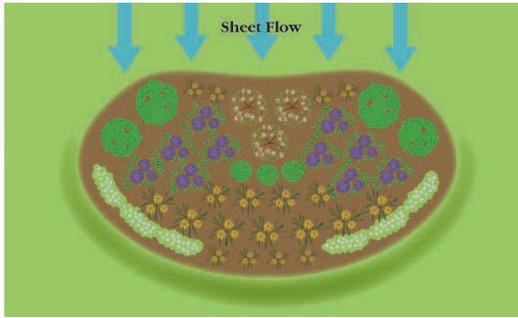
A. Component 1: Water Entry Areas & Inlet

Water can enter rain gardens in three ways:

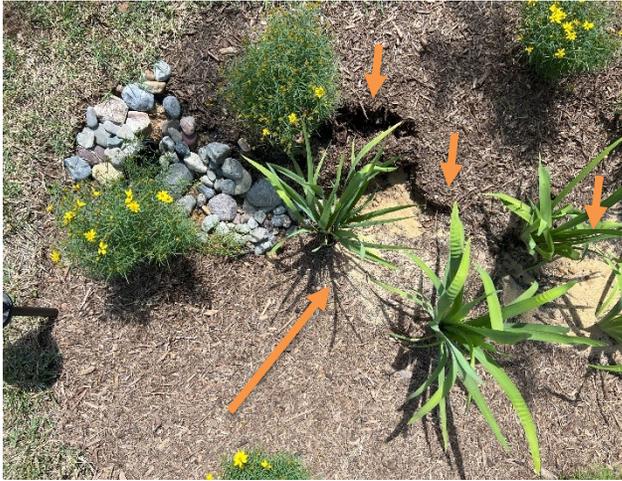
1. Runoff from the roof is directed into the rain garden by gutters and pipes
2. Sheet flow (ground level runoff) from impermeable/compacted areas
3. Direct rainfall

The table below describes the different parts of the water entry areas, along with their function and required maintenance.

Component Part	Function	Maintenance Actions
Gutters & Downspout Connection	Gutters capture stormwater runoff from your roof, carry it down through one or more downspouts through an extension pipe whose opening delivers water into the rain garden at the inlet (described below).	<p>Consider using mesh filters or gutter covers to prevent solid material from clogging the downspout.</p> <p>Keep gutters free of leaves and other debris.</p> <p>Make sure gutters, downspouts, and extension pipes are all securely connected to each other (avoiding leakage before entering the rain garden) and are not clogged.</p>
Inlet -- Lower Downspout Opening (where water flows out from pipe into rain garden)	Most RiverSmart rain gardens have 1-2 downspouts connected to an extension pipe that runs underground and opens into the rain garden. Water runs from the roof to enter your rain garden at the exposed end of the downspout extension pipe. This opening, where the rooftop water enters the rain garden, is referred to as the "inlet."	<p>Remove any debris that has accumulated in the inlet opening where the downspout extension enters the rain garden.</p> <p>Check regularly during and after heavy rains, and at least once per season, that the inlet is not cluttered, blocked, or buried.</p>

<p>Ground/Slope under inlet (area in rain garden where stormwater hits the rain garden)</p>	<p>River rock or similar stone is typically placed under and around the inlet to stabilize the soil where water enters the garden. The rock slows and spreads out the stormwater as it enters your rain garden. The rock should prevent erosion around the inlet. Inlet stone should not block the inlet and should allow water to run across the stone and fall into the center of the rain garden bowl.</p>  <p>Image Credits: Alliance for the Chesapeake Bay, RiverSmart Homes Program</p>	<p>Check the soil around and under the inlet for erosion. You may need to reposition or add new stone to slow or redirect the water. Ensure that the stone is not so high that it blocks the majority of water from entering the center of the rain garden. Check regularly after heavy rains.</p> <p>See pictures of erosion in rain gardens immediately below this chart.</p>
<p>Sheet Flow Entry: inflow from surrounding impervious or compacted surfaces</p>	<p>Water from surrounding impervious or compacted surfaces may enter directly into the rain garden (as sheet flow).</p>  <p>Image Credit: Northern Virginia Soil and Water Conservation District</p>	<p>Allow any sheet flow to enter the rain garden. Do not place berms or edging between sheet flow areas and edges of rain garden.</p> <p>If there is erosion on the sides of the rain garden bowl, there may be a need to stabilize the soils or add/modify native plants around the upper slope. See Section III for more information on native plants.</p>

Examples of what erosion can look like in a rain garden:



The inlet of this rain garden has insufficient stone protection which is creating gullies through the garden.

Image Credit: Alliance for the Chesapeake Bay



The berm of this rain garden is not compacted enough and overflowing water is eroding the berm.

Image Credit: Alliance for the Chesapeake Bay

B. Component 2: Rain Garden Basin

Rain gardens should be shaped like a bowl or bathtub, with a flat, level bottom, and sloped sides. The rain garden basin should appear as a depression in the ground and not be level with the surrounding area. The depression should be at least 6 inches below the surrounding ground level so that the rain garden basin may allow water to pond temporarily (i.e. up to 48 hours) after a rain event. The following table describes the different parts of the rain garden basin, along with their functions and required maintenance. A well-maintained rain garden basin maximizes water capture during a rain event. If not properly maintained, the basin may fill in and need to be re-established.

Component Part	Function	Maintenance Actions
Ponding Area	The ponding area of the rain garden is the space above the bioretention mix and mulch layers, below the top of the berm. The ponding area should be a minimum of 6 inches of void space.	<p>Over time, debris, sediment, or mulch can build up in the ponding area and reduce the ponding depth. If this has happened, remove the excess material, taking care to protect your native plants (and plant roots).</p> <p>Measure the ponding depth at least once per year.</p> <p>The depth of your ponding area may need to be increased if your rain garden appears to receive more than the anticipated amount of stormwater and is frequently overflowing. Consult with the RiverSmart Maintenance Assistance Program if you think the size of your rain garden's ponding area should be modified.</p>

<p>Bioretention Mix or Growing Media (Bowl Soils Below Native Plant Layer)</p>	<p>The soil beneath the ponding area (which should be 18 inches deep) is a special mix of soil that includes sand (the “bioretention mix or growing media”).</p> <p>The growing media is designed to ensure that the rain garden drains quickly and takes no longer than two days after a rain to drain completely.</p> <p>Plants selected for the bottom of the ponding area are chosen, in part, because they can grow in this soil type.</p>	<p>Check to see if soil in the bowl is moving around the ponding area, creating “gullies,” or if water is standing for more than 48 hours in the rain garden.</p> <p>If these problems cannot be fixed by adjusting rocks at the inlet or increasing plant density, you should consult with your installer or the RiverSmart Maintenance Assistance Program to identify the problem.</p>
<p>Vegetative Layer (Native Plants and Mulch)</p> <p>(This topic is covered in detail as Component 4 in Section III)</p>	<p>The native plants in the rain garden basin help stabilize the soils and uptake or filter water with their root systems.</p> <p>Healthy soils are porous and spongy, and host microbe communities that both hold water and create fertile soils for plants.</p>	<p>Utilize the Native Plant Center to find the best plants for your garden based on the soil composition, moisture level, and sun exposure.</p>

Tips for Components 1-2:

- ✓ When you clean out the inlet and drainage pipes, wear gardening (or other protective) gloves if possible.
- ✓ Always make sure you can see the opening of the inlet and that it is completely clear. It is best to make sure water is flowing freely from the inlet after a moderate to heavy rainfall.
- ✓ Managing heavy storms often requires speedy infiltration. However, if water filters through rain gardens too quickly, then the native plants in the rain garden may not have access to enough water in the soils to sustain themselves. Creating soils that drain too quickly can create a situation where few plants can survive. Native plants must be selected for their location within the rain garden and be well-suited to the soil mixes to thrive. RiverSmart specifications are designed to achieve this balance.

C. Component 3: Berm & Overflow Areas

1. Berm:
 - a. Your rain garden’s berm is a raised strip of compacted ground that surrounds the downhill portion of your rain garden’s ponding area.



Example of standard berm



Example of stone-reinforced berm

Image Credits: Alliance for the Chesapeake Bay, RiverSmart Homes Program

- b. The purpose of the berm is to function like a small retaining wall to keep a certain volume of water in the rain garden until it can infiltrate into the ground (and prevent it from flowing to other locations downhill).
- c. The most important features for berm “performance” are its height and stability. The berm should be strong and solid. Make sure the berm’s height is level and even across the width of the berm.
- d. Berms should not be planted or have plants or weeds growing in them. Plant roots can weaken their structure and plants can lead to uneven overflows, which can aggravate channeling and erosion. Berms should be mulched. See Appendix I for more information on berm maintenance.

Warning: Any time (1) water appears to be frequently overflowing your berm, (2) you cannot clearly identify your berm, or (3) your berm seems to be eroding (completely or partially), you should add height to the berm and/or stabilize it. See Appendix I on berm maintenance for further guidance.

2. Overflow Areas:

- a. Your rain garden was designed to safely overflow during extremely heavy storms when rain falls faster and in greater volumes than your rain garden can capture. The overflow area is typically located just outside the edge of the rain garden that slopes away from the house and away from any nearby sidewalks or driveways (ideally into another permeable area).
- b. **Your rain garden should rarely overflow.** Overflow water can erode the berm or other areas that it may reach. If there is erosion from frequent overflows, and the berm is properly in place and has an even height, then frequent overflows will likely indicate a problem – possibly due to insufficient ponding depth, slow water infiltration into the rain garden (or surrounding soils), or other problems like an improperly sized rain garden.
- c. Check the overflow area after major storms and determine whether any soil, mulch, or other sediment appears to be running over the berm – or if you notice holes or uneven heights in the berm itself. If so, repair the berm, and consult a rain garden expert if necessary.

III. Rain Garden Native Plantings, Healthy Soils & Native Plant Care (Component 4)

A. Multiple purposes of native plants in rain gardens

1. Uptake water
2. Maintain porous rain garden soils to ensure water infiltration over time
3. Stabilize soils and minimize erosion
4. Support biodiversity
5. Beautify the landscape

B. Native Plant Placement

Different kinds of native plants are necessary for different parts of the rain garden, both to ensure their survival and to maximize the functionality of the rain garden. The deep center of the rain garden (labeled as "base" in the diagram below) will need native plants that can tolerate a lot of water sporadically. The inside of the berm needs native plants that like drier conditions.

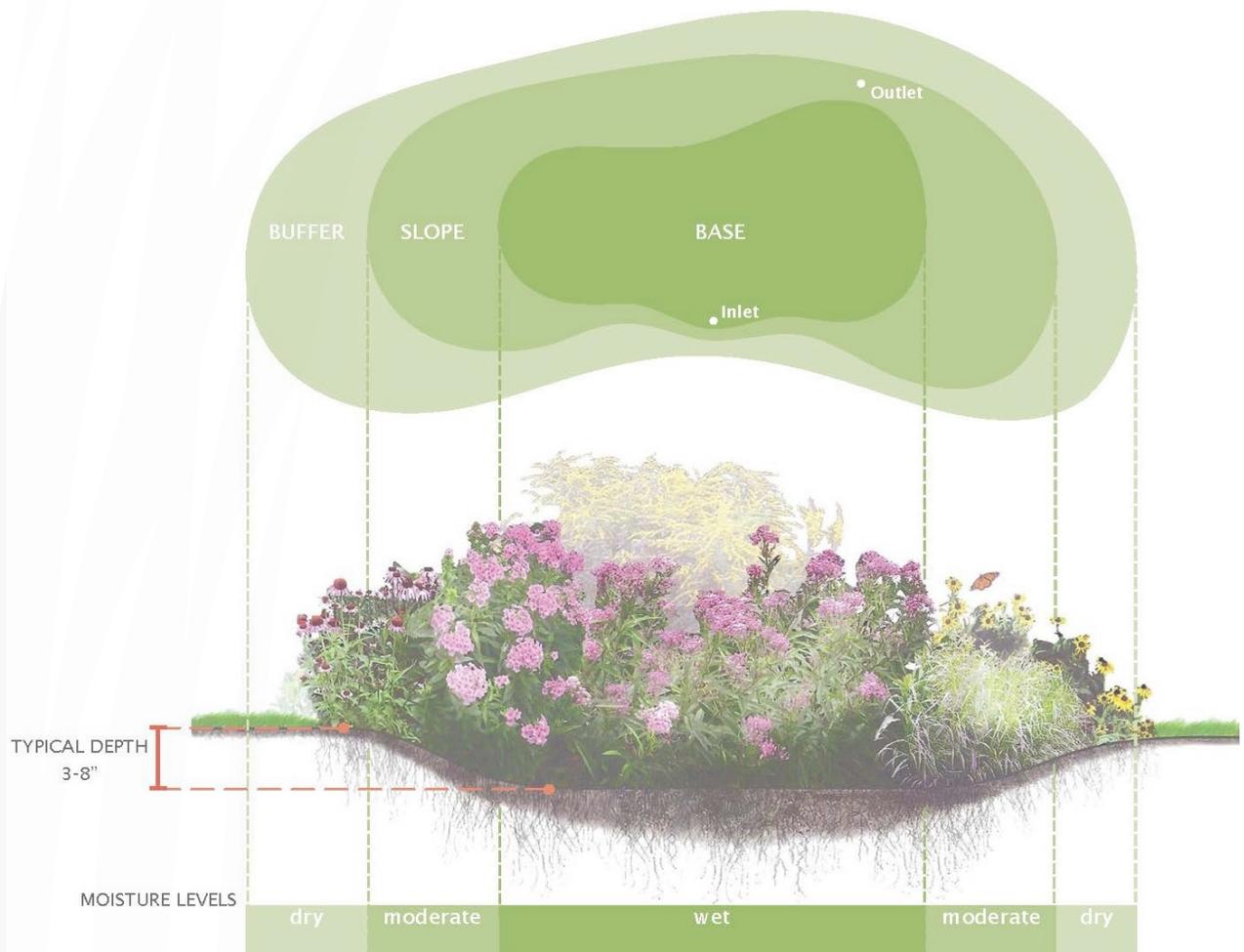


Image Credit: The Rain Garden Manual of New Jersey, Rutgers Cooperative Extension

C. Native Plant Density

Dense native planting (i.e. allowing plants to fill in the bowl and sides of the rain garden) is beneficial. It increases the stability of the rain garden, increases water absorption, and strengthens the garden's native plant community. It also reduces the need for mulching and helps with weed suppression. Including a groundcover layer of plants in the garden also acts as a "green mulch."

D. Soil Maintenance - Definitions

1. **Mulch** - Mulch is any material that is placed on top of soil and used to assist with moisture retention and weed suppression.
2. **Soil Amendment** - A soil amendment is any material added to the soil to improve water retention, water infiltration, drainage and structure - creating the necessary conditions for healthy root development.
3. **Fertilizer** - Fertilizers are concentrated nutrients that are added to the soil only to improve plant growth.
4. **Compost** - Compost is a biologically active material that results from decomposition of organic matter under controlled circumstances. It provides natural nutrients to plants and improves soil structure. For purposes of this section, compost can be considered either a soil amendment or an organic fertilizer.

E. Soil Maintenance - Using Mulch

1. Purpose: Mulch can protect young native plantings from harsh or extreme weather by maintaining soil moisture, preventing soil erosion, and minimizing weed growth. These purposes can be useful during the early establishment period of the plants, but, after establishment, mulches are often overused and unnecessary for plant health or rain garden function.
2. Before Using Mulch, You Should Know:
 - a. Once your rain garden native plants have matured, if your native plants are healthy and growing, your soils have the right nutrients and moisture levels for those plants. Your plants are great indicators of soil health.
 - b. Mulches with high carbon-to-nitrogen ratios decompose slowly and are primarily used for retaining soil moisture and suppressing weeds. They are not proven to affect organic nutrients in soils.
 - c. Established native plants with the right plant density, particularly if covered in natural leaf litter from the plants themselves, often don't need moisture retention or weed suppression assistance.
 - d. Overusing mulch can cause problems in rain garden function, including: clogging of the inlet, burying the inlet areas, and reducing the depth of the ponding area, as well as waste time, money, and effort. Excessive mulching together with excessive watering can create anaerobic conditions - which kills aerobic microorganisms and is highly counterproductive.
3. Using Mulch: The best kind of mulch to use is undyed shredded, hardwood mulch that has been cleaned of contaminants. Be sure to steer clear of dyed mulches - these are not necessarily safe for wildlife, water, or plants.

F. Soil Maintenance - Using Compost or Leaf Litter

1. Compost: Compost generally has a low carbon-to-nitrogen (C/N) ratio (especially those that are "hot composted"). Low C/N mulches have been shown to increase soil organic matter and improve soil health and microbial health. If the goal is to enhance physical, chemical, and biological soil properties, the best choice is compost. The best compost is made of completely broken-down organic materials that are not mixed with soil. It should be free of pesticides and have a light, fluffy texture

(if it smells like garbage it has not yet completely broken down). Some compost – particularly if not collected from safe sources or not heated appropriately – can contain dangerous chemicals and toxins, or even the seeds of some invasive plants. So, know your source.

Compost warning: Too-frequent composting can introduce too many nutrients to the top soil or soil media, some of which may be taken up by infiltrating water or overflow water and introduced to waterways as pollutants. Remember: if your plants are thriving, then leave them alone. More is NOT always better.

2. Leaf Litter: A great source of natural nutrients and soil protection is available from leaf litter and on-site organic matter. If your rain garden only needs additional nutrients or winter insulation, on-site organic materials like leaves, seeds, dead flowers, husks (and whatever naturally falls from the native plants in your rain garden) provide excellent nutrition and cover for your plants at no cost to you. You just have to ensure the materials don't become compacted within the rain garden bowl. Fluffing or turning the organic matter can prevent this problem.

G. Soil Maintenance – Conventional Fertilizers

1. Using conventional fertilizers in rain gardens can be harmful.
2. Fertilizers are rarely needed for native plants. Fertilizing is not a part of the maintenance plan for your rain garden. The garden sustains itself with the help of organic material in the topsoil. Rain gardens are meant to help remove excess nutrients from runoff. Adding fertilizer will contribute to excess nutrient loading. Native plants do not require supplemental fertilizer except in unusual conditions.
3. Nutrients are usually good for plants and living soils, but too many nutrients in the soils from fertilizers (particularly nitrogen) – in excess of what the plants need – leads to nutrients leaching into water flowing into our rivers, which can overwhelm aquatic systems and damage aquatic life.

H. Native Plant Care – Get to Know Your Natives

1. Learn your planting plan and get to know the native plants in your rain garden. It can help to place identification markers by the plants as you are learning them.
2. Observe them over a couple of seasons: which plants have done well? which ones have died?
3. Learn some basics about your native plants. Many plants naturally die back in late fall/winter (don't assume they're dead when they do that!).
4. Learn how your native plants spread and how aggressive different native plants in your garden are – do some overtake others? Do you have certain plants that seem to be taking over or crowding out other plants? If so, the balance of native plants may need to be adjusted or some may need to be thinned and/or divided.
5. Be sure you have room to inspect the soil in your rain garden (both visually and by hand). If the plant growth is too dense to do that, you may need to thin out certain native plants.
6. Do not use pesticides and herbicides. Native plants will still thrive in the presence of insects, pollinators, birds, and other native animal communities. You don't need herbicides and pesticides for native plant care.
7. Search the Alliance's [Native Plant Center](#) for more information on maintaining the plants in your rain garden.

I. Native Plant Care – Watering and Overwatering

1. The native plants in your rain garden are adapted to local weather conditions and once established (typically after one year) they should need little supplemental watering through the seasons. However, plants will need extra water through prolonged, dry and hot weather conditions. Wilting,

leaf drop, and leaf browning that last beyond one hot day can be signs that your plants need supplemental water.

2. The best method of watering is to water deeply at the base of the plant. Deep watering should flow to the depth of the plant's roots to approximately 6 - 10 inches deep. Deep watering during early growth and through periods of drought promotes strong root systems that can reach below surface water, making a plant more drought tolerant. Watering at the base of the plant rather than on the leaves minimizes evaporation and susceptibility to leaf pathogens. Soaker hoses can be helpful for deep watering without a lot of evaporation.
3. Best times to water are in the early morning or late afternoon, when the sun is low and there is less water waste from evaporation.
4. When watering is necessary, it is very important not to overwater. If there is steady rain that amounts to 1 inch over the course of several days to one week, this is sufficient water for your plants. Rain gauges are a good way to measure the amount of accumulated rain.

J. Seasonal Tasks - Your Preferences

1. The effort you need to put into seasonal care (i.e. pruning, separating, transplanting, replacing) depends on how you like your rain garden to look.
2. Minimal pruning is fine if you like a wilder look, and will allow native plants to fill in the bowl of your rain garden – for maintenance, you just need to be able to visually determine when there is standing water at the bottom of the bowl, when the soils are wet, and when the rain garden is dry.
3. Habitat-friendly garden: After each growing season, the stems and seed heads can be left for winter interest, wildlife cover, and bird food. Leave seeds on perennials through winter for wildlife. There is no need to cut back dead plant material. If you want to dead-head stalks, it is best to leave at least 4-6 inches of stalk to help native bees as they nest. Once spring arrives and new growth is 4-6 inches tall, you may want to remove dead plant material (or, you can leave it to enrich your plants and soils).

K. Tips on Restoring or Modifying the Native Plant Mix

1. If you add to your garden, be sure to use native plants that will “play nicely” with the existing native plant community; also, be sure to plant the new plants where they will be happiest within the rain garden (water loving – center of rain garden; drought resistant – on slopes).
2. Don't just automatically replace native plants that die with the same type of native plant – it could be the wrong plant type for your plant community or that species does not thrive in your soil types, level of shade, or levels of water.
3. Established native plants rely on water from natural rainfall patterns, though they may need additional water during extended dry/hot weather.

L. Invasive Plants vs. Volunteers: When Not to Welcome “Visitors”

1. You may find some new plants in your garden that you didn't plant. They may be natives carried by birds or wind, and they may fit nicely in your garden. However, invasive plants will almost certainly enter your garden as well. Those should be removed at first sight in accordance with federal or local government recommendations. See the USDA's National Invasive Species Information Center for more information and resources on invasive plants and weeds.

IV. Appendices

- A. Appendix 1: Maintaining Rain Garden Berms
- B. Appendix 2: Mosquito Control

Appendix I: Maintaining Rain Garden Berms

Your berm was likely made from the original soil that your contractor excavated when constructing your rain garden. The berm should be about level with the uphill edge of the rain garden (where the inlet is located).

If your berm has eroded or collapsed, you will need to rebuild it. The lowest cost option is to use clay soil from your yard (or a neighbor's yard) to build the berm.

Build your berm so that it is level with the uphill portion of your rain garden and has gently sloping sides. You will need to compact the soil to prevent the berm from collapsing when it rains. You can do this by packing it down with your hands or feet.



If compacted clay soils are not strong enough to keep the berm solid, stable, and level, you may add rocks or bricks around the berm to help strengthen it (see picture above in Berm section). You should not plant your berm or allow plants to grow on it.

Optional Preventative Maintenance: The berm should be covered with 2-3 inches of non-dyed hardwood mulch in order to suppress weeds. In some cases, people will also place ground covers (like grass) on their berms to limit erosion, but the RiverSmart program does not recommend this practice.

Appendix 2: Mosquito Control

It's important to acknowledge that the District of Columbia is natural habitat for certain mosquitoes, and there is no way to eliminate all mosquitoes from a neighborhood or area without doing extensive damage to the environment and human health. However, there are a number of environmentally-friendly actions that can reduce the number of mosquitoes in our neighborhoods.

Here are some non-chemical ways to control mosquitoes:

1. **Eliminate Unprotected Standing Water.** The most effective means of mosquito management is eliminating unprotected standing water – particularly water that sits stagnant for over 3 days. Mosquito larvae cannot live out of water, and breeding times can range from 5-12 days (transformation from an egg to an adult occurs in about 7 days, depending on weather events and temperature).
2. **Water Drainage/Removal.** Keep an eye out for standing water:
 - a. Infrequent and heavy rains are not expected to be an issue because larvae rafts will likely float away from populated areas; but regular/frequent rains can create a problem.
 - b. Unusual suspects: A typical property has far more mosquito breeding areas in the yard than one may think (cups, flower pot bases, children's sand box toys, corrugated drainage pipes, bottle tops, flower-pot dishes, gutters, toys, recycling bins, etc.).
 - c. Rain barrels: a covered barrel with a filter screen that is clean and free of moisture-retaining debris will help prevent mosquito breeding.
3. **Stormwater management.** Use stormwater best management practices (like rain gardens, bioswales, and conservation landscapes) to make sure water is not pooling or standing on your property. Drain gutters completely. If you have space available, plant native trees and perennials to soak up additional water (and enable soils to soak up more water too). Mosquito eggs will have trouble surviving in a well-drained rain garden or a forested area that is properly draining. Bird baths can be kept free of mosquitos with the simple addition of a bubbler or small fountain to create moving water where mosquitoes will not lay eggs.
4. **Biological/predatory controls in standing water:** If you have water that you either want (like bird baths or ponds) or cannot remove (i.e. clay soils and wetland habitat), you might consider biological controls:
 - a. Dragonflies feed on mosquitoes. You can encourage dragonflies by planting “dragonfly friendly” plants, like pickerelweed, water lilies, and arrowhead (particularly in areas that do stay wet or pond).
 - b. Creating a healthy habitat for birds can be an effective mosquito control. Birds, particularly hummingbirds, like mosquitoes too.
 - c. Fish (preferably native) can also control mosquitoes in water.
5. **Planting choices:** Avoid mosquito “friendly” plants like cattails (even though they are native to this area) and algae mats in water -- as they foster and encourage mosquito population growth. Incorporate plants that attract mosquito predators (see above).
6. **Ovitrap:** Learn how to make an ovitrap for mosquitoes [here](#). (last accessed August 29, 2023)
7. **Mosquito dunks:** Mosquito dunks or granules for ponds or water barrels without fish are also an option. Mosquito dunks contain crystals from *Bacillus thuringiensis* serotype israelensis (BTI), which kills mosquito larvae that ingest the crystals. ([wikipedia](#); [summit chemical](#)).
8. **Bug Zappers - Caution:** Some experts believe that Bug Zappers tend to kill primarily beneficial insects and can be deleterious to human health.
 - a. Unfortunately, the District not only has native mosquitoes but invasive mosquitoes as well (i.e. Asian Tiger Mosquito). The invasive mosquitoes are substantially hardier and more aggressive, but they will still respond to the control measures described above. If all else fails, protective, lightweight clothing is always a safe and effective option for protecting oneself against mosquitoes.
 - b. **Warning:** If your rain garden is not infiltrating (draining) properly within 48 hours, this may indicate that your rain garden has a problem. If water sits for extended periods, mosquitoes may breed there. A mosquito problem can be a symptom of a bigger problem with your rain garden function.