Raingardens
Attractive, functional
Stormwater management

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Developed acreage in North Carolina increased 88.1% over a fifteen year period from 1982-1997. As development occurs, extensive surface area previously covered with vegetation is replaced by impervious surfaces, and the area’s hydrology is altered.

When rain falls on natural areas such as a forest or meadow it is slowed down, filtered by soil and plants, and allowed to soak back into the ground. When rain falls on impervious surfaces like rooftops, roads, and parking lots, it does not soak into the ground and stormwater runoff is created. As stormwater flows across impervious surfaces, it picks up pollutants and excess heat. During large rainfall events stormwater runoff can cause flooding. It is estimated that 70% of pollution in streams, lakes and rivers originates in stormwater runoff.

Stormwater runoff affects our local streams and rivers. The heating of stormwater can negatively impact aquatic ecosystems, causing loss of habitat, especially in areas of high elevation featuring cold water trout streams. Eroded soil and sediment, nitrogen and phosphorous rich nutrients, and toxic chemicals in stormwater have adverse effects on aquatic life and riparian vegetation, as well as our fresh water supply. There are several methods of dealing with stormwater, such as filters, grassy swales, and bioretention areas, i.e. raingardens and stormwater wetlands. We can’t stop developmental growth, but we can lessen future impact on our land and water by the choices we make today.

**Common Stormwater Pollutants**

- Automobile fluids (oil, gasoline, anti-freeze, etc.)
- Pesticides and fertilizers
- Pet waste
- Bacteria
- Atmospheric Nitrate and Ammonium
- Litter
- Sediment
- Grass Clippings, Leaves, and Other Yard Wastes
Raingardens

Raingardens are an attractive, functional stormwater management technique. The mix of compost, sand, soil, and native plants captures, cools and filters runoff before it enters our streams and rivers. Raingardens are placed between stormwater runoff sources (roofs, driveways, parking lots) and runoff destinations (storm drains, streams, and lakes). Backyard raingardens are a fun and inexpensive way to improve water quality and enhance the beauty of your yard or business.

- Raingardens temporally hold, filter and cool stormwater runoff.
- Complex processes, such as ion exchange, volitization, adsorption, and evapotranspiration, remove pollutants from stormwater.
- Microorganisms in raingardens breakdown pollutants, such as petroleum based solvents.
- Levels of heavy metals, such as zinc and copper, are significantly reduced in runoff that is treated by a raingarden.
- Infiltration in raingardens reduces the velocity of runoff and prevents flooding.
- Raingardens provide a suitable habitat for many different types of organisms.
- Raingardens enhance the beauty and value of your business or residence
Transylvania County Public Library Raingarden

1. River Oats
2. Inkberry Holly
3. Cardinal Flower
4. Blue Flag/ Iris Versicolor
5. Stokes Aster
6. Garden Phlox (Tracy’s Treasure)
7. Chokeberry
8. False Indigo
9. Red Twig Dog Wood
10. St. John’s Wort
11. Rose Mallow
12. Elderberry
13. Gay Feather
14. Creeping Phlox
15. American Plum
16. Black-Eyed Susan
17. Fringe Tree
18. Clethera (Sixteen Candles)
19. Golden Rod (Fireworks)
20. Spotted Joe Pye Weed
21. Bee Balm
22. Green and Gold
23. Garden Phlox (David)
24. Paw Paw Tree
25. American Beauty Berry
26. Sweet Shrub
27. Garden Phlox (Ping Pong)
28. Witch Hazel

This Raingarden is one of two located at the Transylvania County Public Library. It filters and cools runoff from the parking lot and roof. Here you can see the locations of native plantings within the raingarden.
Backyard Raingarden Construction

Raingardens should be installed after other construction is completed around your home. Sediment from construction sites can collect and settle in raingardens, reducing infiltration, and may result in damage to plants.

1. Select a location:
   - When it rains, observe where the water goes. Where does your driveway runoff go? Where does your roof runoff go?
   - Select a location downslope from your property’s runoff sources.
   - Raingardens should be at least 10 ft. from the foundation of your home.
   - At least 25 ft. from septic system drainfield.
   - Not within 25 ft. of a well head.
   - An ideal location for a rain garden is in full to partial sun.
   - The water table should be at least 2 ft. below the surface.

2. Observe soil permeability:
   - Well drained sandy soils are ideal for rain gardens.
   - Dig a 1 ft. hole at the proposed rain garden site. Fill the hole with water or observe it after a heavy rain. If the hole still contains water after 48 hrs, the soil is impermeable, and this is not a good location for a rain garden. Try another location, or consider creating a wetland garden. * pg 10

3. Determine the size of your raingarden:
   - Estimate the area of impervious surfaces draining to the raingarden. This includes roofs, sidewalks and driveways.
     1. Determine the area of your roof.
     2. Estimate the percentage of runoff that drains from the roof to your proposed raingarden location.
     3. Multiply the area of your roof by the percentage of runoff drained to the raingarden location. For example, if your roof’s area is 3000 ft², and 75 percent of your roof’s runoff is drained to the raingarden location, then [3000 X 0.75] = 2250. This is the drainage area of your roof.
     4. Add the drainage area of your roof to the total area of other impervious surfaces, such as sidewalks and driveways. For example, we have 2250 ft² for the roof, and if you have a 1000 ft² driveway, and a 800 ft² walking path, then: 2250 ft² + 1000 ft² + 800 ft² = 4050 ft².
       The total drainage area to your raingarden site is 4050 ft².
     5. Divide the total impermeable drainage area by 20, to get an estimate of the raingarden’s area requirements for a depth of 6 inches. For a shallower depth of 3 inches, divide this total area by 10. * for help see sizing chart on page 8.
4. Sketch a design:
- Take measurements, and stake or flag the area
- Sketch out, to scale, the approximate size and shape of your raingarden
- Include direction of runoff flow, existing features, and plant placement in your sketch.

5. Begin construction:
- The Raingarden should be dug 3” to 6” deep (depending on the area requirement estimated in step 3), with a slight depression in the center
- The dugout soil can be used to make a berm at the down slope end of your raingarden.
  * see illustration.
- The Raingardens ideal soil mixture should consist of approximately
  50-60% sand,
  20-30% topsoil, and
  20-30% compost.
- Once a location is selected, you may decide to send additional water to this site. Flexible plastic pipe can be used to direct water from downspouts and collecting areas to the rain garden.

6. Planting:

   **It is important to select plants that will tolerate fluctuating levels of soil moisture.** Raingardens that contain sandy soil rarely hold water for more than a few hours. Loamy or silty soils can pond water for 1-2 days. For best results use container-grown plants. Seeds tend to get washed out in raingardens, and have a hard time establishing themselves.

- Native plants are best; they are well adapted to the climate and insects that live in your area. It is less likely that fertilizers and pesticides will be necessary, and using less or no fertilizers and pesticides at all benefits water quality.

- There will most likely be varying degrees of wetness within your raingarden. Plant species that can tolerate a couple days of flooding should be planted in the deepest part of your raingarden, where water is most likely to pool. Plants that can’t tolerate flooding as well should be placed around the edges or shallow areas of your raingarden.

- **A list of native plants suitable for raingardens can be found on page 9.**

7. Mulching:

   Apply 2-3” of hardwood mulch. Lighter mulches will tend to float, so avoid pine bark and pine straw mulches. Mulch is important in pollution removal, maintaining soil moisture, and in preventing erosion.

   The Berm should be covered with mulch or grass to prevent erosion.
<table>
<thead>
<tr>
<th>Impermeable Surface Area</th>
<th>Required Size of Rain Garden</th>
<th>Potential Rain Garden Dimensions</th>
<th>Required Size of Rain Garden</th>
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</table>
For moist soils: plant in the deepest parts of your raingarden
Willows/ *Salix* species
Cinnamon Fern/ *Osmunda cinnamomea*
Swamp Rose/ *Rosa palustris*
Washington/ Hawthorn *Crataegus phaenopyrum*
Native Brake-Cane/ *Arundinaria gigantea*
Silky Dogwood/ *Cornus amomum*
Buttonbush/ *Cephalanthus occidentalis*
Sweetbay Magnolia/ *Magnolia virginiana*

**For intermediate soils:**
Red Maple/ *Acer rubrum*
Cherry birch/ *Betula lenta*
Persimmon/ *Diospyros virginiana*
Lady Fern/ *Athyrium felix-femina*
Green and Gold/ *Chrysongonum virginianum*
Black cherry/ *Prunus serotina*
Garden Phlox/ *Phlox paniculata*
Fringe Tree/ *Chionanthus virginicus*

**For Dry Soils: plant in shallow areas or your raingarden or on berm**
Silverbell/ *Halesia Carolina*
White basswood/ *Tilia heterophylla*
Pagoda Dogwood/ *Cornus alternifolia*
American Holly/ *Ilex opaca*
American Hazelnut/ *Corylus americana*
Blueberry/ *Vaccinium ashit*
False Indigo/ *Baptisia species*
Panic Grass/ *Panicum virgatum*

For more information on plant selection visit
http://www.bae.ncsu.edu/topic/raingarden/plants.htm
A wetland garden works like a raingarden, providing habitat for plants and organisms, while treating stormwater runoff. Wetland gardens hold water longer than rain gardens, and feature plants that thrive in wet conditions. *A list of native plant species suitable for wetland gardens can be found on page 11.*

One common concern when it comes to wetland gardens is mosquito infestation. A wetland garden may actually reduce mosquito populations in your area. Wetland gardens provide habitat for natural predators of mosquitoes, such as birds, frogs and other insects. Wetland gardens reduce flooding in adjacent areas. Adjacent areas that flood periodically may serve as habitat for mosquitoes, but not for predators of mosquitoes.

Encephalitis is associated with the tree-hole mosquito. Tree-hole mosquitoes lay their eggs in small pools of water, and in their natural environment these pools may be found in the small holes of trees. In a manmade environment tree-hole mosquitoes utilize small pools of water including bird-baths, tires, and any small container holding stagnant water. The environment created by a wetland garden is not likely to create a breeding ground for tree-hole mosquitoes, as the pool created is too large. A wetland garden should not increase the risk of encephalitis around your home, and may have the potential to reduce it.

**Wetland Garden Construction**
- Wetland gardens are best for relatively impermeable soils.
- Wetland gardens should typically have a length to width ratio of 1.5:1, with the long axis perpendicular to the direction of runoff flow.
- A depression should be dug, containing various depths between less than 6” to 18” or more. A small sediment forebay, should be dug to capture the initial flow entering the pool from your runoff sources. Sediment forebays typically have an area of approximately 10% the total area of the wetland garden. Sediment carried by runoff will be captured in the sediment forebay. Sediment levels in the rest of the marsh will remain low, making maintenance easier.
NC Native Plants Suitable for Wetland Gardens

Cardinal flower *Lobelia cardinalis*
Marsh pink *Sabatia* species
Seashore mallow *Kosteletskyia virginica*
Blue flag/ *Iris versicolor*
Blue lobelia/ *Lobelia* species
Joe Pye weed/ *Eupatorium fistulosum*
Buttonbush/ *Cephalanthus occidentalis*
Elderberry/ *Sambucus canadensis*
Swamp milkweed/ *Asclepias incarnata*
Bee Balm/ *Monarda didyma*
Spicebush/ *Lindera benzoin*
Pawpaw/ *Asimina triloba*

**Carnivorous plants** (do best in sandy soils)
Yellow pitcher plant/ *Sarracenia flava*
Sundew/ *Drosera* species
Purple pitcher plant/ *Sarracenia purpurea*
Venus Flytrap/ *Dionaea muscipula*
Butterwort/ *Pinguicula* species
See these Sites for more information

Backyard Raingardens
http://www.bae.ncsu.edu/topic/raingarden/

Landscape plants for wet sites
http://www.ces.ncsu.edu/depts/hort/hil/hil-646.html

Plants for wetlands and raingardens

Urban Horticulture Website
http://www.ces.ncsu.edu/depts/hort/consumer/index.html

Stormwater Wetland and Raingarden Installation at The NC Arboretum
http://www.bae.ncsu.edu/programs/extension/wqg/frenchbroad/raingarden_tnca.pdf