Citizen's Guide

To Protecting Wilmington's Waterways

Solutions to protect our waterways from polluted stormwater runoff

CITY OF WILMINGTON STORMWATER SERVICES

Stormwater BMP How-To, Color Photos, Native Plant Lists, Homeowner Info, Watershed Map, Glossary, Local Contacts

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INTRODUCTION




When rain falls on natural areas, such as a forest, it is slowed down, filtered by soil and plants, and allowed to soak back into the ground. In contrast, when rain falls on impervious, or hard surfaces, like rooftops, roads and parking lots, rain does not soak into the ground and stormwater runoff is created. Stormwater runoff picks up pollution such as pet waste, fertilizer, pesticides, motor oil, litter and yard waste and drains directly into local creeks, streams, and waterways. The final destination of polluted runoff is the Cape Fear River or Intracoastal Waterway.

Washing your car on the grass, limiting fertilizers and pesticides, picking up pet waste and throwing litter in the trash, are just a few simple ways that you can prevent water pollution everyday. In addition, there are several simple things you can do on your own property to protect water quality. A Best Management Practice (BMP), also known as a "stormwater solution" is a landscape addition or technique that reduces pollution and/or the amount of stormwater runoff flowing into local waterways. Examples of BMPs include rain barrels, backyard wetlands, habitat gardens, shade trees, grassy swales, riparian buffers and landscaping with native plants.

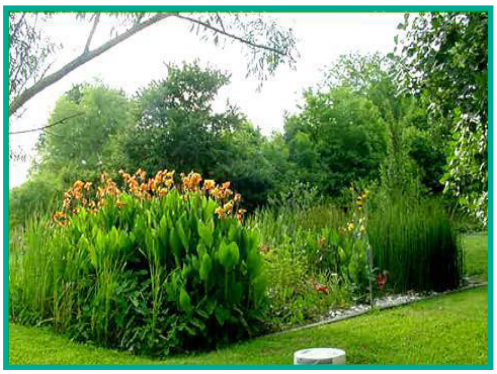
There are many benefits to installing BMPs on your home or commercial property. Some BMPs prevent water pollution by capturing polluted runoff and allowing it to soak back into the ground, while other BMPs act as natural barriers between polluted runoff and waterways. Other BMP benefits include flood reduction, reduced soil erosion, water conservation and wildlife habitat. Installing BMPs can even save you time and money, increase property values and provide breathtaking aesthetic views.

This guide takes you step-by-step through several different stormwater BMPs explaining what they are, how they protect water quality, how you can easily install one and includes extensive lists of drought and disease resistant plants suitable for BMPs in Southeastern North Carolina. Descriptive pictures and website resources also accompany each section. The guide also contains a glossary, local water quality resources, stormwater brochure, Wilmington Watersheds Map and more. For more information or to obtain a guide, call Stormwater Services, **(910) 343-4777** or visit **www.wilmingtonnc.gov/stormwater**

Visit and view all of the BMPs listed in this guide (except Backyard Wetlands) at the Stormwater Demonstration Site in Anne McCrary Park located off Randall Parkway in Wilmington, NC.

Make the connection - YOU are the SOLUTION to STORMWATER POLLUTION!

BACKYARD WETLAND



Backyard wetlands are designed to improve water quality by absorbing and filtering pollutants carried in stormwater runoff. A backyard wetland can temporarily store, filter and clean runoff from your rooftop, lawn and other impervious surfaces before it reaches a receiving waterway. In the wetland, pollutants such as sediment, nutrients, heavy metals and bacteria are able to settle out, be taken up by wetland plants or be "digested" by naturally occurring microorganisms.

A backyard wetland can also provide habitat for many interesting creatures from butterflies and bees to salamanders, toads, frogs, birds and unique plants. It can provide many of the same benefits that natural wetlands offer and can replicate some of the important natural functions of wetlands that may have been lost when your house or community was developed.

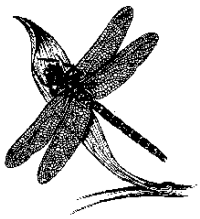
If you have a naturally occurring wet spot in your yard or a low swale or drainage way, you can easily turn it into a wetland paradise. Even if you do not have a natural wet spot on your property, you can still establish an area in your yard to grow many of the beautiful plants associated with wetlands. Most wetland plants do not require standing water to grow successfully and will survive even in an area that appears dry on the soil surface during much of the growing season.

Backyard Wetland Benefits

- **Improve local water quality**
  Backyard wetlands remove, retain and process pollutants and sediment carried by stormwater runoff.
- **Provide flood storage and erosion control**
  Wetlands absorb, retain and slowly release runoff which provides flood storage control and helps prevent property flooding.
- **Replenish groundwater supplies**
  Backyard wetlands collect runoff and allow it to soak into the soil to recharge groundwater supplies.
- **Provide food and habitat for wildlife**
  Backyard wetlands can provide critical habitat for wildlife, which is important in urban areas that lack natural, undeveloped land.
- **Provide recreational, educational, aesthetic and research opportunities**
  Backyard wetlands can provide numerous opportunities to observe wildlife, partake in a hobby such as gardening and they add immense beauty to your landscape.

What is a Wetland?

Wetlands are areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas. Wetlands vary widely because of regional and local differences in soils, topography, climate, hydrology, water chemistry, vegetation, and other factors, including human disturbance. Indeed, wetlands are found from the tundra to the tropics and on every continent except Antarctica. Even wetlands that appear dry at times for significant parts of the year -- such as vernal pools-- often provide critical habitat for wildlife adapted to breeding exclusively in these areas.



Wetlands and Mosquitoes

Mosquitoes will not survive in wetlands that dry out in less than a week after a summer rain, or in wetlands connected to a deeper pond that supports small fish or aquatic insects that feast on mosquito larvae. Wetlands can provide habitat for many natural enemies of mosquitoes including certain birds, frogs, fish and insects that feed on mosquito adults and larvae. Backyard wetlands can actually decrease mosquito populations by providing proper habitat for such predators.

Where to Place a Backyard Wetland

A natural depression, ditch or area in your yard that tends to stay wet is an ideal place to develop a wetland. Other areas with slowly draining soil or in the path of runoff are suitable sites for a backyard wetland. When selecting a site, consider the following:

- If there is an existing wetland, check state and local wetland regulations before altering it.
- Unless you completely own a ditch, check with local authorities before making any alterations. Be sure you won't cause adjacent properties to flood.
- Is the potential wetland site located away from your foundation, out buildings, existing landscaping or neighboring properties that might be damaged by excessive moisture?
- Locate the backyard wetland where it is unlikely to attract unattended children. Check local safety ordinances and building ordinances for restrictions and permits.
- How will the potential wetland site be integrated into your existing landscape?
- If you need supplemental water, is it readily available or can you use roof drainage or water from a rain barrel?

Building a Wetland in an Existing Wet Area or Drainage Way

Since wetlands refer to a range of conditions, there is a lot of potential for including wetland plants in your yard. You may want a wetland that only stays wet for a short period of time after heavy rains or one that stays wet most of the time. It depends on the site and your desires. Installing a wetland in your yard may mean planting wetland plants in an existing wet area of your yard or existing drainage way.

In some instances, all you need to do is stop mowing during dry periods. Too often homeowners go to great lengths to establish plants that are not adapted to the site or to modify the site, when it would be more effective to use plants suited to the conditions. Numerous wetland plants are well adapted to wet conditions and will provide beauty as well as wildlife habitat.

1. Construct the wetland in an existing drainage way or by building a small berm to hold back water for a few days or weeks.
2. Put a stake in the center of the lowest portion of the drainage way where you want to construct the wetland.
3. Using a level on a large board or string, place a stake where a level line reaches the ground on either side.
4. Remove any existing sod from an area about 4 feet wide along the line of the berm and over about half the area that will be flooded.
5. Build your berm about 4 feet wide at the bottom and 1 foot at the top. The center should be 4 to 6 inches higher than the ends to allow for settling and to force water flowing over it around the ends, reducing the likelihood of erosion.
6. Cover the compacted berm with purchased grass sod or the sod you originally removed from the area.
7. Plant wetland-adapted plants in bands from the deepest areas to an area about six inches above the expected high water level, selected according to the degree of soil saturation they require.

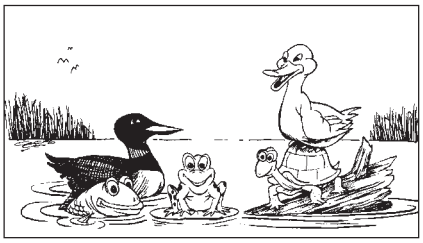
Establishing Plants

Select plants that are suitable for a wetland, hardy for your area, and provide the desired wildlife habitat and aesthetics. Use a mix of diverse native plants. The species of plants most common in other wetlands in your area with similar flooding cycles will be easiest to grow and need the least maintenance. Most trees, shrubs, ferns and many other plants grow best in soils that are only saturated early in the growing season and after heavy rains. Others need almost continually saturated soil. *(See Backyard Wetland Plant lists on the following pages).*

Rooted aquatic plants, such as water lilies, need to be continually flooded. Once established, emergent aquatic plants, like pickerelweed, will thrive in water a couple feet deep. However, most have a narrow tolerance range that may vary depending on where you live. Always check with a reputable nursery or other expert before making final decisions on what varieties to plant. Plants should always be purchased from a reliable source.

Beware! Native wetland plants are available in many areas, but be sure to buy them from a reputable nursery to avoid importing invasive plant species that could overtake a wetland. There are many species that have been naturalized in North America and are often considered native plants. Unfortunately however, some of these species are more competitive and have become invasive, crowding out the native species that provide habitat for indigenous plants and wildlife.

The plants you select for your wetland will depend on:

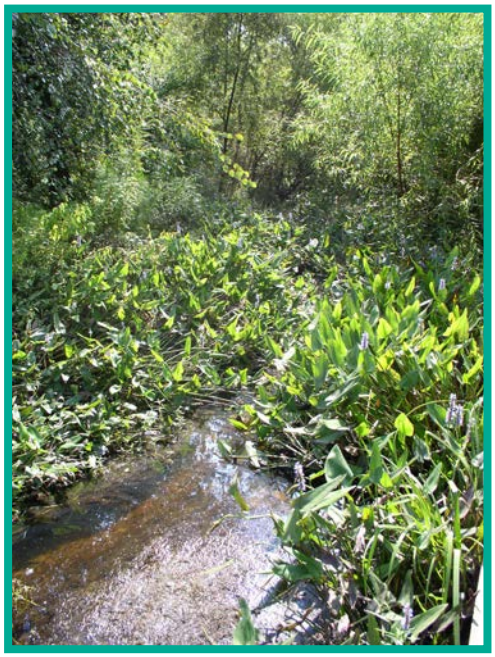


- the length of time the soil will be saturated or covered with water
- depth of the water
- amount of sunlight on the site
- climate
- soil pH
- size of the wetland

Maintaining a Backyard Wetland

Backyard wetlands should contain native wetland plants whenever possible to reduce your maintenance activities and eliminate the need for fertilizer and pesticides. Weeding, pruning and removing dead or diseased vegetation are a few basic maintenance activities you should do to the wetland. The following are some helpful maintenance guidelines:

- Evaluate plant health and performance. If you notice some species are not doing well, you may need to move them or replace them.
- Weed the wetland. The first few years you may notice weeds growing in the wetland. This is because weed seeds that were already in the soil may have been disturbed when you first planted the wetland plants. You can pull weeds out by hand or just give the wetland plants time to establish themselves and they will eventually out-compete the weeds.
- Cut back herbaceous plants in the winter. This is an optional maintenance activity.



Plants for Backyard Wetlands

Hundreds of species of wetland plants occur throughout North Carolina. Many produce attractive flowers and foliage and are valuable sources of food and shelter for birds, butterflies and other wildlife. The following lists are suggested plants suitable for use in small backyard wetlands. All are native to Southeastern North Carolina and many occur throughout the state. All of these plants can be purchased at specialty native plant nurseries, though a few are commonly used as ornamentals and are widely available from local garden centers (widely available plants are marked with a star*).

(* = denotes plant that is commonly available at local garden centers)

Floating Rooted Aquatic Plants

Floating rooted aquatic plants grow with their roots in the mud while their leaves and flowers float at or stick up above the water's surface. These aggressive growers prefer to grow in 3'-6' of standing water and can quickly fill a small pond or wetland. In the wild, their spread is usually limited by varying water levels. If these plants are desired, it may be best to grow them in large, sturdy containers without holes in the bottom to keep their aggressive root systems in bounds. Grown this way, they will need to be divided and repotted every other year in early spring.

Common Name	Scientific Name	Comments
American Lotus	*Nelumbo lutea*	Bold plant with foliage and flowers stems standing 4'-6' above water's surface. Large, showy yellow flowers produced throughout summer.
Spadderdock, Cow Lily	*Nuphar luteum*	Heart shaped leaves float on water's surface. 1"-2" wide, globe shaped, yellow flowers are born throughout summer.
Fragrant Water-lily	*Nymphaea odorata*	Rounded, heart shaped leaves float on water's surface. Large, white, sweetly fragrant flowers open throughout summer.
Floating Hearts	*Nymphoides aquatica*	Large heart shaped leaves float on water's surface. Dainty, 5-petaled, 1"-2" white flowers emerge among the foliage and stand up a few inches above water's surface.

Submerged and Free-Floating Aquatics

Like floating rooted aquatics, these two types of aquatic plants require pools of permanently standing water to grow successfully. Though they are not necessary for the success of a backyard wetland, their inclusion will certainly add interest and increase habitat value. Submerged plants grow completely underwater, though some do produce small flowers that float at the water's surface. They help to keep the water oxygenated and provide habitat for fish.

Examples of native submerged aquatics include Eelgrass (*Vallisneria americana*), Coontail (*Ceratophyllum demersum*), and Common Water Nymph (*Najas guadalupensis*). Free floating aquatics float on top of the water with their roots hanging down into the water below. These plants tend to increase rapidly and can quickly cover the surface of a pond or wetland. Native species include Carolina Water Fern (*Azolla caroliniana*) and Bladderwort (*Utricularia inflata*).

CAUTION: Extreme care should be taken when introducing free-floating aquatics so that only native species are used. Many invasive, non-native aquatic plants are available that could overtake a wetland. Avoid these!

Emergent Aquatic Perennials

This group of plants prefers to grow in 3” to 6” of standing water, with their crowns and roots in the mud but their leaves and flowers emerging up above the water. They can tolerate periods of dryer conditions, but in general, need saturated soils to grow best. They are perfect for growing at the edges of ponds or in shallow standing water.

Common Name	Scientific Name	Exposure	Comments
Duck Potato*	*Sagittaria latifolia*	sun to light shade	Tough emergent aquatic with arrowhead shaped leaves and spikes of white flowers produced throughout summer. Reproduces rapidly.
Arrow Arum	*Peltandra virginica*	sun to part shade	Elegant arrowhead shaped leaves and interesting green flowers on a clump forming plant.
Pickerelweed*	*Pontederia cordata*	sun to part shade	Upright plant producing numerous 3’ tall spikes topped with blue flowers all summer. Tough and attractive.
Lizard’s Tail*	*Saururus cernuus*	sun to part shade	Spreading perennial that will grow in shallow standing water and wet soils. Pendant spikes of white flowers in late spring and summer.
Blue Flag*	*Iris virginica*	sun to part shade	Blue flowering, 3’ tall iris that prefers to grow in shallow standing water or water’s edge.

Sedges and Rushes

This large family of grasslike plants includes many different moisture loving species. Most will grow happily in shallow standing water or permanently moist soils, though many can tolerate periods of dryer conditions. Sedges and rushes should be used as fillers in a backyard wetland. They are excellent for stabilizing soil and can be used in large sweeps for visual interest. Some of the more attractive species are listed below.

Common Name	Scientific Name	Comments
Hop Sedge	*Carex lupulina*	2’-3’ tall sedge producing dramatic clusters of pineapple shaped light green flowers in early summer.
Soft Rush	*Juncus effusus*	Common rush found throughout NC. 2’-3’ tall with dark green spiky foliage. Green flowers age to brown seed pods throughout summer.
White-top Sedge	*Rhynchospora latifolia*	Showy 2’ tall, spreading sedge bearing attractive white bracted flowers throughout summer.
Woolgrass	*Scirpus cyperinus*	Large, 3’-4’ tall and wide clump forming bulrush producing wooly green flower heads in summer that age to an attractive rusty brown as seed mature.

Moisture-Loving Perennials

Many of our most attractive native perennials grow in moist soils or wetlands. These plants return year after year to bring color and seasonal variety to backyard wetlands. The flowers of many of these perennials are excellent nectar sources for butterflies and hummingbirds. Some of these plants increase rather quickly by spreading roots known as rhizomes and stolons, while others tend to stay in one place forming large clumps. The growth habit of each is noted below, as well as the average mature size (height x width).

Common Name	Scientific Name	Size	Exposure	Comments
Swamp Milkweed*	*Asclepias incarnata*	3'-4' x 2'-3'	sun - part shade	Pink flowers in early summer. Larval food of monarch butterflies.
Turtlehead	*Chelone glabra*	3' x 3'	sun - part shade	Fall bloomer with spikes of white snapdragon shaped flowers.
Swamp Tickseed	*Coreopsis helianthoides*	2'-3' x 2'-3'	sun - part shade	Fall bloomer producing masses of golden sunflower shapes flowers.
Plume Grass	*Erianthus giganteus*	7'-10' x 3'-5'	sun - light shade	Dramatic tall grass with showy flower plumes in fall.
Hatpins, Pipewort	*Eriocaulon decangulare*	1'-2' x 1'-2'	sun - light shade	Small white ball shaped flowers on the end of straight stems actually do resemble hatpins. Flowers all summer.
Joe Pye Weed*	*Eupatorium fistulosum*	5'-7' x 3'-4'	sun - part shade	Masses of rosy-mauve flowers in late summer-fall attract hundreds of butterflies.
Swamp Sunflower*	*Helianthus angustifolius*	5'-7' x 3'-4'	sun - part shade	Towers of 3" wide golden sunflowers in fall - attracts butterflies.
Red Star Hibiscus*	*Hibiscus coccineus*	4'-6' x 3'-4'	sun - part shade	Tough, clump forming, sturdy plant with star shaped red flowers in summer.
Rose Mallow*	*Hibiscus moscheutos*	4'-6' x 3'-4'	sun - part shade	Tough, durable plants with huge white, pink or rose flowers in summer.
Seashore Mallow	*Kosteletskya virginica*	4'-6' x 3'-4'	sun - part shade	Tall airy plants are covered with 2"-3" pink flowers all summer.
Cardinal Flower*	*Lobelia cardinalis*	2'-4' x 1'-2'	sun - part shade	Tall spikes of crimson red flowers in late summer and fall - attracts hummingbirds and butterflies.
Cinnamon Fern	*Osmunda cinnamomea*	3'-5' x 2'-3'	sun - part shade	Dramatic clump forming fern with rusty fiddleheads in spring.
Royal Fern	*Osmunda regalis*	3'-5' x 2'-3'	sun - part shade	Dramatic clump forming fern with bold textured foliage.
Switch Grass	*Panicum virgatum*	3'-4' x 2'-3'	sun - part shade	Upright fall blooming grass whose airy seedheads persist through winter.
Green Headed Coneflower	*Rudbeckia laciniata*	4'-6' x 3'-4'	sun - part shade	Yellow flowers in summer on tall plants. Good for butterflies.
Goldenrod	*Solidago rugosa*	3'-5' x 2'-3'	sun - part shade	Multiple spikes of golden yellow flowers in late summer and fall.
Ironweed	*Vernonia noveboracensis*	5'-7' x 3'-4'	sun - part shade	Royal purple flowers atop tall stems in late summer, fall - attracts butterflies.
Atamasco Lily	*Zephyranthes atamasco*	1' x 1'	sun - part shade	Spring bloomer with large white trumpet shaped flowers. Grows from bulbs.

Moisture-Loving Woody Plants

Woody plants are a valuable component of a backyard wetland, providing shelter for nesting birds, berries for wildlife, large root systems that hold soil in place and year round structure. The various wetlands that are found across our state are inhabited by many different species of trees and shrubs. Most of these plants are tough and adaptable, tolerating periods of flooding as well as drier conditions. Many will grow just as happily in average, well-drained soil as they will in wet boggy areas. The majority are deciduous plants (D) that loose their leaves each fall, but a few are evergreen (E). The mature size is listed as height (H) x width (W).

TREES

Common Name	Scientific Name	E/D	Exposure	H x W	Comments
Red Maple*	*Acer rubrum*	D	sun to light shade	40’-60’ x 20’-30’	Medium to large tree with excellent fall color. Produces showy red flowers and seed pods in early spring.
Pawpaw	*Asimina triloba*	D	sun to part shade	15’-25’ x 10’-20’	Suckering multi-stemmed shrub or small tree producing sweet banana like fruit in autumn.
River Birch*	*Betula nigra*	D	sun to light shade	30’-40 x 15’-20’	Adaptable tree which produces attractive light colored flaky bark. Often grows with multiple trunks.
Redbud*	*Cercis canadensis*	D	sun to part shade	15’-25’ x 10’-20’	Graceful small tree producing bright rosy purple flowers in early spring.
Atlantic White Cedar	*Chamaecyparis thyoides*	E	sun to light shade	30’-50’ x 10’-20’	Tall, slender evergreen formerly used to make log cabins. Smaller growing selections are available.
Fringe Tree	*Chionanthus virginicus*	D	sun to part shade	10’-20’ x 10’-15’	Large shrub or small multi-stemmed tree bearing fragrant, white flowers in early summer, followed by blue berries on female plants.
Swamp Dogwood	*Cornus foemina*	D	sun to part shade	15’-25’ x 10’-20’	Large shrub or small multi-stemmed tree producing flat clusters of white flowers followed by blue berries. Excellent food source for birds.
TiTi	*Cyrilla racemiflora*	Semi E	sun to part shade	10’-20’ x 10’	Large shrub or small multi-stemmed tree producing masses of tiny white flowers in drooping spikes in mid summer.
Possumhaw	*Ilex decidua*	D	sun to light shade	15’-25’ x 10’-20’	Small tree whose stems are lined with bright red berries in fall and winter.
Sweetbay*	*Magnolia virginiana*	Semi E	sun to light shade	20’-30’ x 10’-15’	Small tree with large, fragrant white flowers in early summer. Often grows with multiple trunks.
Swamp Redbay	*Persea palustris*	E	sun to part shade	20’ -30’ x 10’-15’	Evergreen upright tree. Salt tolerant and deer resistant.
Pond Cypress	*Taxodium ascendens*	D	sun to light shade	60’-70’ x 10’-20’	Columnar habit with fine textured, feathery foliage. Rusty brown fall color.
Bald Cypress*	*Taxodium distichum*	D	sun to light shade	50’-70’ x 20’-30’	Majestic large tree, synonymous with Southern swamps. Amazingly adaptable and will grow in almost any soil and up to 3’ of standing water.
Black Willow	*Salix nigra*	D	sun to light shade	20’-40’ x 15’-20’	Medium sized tree with long narrow leaves. Often used in stream bank stabilization.

SHRUBS

Common Name	Scientific Name	E/D	Exposure	H x W	Comments
Chokeberry	*Aronia arbutifolia*	D	sun to light shade	6’-10’ x 3’-5’	Upright, suckering shrub producing flat cluster of white flowers in early spring - followed by generous clusters of bright red berries in fall and winter.
Beautyberry	*Callicarpa americana*	D	sun to part shade	4’-6’ x 3’-5’	Striking clusters of magenta berries line stems in late summer and fall. Best cut back to 1’ in early spring.
Sweet Shrub	*Calycanthus floridus*	D	sun to part shade	5’-8’ x 5’-8’	Suckering shrub bearing fragrant maroon flowers in early summer.
Buttonbush	*Cephalanthus occidentalis*	D	sun to light shade	6’-12’ x 6’-12’	Interesting round clusters of small white flowers in summer attract many butterflies. Adaptable - will grow in standing water or well drained soil.
Pepperbush, Summersweet*	*Clethra alnifolia*	D	sun to light shade	4’-6’ x 3’-5’	Suckering shrub with extremely fragrant spikes of white or pink flowers in summer and yellow autumn color.
Silky Dogwood	*Cornus amomum*	D	sun to part shade	6’-10’ x 6’-10’	Flat clusters of white flowers are followed in autumn by blue berries which are a valuable food source for birds.
Strawberry Bush, Hearts-a-Bustin	*Euonymus americanus*	D	sun to part shade	4’-6’ x 3’-5’	Common names refer to the attractive red and orange seed pods that decorate this suckering shrub in autumn.
Dwarf Fothergilla	*Fothergilla gardenii*	D	sun to part shade	3’-5’ x 3’-4’	Small, white, fringy, honey scented flowers in spring. Excellent yellow, orange and red fall color.
Inkberry*	*Ilex glabra*	E	sun	5’ x 5’	Evergreen shrub with small black berries in fall.
Winterberry*	*Ilex verticillata*	D	sun to light shade	6’-10’ x 6’-10’	Large shrub covered with red berries all winter. Plant several to insure good pollination.
Yaupon*	*Ilex vomitoria*	E	sun to light shade	10’-20’ x 5’-10’	Extremely tough and adaptable upright shrub. Stems of female plants are lined with translucent red berries in fall. Dwarf forms are available.
Virginia Sweetspire*	*Itea virginica*	D	sun to part shade	4’-6’ x 3’-5’	Suckering shrub producing pendant spikes of white fragrant flowers in late spring. Exceptional autumn color.
Spicebush	*Lindera benzion*	D	sun to part shade	6’-10’ x 6’-10’	Small but attractive bright yellow flowers in early spring. Followed by red berries on female plants. Larval host plant for Spicebush Swallowtail butterflies.
Wax Myrtle*	*Myrica cerifera*	E	sun to light shade	6’-15’ x 6’-12’	Tough, adaptable plant that can be grown as a shrub or small multi-stemmed tree.

SHRUBS

Common Name	Scientific Name	E/D	Exposure	H x W	Comments
Coastal Azalea	*Rhododendron atlanticum*	D	sun to part shade	3’-5’ x 3’-4’	Produces clusters of white, extremely sweetly scented flowers in early spring before the leaves come out.
Swamp Honeysuckle	*Rhododendron viscosum*	D	sun to part shade	9’-15’ x 6’-10’	Large native azalea producing white, fragrant flowers in early summer.
Swamp Rose	*Rosa palustris*	D	sun to light shade	5’-10’ x 5’-7’	Suckering shrub bearing fragrant pink flowers in summer. Red fruits (hips) in fall.
Dwarf Palmetto	*Sabal minor*	E	sun to shade	5’ x 5’	Dramatic clumping palm for outer Coastal Plains.
American Snowbell	*Styrax americanus*	D	sun to light shade	6’-10’ x 5’-8’	Fine textured shrub covered in white bell shaped flowers in spring.
Possumhaw Viburnum*	*Viburnum nudum*	D	sun to part shade	6’-10’ x 6’-10’	Flat clusters of creamy white flowers are followed by cream to pink berries that mature to blue in fall. Wine and burgundy autumn color.
Honeycups	*Zenobia pulverulenta*	D	sun to light shade	3’-5’ x 3’-4’	Gracefully arching shrub whose stems are laden with white bell shaped flowers in spring. Nice autumn color.

Plants for Backyard Wetlands courtesy of Charlotte Glen, Urban Horticulture Agent, North Carolina Cooperative Extension.

Sources for This Section and Additional Backyard Wetland Info

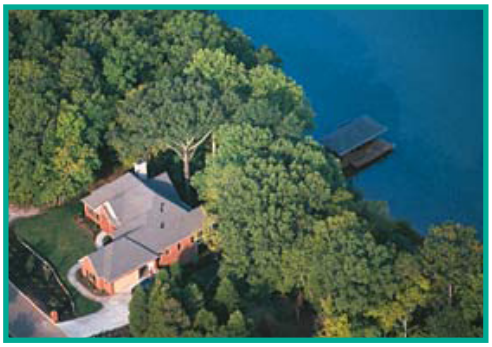
NCSU Aquatic Weed Management http://www.weedscience.ncsu.edu/aquaticweeds/factsheets.html

EPA Wetlands Info http://www.epa.gov/owow/wetlands/what/definitions.html

Do-It-Yourself Backyard Wetlands http://doityourself.com/pond/backyardwetlands.htm

Wetlands Initiative http://www.wetlands-initiative.org/

BUFFER

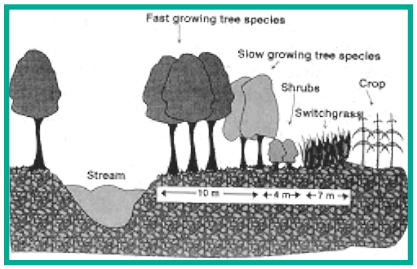


Buffers provide immediate protection for waterways by filtering pollutants from runoff, preventing erosion and protecting waterfront property.

Commercial and residential development has replaced much of our community's natural means for reducing water pollution. Without natural filters like trees and shrubs, polluted stormwater runoff flows directly into local creeks, lakes and waterways without treatment.

A riparian buffer (vegetated buffer) is an area of native vegetation located adjacent to a water body that protects it from sediment and pollutants contained in stormwater runoff. Buffers stabilize stream banks, remove sediment and pollution from runoff, provide habitat and shelter for wildlife and act as a barrier between water and developed land. Buffers are best planted with native plants, trees and shrubs.

Buffer Benefits



- **Filter stormwater runoff**
  Buffers trap and remove sediment, nutrients, chemicals and bacteria from stormwater runoff before it reaches receiving waterways.
- **Control flooding and recharge groundwater**
  Buffer vegetation helps control the speed and amount of runoff that flows into waterways, which reduces the risk of flooding and erosion. Buffers soak up runoff and allow it to seep into the ground to recharge groundwater supplies.
- **Protect property and prevent erosion**
  Roots from trees and shrubs anchor soil and stream banks in place, making them less likely to wash away during heavy rains. Buffers also provide natural protection from hurricanes.

- **Wildlife habitat**
  Buffers provide excellent habitat for birds and aquatic and terrestrial wildlife. Buffers shade waterways and help keep the water cool in summer months, which is especially important for fish and aquatic life which need cooler water to survive. Buffers also serve as corridors for migratory wildlife.
- **Provide privacy and save time and money**
  Buffers can be planted so that they block views of nearby development, preserve the natural character of the shoreline and provide privacy for waterfront homeowners. Buffers also increase property values and decrease yard work.

Buffer Recommendations

Buffer Size

Size depends on what you want the buffer to do. The state minimum width is 30 feet, but the New Hanover Soil and Water Conservation District prefers a buffer width of at least 35 feet to achieve maximum benefits. However, keep in mind, that any size buffer is better than none at all. *See the table below for more information about buffer widths.*

Slope

For a buffer to filter water effectively, water must be allowed to flow through it slowly and evenly. The North Carolina National Estuarine Research Reserve reports that slopes of less than 15% are ideal for buffers. Steep slopes carry water too quickly for the water to be absorbed efficiently. Fast-moving water can also cause soil erosion.

Plants Selection

Buffers should contain a variety of native trees, shrubs and grasses that will survive easily in our climate without the use of fertilizers and pesticides. Plants should also be selected to provide habitat for wildlife. *See the following pages for buffer plant suggestions.*

Effectiveness of Buffers Based on Width

Buffer Width	Pollutant Removal Effectiveness	Wildlife Habitat Value
15 ft.	50% or greater sediment and pollutant removal	Poor habitat; good for temporary wildlife activities.
35 ft.	60% or greater sediment and pollutant removal	Minimally protects stream habitat. Good for temporary wildlife activities.
50 ft.	70% or greater sediment and pollutant removal	Minimal general wildlife and avian (bird) habitat.
65 ft.	70% or greater sediment and pollutant removal	Minimal general wildlife habitat. Some value as avian habitat.
100 ft.	70% or greater sediment and pollutant removal	May have use as a wildlife travel corridor and avian habitat.
165 ft.	75% or greater sediment and pollutant removal	General wildlife and avian habitat value.
245 ft.	80% or greater sediment and pollutant removal	Fair to good general wildlife and avian habitat value.
330 ft.	80% or greater sediment and pollutant removal	Good wildlife habitat value. May protect significant wildlife.
660 ft.	90% or greater sediment and pollutant removal	Excellent wildlife value. May support a diverse community.
2000 ft.	99% or greater sediment and pollutant removal	Excellent wildlife value. Supports a diverse community. Protection of significant wildlife.

Planting a Buffer

1. Deciding when to plant a buffer will depend on the type of plants you want to install. Trees and shrubs should be planted when they are dormant—either in early spring after the ground thaws or in autumn after the leaves fall.
2. Know where your property and utility lines are located and be sure to obtain any necessary permits if needed.
3. Decide on the width of your buffer and how many plants you'll need.
4. Arrange plants so they create a gradual buffer instead of an abrupt one. Guidelines for vegetation spacing widths in a buffer are:

Shrubs	3-6 feet apart
Small trees	5-8 feet apart
Large trees	8-12 feet apart
Groundcovers	1-3 feet apart

5. Rooted plants should be put in holes that are 2-3 times as wide as the root ball, but only as deep as the root ball. Fill in the hole with the original soil, then water to settle the soil.
6. Water the buffer once a week for the first growing season, but make sure not to over-water, which could damage new plants and cause the soil to erode. Use only lime or wood ash to fertilize the buffer zone.
7. Mulch the buffer with organic mulch such as leaf humus, wood chips, pine mulch or other shredded bark; avoid redwood and cedar mulch. Mulch controls weed growth, helps the soil retain moisture and prevents erosion.
8. If necessary, build a temporary barrier to keep out unwanted visitors. Chicken wire is effective to keep small animals away from seedlings until they become established.

Roadside Buffers

Buffers can also be planted alongside roadways or parking lots to provide a barrier between impervious (hard) surfaces, land, and waterways. The vegetation planted in a roadside buffer provides pollutant removal by cleansing and filtering polluted runoff flowing off of impervious surfaces. These types of buffers can be planted with an assortment of colorful vegetation that attracts and provides habitat for wildlife as well. Just be sure that wildlife you want to attract can survive near busy roads or parking lots. Butterflies and birds are ideal to attract to roadside buffers.

Buffer Maintenance

Water the buffer once a week during the first growing season. Periodically check for soil erosion, insect disease or storm damage. Do not use fertilizers or pesticides and leave the vegetation, leaf litter and undergrowth undisturbed. Lastly, make sure the buffer is doing what it was designed to do - if it's not, you may need to install more plants or build a larger buffer.

Woody and Herbaceous Buffer Plants

TREES		
Black gum*	*Nyssa sylvatica*	Dry. Fruits used by many birds and bees.
Carolina Ash*	*Fraxinus caroliniania*	Tolerates salt and some shade. Butterflies and birds use.
Green Ash*	*Fraxinus pennsylvanica*	Sun to shade. Fast growing.
Magnolia, Southern	*Magnolia grandiflora*	Attractive flowers, fruit eaten by birds and squirrels.
Oak, Live	*Quercus Virginiana*	Dry site w/full sun. Food, nest, roost site for birds/mammals.
Oak, Southern Red	*Quercus falcata*	Dry to moist. Good nesting and acorns.
Sycamore*	*Plantanus occidentalis*	Excellent nutrient scavenger. Fast growing.
SMALL TREES		
American Holly*	*Ilex opaca*	Female plant has red berries.
Eastern Red Cedar*	*Juniperus virginiana*	Full sun. Dry soil. Birds eat fruit, use for nesting/roost cover.
Palmetto*	*Sabal palmetto*	Wet to dry. Sun to shade. Salt tolerant. Monk butterfly.
Red Buckeye	*Aesculus Pavia*	Spike of red flowers-early summer-hummingbirds.
River Birch*	*Betula nigra*	Attractive tree, wet or dry sites, full sun.
Sweet Bay*	*Magnolia virginiana*	Attractive flowers, fruit eaten by birds and squirrels.
Wax Myrtle*	*Myrica cerifera*	Vigorous-tolerates dry, wet, sun & shade, Painted Bunting habitat.
Yaupon Holly*	*Ilex vomitoria*	Amazingly adaptable, Painted Bunting habitat.
SHRUBS		
American Beautybush*	*Callicarpa americana*	Likes sun, tolerates shade and dry soil. Fall berries.
Buttonbush*	*Cephalanthus occidentalis*	Water and draught tolerant. Summer flowers – butterflies.
Elderberry*	*Sambucus canadensis*	Handles dry-wet. Needs some sun. Birds love.
Groundsel Tree*	*Baccharis halimifolia*	Quite salt tolerant, needs some moisture. Leaves-poisonous.
Highbush Blueberry*	*Vaccinium corymbosum*	Great fruit producer. Loves sun, tolerates shade, wet or dry.
Inkberry*	*Ilex glabra*	Wet or dry soils. Tolerates shade, salt. Birds eat berries.
Marsh Mallow	*Hibiscus moscheutos*	White specimen flowers - hummingbirds
Sparkleberry*	*Vaccinium arboreum*	Dry soil, tolerates salt. Shade to sun. Many birds and butterflies.
Sweet Pepperbush*	*Clethera alnifolia*	Beautiful, fragrant blooms. Tolerates sun, shade, wet or dry.
Virginia Sweetspire*	*Itea virginica*	Sun - shade, well drained to wet soil. White flowers, fall color.

GRASSES**		
Salt-meadow cordgrass*	*Spartina patens*	From high tide line landward, weeping clumps.
Coastal panicgrass*	*Panicum amarum*	'Atlantic' tall, upright, well drained sites
Switchgrass*	*Panicum virgatum*	Many ornamental cultivars, dry-wet sites, upright.
FORBS AND WILDFLOWERS**		
Bee Balm, Bergamot	*Monarada didyma*	Sun. Dry sites. Red flowers attract hummingbirds.
Black-Eyed Susans	*Rudbeckia fulgida*	Sun to part shade. Birds and butterflies.
Blazing Star	*Liatris scariosa*	Sun to part shade. Butterfly magnet.
Butterfly Weed	*Asclepias tuberose*	Full to part sun. Butterfly magnet.
Indian Blanket*	*Gaillardia pulchella*	Sun, dry site. A dune plant w/ orange summer flowers
Goldenrod*	*Solidago spp.*	Sun, dry site. Yellow flowers, bees butterflies.
Phlox	*Phlox spp.*	Sun to shade. Hummingbirds.
Purpled Cone Flower	*Echinacea purpurea*	Sun to light shade. Drought resistant. Seeds for finches.
Sea Shore Mallow*	*Kosteletzkya virginia*	Salt tolerant. Attracts butterflies and hummingbirds.
Threadleaf Coreopsis	*Coreopsis verticillata*	Yellow flowers. Full sun, dry sites.
VINES		
Cross Vine	*Bignonia capreolata*	Sun to part shade. Evergreen, orange flowers. Hummingbirds.
Trumpet Vine	*Campsis radicans*	Sun to part shade. Evergreen, orange flowers. Hummingbirds.

*** Known tolerance to salt-spray.**
**** When using herbaceous plants, at least one species of grass should be in the mix. Note: these grasses will not form sod. They are bunching grasses and should be allowed to go to seed head, for their intended purpose and aesthetics.**

Plant list courtesy of New Hanover Soil & Water Conservation District (910) 798-7130 or soilwater.nhcgov.com

Sources for This Section and Additional Buffer Info

NH Soil & Water Conservation District	http://soilwater.nhcgov.com
Natural Resource Conservation Service	http://www.nrcs.usda.gov/feature/buffers/#Anchor-WhatBuffer
Environmental Protection Agency	http://www.epa.gov/owow/nps/ordinance/buffers.htm
US Department of Agriculture	http://www.na.fs.fed.us/spfo/pubs/n_resource/buffer/cover.htm
Connecticut River Valley	http://www.crjc.org/riparianbuffers.htm
Chesapeake Bay Riparian Forest Buffers	http://www.chesapeakebay.net/info/forestbuff.cfm
Virginia Department of Forestry	http://www.dof.virginia.gov/rfb/

HABITAT GARDEN

Habitat gardens can beautify a landscape and provide habitat for wildlife.

A great way to bring nature to your doorstep is to plant a habitat garden. Unlike a common flower or rain garden, habitat gardens are planted specifically for the purpose of supporting and protecting wildlife.

The best part about planting a habitat garden is that you decide what type of wildlife you want to attract and which plants you will use in the garden. Birds, butterflies and small wildlife are some of the most common species to attract to a habitat garden, but you can also attract beneficial insects, such as dragonflies, which can help keep mosquito populations in check.

Habitat Garden Benefits

- **Provide habitat for wildlife in urban areas**
  Installing a habitat garden on your property is especially important in urban areas where there may be a shortage of natural, undeveloped land and habitat for wildlife.
- **Educational and recreational opportunities**
  Habitat gardens provide many opportunities to observe and enjoy wildlife in their natural habitat.
- **Improve local water quality**
  Habitat gardens contain many plants that absorb and filter pollutants from stormwater runoff.
- **Enhance the beauty of your yard**
  Habitat gardens can contain a wide variety of plants that attract birds, butterflies and other wildlife and beautify your landscape at the same time.

Landscaping for Birds

There are four basic elements that will attract birds to your garden: water, food, shelter and a place to reproduce and raise young.

Water

Water, whether it is in the form of a water garden or small birdbath, will attract many bird species. Make sure the water source provides a year-round source of clean water to prevent transmission of disease.

Food

Install plants that produce berries, fruits, nuts, nectar or attract insects in order to attract birds. For example, some birds eat insects as a source of protein and also feed insects to their young. Therefore, installing plants that attract insects will attract certain birds.

Shelter

Birds need protective cover from the elements and predators. Shelter is also used for developing nesting sites and for relaxing. Birdhouses and densely-planted shrubs are also suitable for shelter. A shelter-friendly garden is sure to attract many bird species.

Tip: Put a bell on an outdoor cat's collar to warn birds of danger.

Reproduction

Having a safe place for birds to raise and nurture their young is extremely important. Live trees, shrubs and even patio plants serve as good nesting areas. Dead or dying trees known as "snags" are good nesting sites as well. When natural snags or vegetation are not present, nesting boxes can be used instead.

Landscaping for Butterflies

To ensure a successful butterfly garden, your garden should contain plants that support all phases of a butterfly's life cycle. Butterflies need a place to lay eggs, a place to form a cocoon, food plants for the caterpillars and nectar plants for the adult butterflies.

Food Plants

Food plants attract caterpillars that will eventually grow into butterflies. In a sense, you can grow your own butterflies by planting the right food plants.

Tip: Food plants may need to be located away from other landscape beds because caterpillars have been known to chew leaves and flowers.

Nectar Flowers for Adults

Plant a diverse group of flowers and make sure something is in bloom from spring to late fall.

Shelter

Butterflies love sunshine, so locate the garden in a sunny area. Butterflies are active on warm, windless, sunny days when temperatures are between 65°-95°F. Make sure the garden also provides shade; butterflies retreat to shaded areas when temperatures rise above 95°F.

Planting a Habitat Garden

It is important to plant the proper vegetation for the wildlife you want to attract; otherwise you may attract critters you hadn't bargained for. In fact, you may already have plants and trees that are home to different wildlife species and you may not even know it. So take stock of the plants you already have because you may be closer to having a habitat garden than you think! Do this:

1. Decide what type of wildlife you want to attract and then choose plants that are appropriate for your garden.

2. Whenever possible, choose native plants. Native plants are adapted to this region and are drought and disease tolerant. They are beautiful, easy to care for and usually do not require fertilizers and pesticides.

3. Let the garden grow! Do not use pesticides in your garden! Pesticides interfere with the natural ecosystem by killing the insects that attract birds and other wildlife to the garden. In addition, your

garden should try to replicate a natural habitat as much as possible, so don't worry so much about keeping its appearance neat and tidy.

Maintaining a Habitat Garden

Maintain a habitat garden by inspecting and evaluating plant health, weeding, pruning, removing dead or diseased vegetation and adding new mulch periodically. Periodic dead-heading throughout the summer will ensure continued blooming for annuals and perennials, sometimes until frost. Once herbaceous (soft-stemmed) plants have stopped growing or become dormant, they can be pruned back to ground level. They will grow back from the roots next year.

All habitat gardens will benefit from a fall clean-up followed by the application of 4-6 inches of new mulch. This will help prevent compaction from rainfall and will make the soil easier to work with in the spring. In addition, periodically clean out water structures, such as birdbaths. Keep bird feeders stocked as well.

Sources for This Section and Additional Habitat Garden Info

Natural Resource Conservation Service	http://www.nrcs.usda.gov/feature/backyard/
Habitat Gardening	http://www.ces.ncsu.edu/
Managing Backyards/Urban Habitats for Birds	http://www.ces.ncsu.edu/forestry/pdf/ag/ag636_01.pdf
Butterflies in Your Backyard	http://www.ces.ncsu.edu/forestry/pdf/ag/ag636_02.pdf
Landscaping for Wildlife with Native Plants	http://www.ces.ncsu.edu/forestry/pdf/ag/ag636_03.pdf
Backyard Wildlife Habitats	http://www.enature.com/backyardwildlife/nwf_bwh_home.asp
National Wildlife Federation	http://www.nwf.org/backyardwildlifehabitat/index.cfm
	http://www.nwf.org/backyardwildlifehabitat/attractbutterflies.cfm
The Butterfly Site	http://www.thebutterflysite.com/gardening.shtml
Insect-eating Birds	http://www.enature.com/articles/detail.asp?storyID=627
Native Plant Database	http://wildflower.utexas.edu/plants/

Habitat Garden Plants

(Denotes deer-resistant plant)*

TREES	SHRUBS	GROUNDCOVER	VINES
Atlantic White Cedar	Abelia	Candytuft	Carolina Jessamine
Bald Cypress	Azalea	Coralbells	Confederate Jasmine
Beech	Beautyberry	Cotoneaster	Coral Honeysuckle
Birch	Blackberry	Euonymous	Cypress Vine
Black Gum	Blueberry	Foamflower	Grape
Black Locust*	Chokecherry	Lamb's Ear	Kiwi
Catalpa	Clethra	Lantana	Morning Glory
Cherry Laurel	Cotoneaster	Leadwort	Passion Vine
Crabapple	Cyrilla	Moss Pink	Virginia Creeper
Dogwood	Gardenia	Santolina	
Fringe Tree	Hydrangea	Sea Thrift	
Hack Berry	Inkberry	Sedum	
Hawthorn	Itea	Sweet Alyssum	
Holly*	Lantana*	Verbena	
Loblolly Bay	Leucothoe	Vinca	
Magnolia*	Lyonia		
Maple	Nandina		
Plum	Pyracantha		
Redbud	Quince		
Red Cedar	Rose Rugosa		
Persimmon	Rose of Sharon*		
Pine	Serviceberry		
Sassafras	Spicebush		
Smoke Tree*	Spirea*		
Sourwood	Sweetshrub		
Sweetgum	Texas Sage		
Tulip Poplar	Virburnum Spp.		
White Pine	Wax Myrtle*		
Yaupon	Weigela		
	Winterberry		

GRASSES	BUTTERFLY PLANTS	CATERPILLAR FOOD	HUMMINGBIRD PLANTS
Andropogon	Chrysanthemum	Butterfly Weed	Beebalm
Blood Grass	Cleome	Catnip	Cardinal Flower
Blue Fescue	Coneflower	Dill	Columbine*
Miscanthus	Coreopsis	Lavender	Coral Bells
Molinia	Cornflower	Mint	Coral Honeysuckle
Mosquito Grass	Cosmos	Parsley	Cosmos
Oat Grass	Dahlia	Rosemary	Impatiens
Panicum	Daylily	Sage*	Kniphofia
Pennisetum	Dianthus	Thyme	Lantana
Quaking Love Grass	Hibiscus		Larkspur
Sea Oats	Hollyhock		Monkeyflower
Sedge	Hyssop		Nasturtium
	Inula		Nicotiana
	Joe Pye Weed		Petunia
	Lantana		Quince
	Lavender		Rosemary
	Leadwort		Salvia
	Liatris		Scarlet Begonia
	Sweet Alyssum		Scarlet Runnerbean
	Tansy		Trumpetcreeper
	Tithonia		
	Trumpet Creeper		
	Verbena		
	Veronica*		
	Viburnum		
	Vinca		
	Yarrow		
	Zinnia*		

These plant suggestions have been provided by Andy and Sandy Wood of HABITATS, specializing in garden designs for backyard birds, habitat enhancement and landscape restoration.

NATIVE PLANTS

The Appendix contains many plants that are native to the Southeast United States.

Native plants are beautiful and hardy and once established, they require much less maintenance than a conventional lawn. By definition, native plants are those plants that are indigenous to a particular region. They are adapted to the local climate and soil conditions and seldom need watering, mulching, fertilizers or pesticides. In the Wilmington area, many people are incorporating native plants into their landscapes as they realize the benefits. There are successful examples of native landscaping practices at local businesses, universities, residences, schools and parks.

Native plants function much like a natural system, with the plants providing nectar, pollen and seeds that serve as food for butterflies, birds and beneficial insects. In contrast, many common landscape plants do not produce nectar and often require insect pest control to survive. Native plants also help protect the soil with their deep and spreading root systems which helps prevent erosion. In developed areas, a popular way to allow stormwater runoff to soak into the ground, rather than run off into storm drains, is to create depressions filled with native plants called rain gardens. Today, local nurseries are carrying a wider selection of native plants choices for consumers.

Native plant communities are vital components of ecosystems. In order to be healthy and sustainable, an ecosystem needs to be filled with a wide array of plants and animals that are indigenous to the area. In addition to providing food and shelter to birds and animals, a healthy ecosystem provides many services to society.

For instance, a healthy forest ecosystem can prevent soil erosion, reduce flooding, detoxify chemicals in air and water, improve the local climate and store carbon that would otherwise contribute to global climate change. Also, some native plants show promise for medicinal purposes.

It is important to remember that although native plants are adapted to the conditions of this region, they still need to be planted and maintained according to site specific conditions. For example, a native plant that requires shade will not be able to survive in full sun. Just because a plant is native, doesn't mean it can survive any condition in the region. Think - right plant, right place!

Native Plant Benefits

- **Native plants are hardy**
  Native plants are hardy because they have adapted to the local conditions and are more apt to survive drought, disease and pest conditions than non-native plants.

- **Eliminate fertilizer and pesticide use**
  Landscaping with native plants reduces the amount of turf (grass) needing fertilization, reduces pesticide use and saves you time and money spent caring for a conventional lawn. Native plants

generally do not require fertilizer, pesticides or supplemental irrigation to survive - they are already adapted to the conditions of this region and can survive without them. This helps reduce the amount of fertilizer and pesticides flowing into our waterways which can cause high nutrient levels, severe algal blooms, low dissolved oxygen levels and impaired aquatic habitat. Replacing turf with native plants can save you time and money spent on fertilizer and pesticides, and reduce maintenance activities such as watering and mowing a traditional lawn.

- **Create a healthy and diverse ecosystem; provide aesthetics**
  Diverse varieties of birds, butterflies and animals are attracted to native plants, thus enhancing the biodiversity of the area and providing habitat in an urban area. The beauty of native wildflowers and grasses creates a sense of place, both at home and work. Native plants increase our connection to nature, help educate our neighbors and provide a beautiful, peaceful place to relax.

- **Improve air quality on a local, regional and global level**
  Planting native plants reduces reliance on traditional lawn care equipment such as lawn mowers, blowers and edgers. This in turn reduces smog and air toxins benefiting the environment and our health.

Sources for This Section and Additional Native Plant Info

NC State Extension Plant Guides	https://plants.ces.ncsu.edu/
NC State Plants	https://gardening.ces.ncsu.edu/plants-2/
NC State Gardening	https://gardening.ces.ncsu.edu/
USDA Plant Database	http://plants.usda.gov/index.html
Benefits of Naturescaping	http://www.plantnative.org/how_benefits.htm
Invasive Plants to Avoid	http://ncbg.unc.edu/invasive-plants-resources/
Carolina Yards and Neighborhoods	https://guilford.ces.ncsu.edu/carolinayards/

PERVIOUS MATERIALS

PERVIOUS WALKWAYS AND PAVEMENT

Typical roads, parking lots and driveways are paved with impervious materials, which means water cannot soak through them. As a result, most of the pollution gathered on these surfaces (motor oil, pet waste, litter, etc.) are carried by runoff into receiving waterways.

On the other hand, pervious materials (also known as porous or permeable materials) allow runoff to soak into the ground. Pervious materials are a great way to improve local water quality and reduce the amount of stormwater runoff leaving your property. There are a variety of pervious materials that are suitable for residential or commercial property use.

Pervious Material Benefits

- **Reduce runoff and flooding**
  Pervious materials absorb runoff and allow it to soak into the ground, thereby reducing the threat of flooding and the amount of runoff flowing into local waterways.
- **Treat pollutants in runoff**
  When runoff is allowed to soak into the ground, the soil is able to filter and remove pollutants.
- **Recharge groundwater supplies**
  Water is able to infiltrate into the ground and recharge groundwater supplies.
- **Suitable alternative to retention ponds**
  Many businesses are required to build a stormwater infiltration system to collect and treat runoff; pervious materials are a great alternative to large, land-consuming retention ponds.
- **Absorb less heat**
  Pervious materials absorb much less heat than traditional pavement or concrete, which is beneficial to receiving waterways and aquatic inhabitants.

Semi-pervious walkway

Two-lane driveway

Eco-stone pavers

Gridblock pavement

Residential Property

Reduce stormwater runoff at home by building sidewalks, walkways and other paths made of pervious or semi-pervious materials. Mulch, gravel, gridblock, eco-stone, stepping stones or natural pathways are excellent alternatives to traditional concrete or pavement.

Commercial Property

Pervious materials, such as gridblock pavement or eco-stone, can be used for sidewalks, driveways or overflow parking lots. Another popular type of pervious material is pervious concrete, which is made up of a mixture of materials that contain "void spaces" (see pictures on right). These void spaces in the pavement allow water to seep through and into the ground. The City of Wilmington's pervious concrete parking lot at the Stormwater Demonstration Site (in Anne McCrary Park) soaks up runoff at a rate equal to natural, undeveloped land!

Pervious Concrete

Pervious concrete can be made of concrete, asphalt, open-celled stones or gravel, but must be mixed in a way that creates an open-cell structure (15% to 25% void spaces) so that water and air can pass through.

Pre-paving Considerations

Pervious concrete is not ideal for every situation. Pervious concrete is suitable for low-flow roads, overflow parking lots, fire lanes, driveways and other areas that have low levels of fast-moving traffic and little or no traffic from heavy machinery. The reason for this is because the pores (or void spaces) in the pavement can get clogged, which reduces its ability to filter water.

Tip: Pervious concrete is slightly more expensive than typical paving materials; but for commercial purposes, it is much less expensive than retention ponds and does not waste precious land area.

Constructing Pervious Pavement

It is a good idea to hire a professional paving company to install pervious pavement parking lots, driveways or sidewalks. The following steps are performed when installing pervious concrete:

1. **Determine whether the soil is suitable for pervious pavement**
   Soils that contain significant amounts of clay or silt may not be suitable for pervious pavement. If needed, have your soil tested for permeability.
2. **Prepare the base area**
   Use a vibratory roller or other suitable equipment to compact the base area to a minimum density of 90% to 95%. The base area must also be moist (no standing water) before the pervious material is poured.

3. **Pour the mixture over the base**
   The material should be unloaded and leveled as quickly as possible. The area must be rolled again immediately after leveling with paving equipment.
4. **Allow the pavement time to set properly**
   After the pavement is rolled, it should be covered with polyethylene film, which should be held down securely. The area should be traffic-free for at least seven days.

Maintaining Pervious Pavement

Proper maintenance of pervious concrete is critical to its operation, but is relatively easy. There are two main problems that can arise as a result of poor maintenance:

The void spaces get clogged with sand or debris

- Remove debris often to prevent clogging.
- Pressure-washing clogged pavement can restore 80%-90% of its permeability and reduce clogging.
- Vacuuming the pavement with a Hi-Vac truck or street sweeper can also greatly reduce clogging.

The soil below the pavement gets compacted

- Large, heavy vehicles cause the soil below pervious concrete to become compacted—this is why pervious pavement is not recommended for high-traffic areas.
- Place signs around pervious areas to warn large trucks or heavy equipment to keep off.

Sources for This Section and Additional Pervious Materials Info

Cool Communities	http://www.coolcommunities.org/cool_pavements.htm
Comfy Country Creations	http://www.comfycountrycreations.com/easystones.htm

RAIN BARREL

During a typical storm of 1 inch of rain over a 24-hour period, over 700 gallons of water runs off an average-sized roof (approximately 1,200 square feet). Since your roof can't absorb rainwater, water flows directly off of it or it flows into gutters, drops through the downspout and onto the ground. Once the water makes it to the ground, it moves quickly toward its drainage destination (a storm drain, ditch, creek, etc.), but not before picking up pollutants such as fertilizer and pet waste from the yard or motor oil from the driveway.

Buy a rain barrel that has a spigot to attach a hose and a screen to keep debris and mosquitoes out.

What is a Rain Barrel?

Rain barrels are simply containers that collect and store rainwater from a roof; the collected water is used to water the landscape. Rain barrels should be positioned below the downspout of a roof gutter. In addition, you can also connect several rain barrels together with a simple connection kit to collect additional rainwater. Rain barrels can be attached to a regular hose for periodic watering or to a soaker hose to continuously provide water to a landscape bed.

Position a rain barrel beneath a gutter downspout.

Rain Barrel Benefits

- **Reduce runoff leaving your property**
  Rain barrels collect and store rainwater, thereby reducing the amount of runoff leaving your property and entering local creeks and waterways.
- **Water your landscape**
  Water that is collected in rain barrels is ideal for plants because it has no added chemicals and is warmer than well or tap water. Many rain barrels are designed with a spigot (or two) to attach a garden or soaker hose.
- **Conserve water during times of drought**
  Rain barrels help to conserve water during times of drought or water shortages. Using water from a rain barrel may be the only way to water your garden during a drought.
- **Save Money**
  Using a rain barrel (or two) can save you money on your water/irrigation bill since you are using free rainwater to irrigate your landscape.

Types of Rain Barrels

There are endless varieties of rain barrels; everything from do-it-yourself barrels to designer rain barrels that cost hundreds of dollars and come in a wide range of colors and sizes. The most important thing to remember is that an efficient rain barrel, whether it is homemade or store-bought, can make a significant difference in controlling water pollution in your community.

Installing a Rain Barrel

Rain barrels should be placed directly under gutter downspouts. Since most gutter downspouts run straight to the ground, you may need to modify yours a bit by cutting or sawing it to make it shorter.

Generally, gutter downspouts consist of a series of aluminum or plastic tubes with ends that are tucked inside each other and nailed or screwed to a building with brackets. Follow these steps to detach and reattach gutter tubes as necessary:

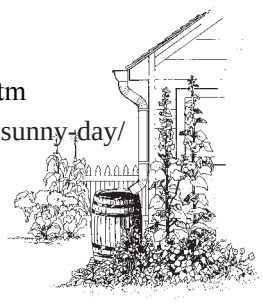
- Use a hammer or screwdriver to undo the brackets that are holding the tubes against the house or building.
- Remove the bottom section of the downspout.
- Place your rain barrel underneath the downspout. A flexible plastic downspout (from a hardware store) can be attached to help direct the flow of water into the barrel if needed; or you can cut the existing downspout to make it shorter.
- Using a hammer or screwdriver, reattach the modified downspout to the building.

Rain Barrel Maintenance and Considerations

- Rainwater that is collected in rain barrels is not safe to drink, cook with or bathe in.
- Buy a rain barrel with an overflow hose to divert excess water away from your house in case the rain barrel fills to capacity. Or you can hook several rain barrels together to harvest more rainwater.
- Make sure your rain barrel has a tight lid or screen so children and animals can't fall in and mosquitoes can't breed. Periodically clean debris off the screen.
- If you are converting an old storage barrel into a rain barrel, make sure you know what type of material the barrel contained before you got it. Some barrels may have contained toxic materials and you don't want to pass these substances on to your lawn or garden.

Sources for This Section and Additional Rain Barrel Info

Benefits of Rain Barrels	http://www.lid-stormwater.net/raincist_benefits.htm
You Grow Girl	http://yougrowgirl.com/rain-barrels-save-it-for-a-sunny-day/
Rain Barrel USA	http://www.rainbarrelusa.com/
Rain Water Solutions	http://www.rainwatersolutions.com/
Rain Barrels Guide	http://rainbarrelguide.com/



RAIN GARDEN/ BIORETENTION AREA

Photo byDavid Hymel Rain Dog Designs

A residential rain garden.

A rain garden (also known as a bioretention area) is a beautiful and inexpensive way to help improve local water quality while enhancing the beauty of your yard or commercial business property. Rain gardens are placed between stormwater runoff sources (roofs, driveways, parking lots) and runoff destinations (storm drains, streets, ditches, creeks).

Rain gardens are planted with a mix of trees, shrubs, perennials and groundcover that are suitable for both wet and dry conditions. Rain gardens are designed with a shallow depression in the center to capture runoff and allow it to soak back into the ground. Plants and soil work together to absorb and filter pollutants from runoff.

The term "rain garden" is typically used when referring to this type of BMP on residential property. Rain gardens tend to be smaller than bioretention areas and are usually placed on residential property.

The term, "bioretention area" is used when referring to this type of BMP on commercial property, city-owned property, or along roads, highways or parking lots. Bioretention areas are typically larger than rain gardens because they treat runoff from larger areas. Many commercial businesses are required to build a stormwater infiltration system to collect and treat stormwater runoff; bioretention areas are a great alternative to retention ponds. In this section, we will use the term "rain garden" to refer to both rain gardens and bioretention areas.

Rain Garden/Bioretention Area Benefits

- **Improve local water quality**
  Rain gardens capture and treat polluted stormwater runoff before it flows into local creeks, streams and waterways.
- **Enhance the beauty of your yard**
  Rain gardens can be planted with a wide variety of beautiful plants, trees and flowers. Rain gardens can also be planted with plants that serve as habitat for birds, butterflies and wildlife.
- **Reduce flooding and recharge groundwater**
  Instead of stormwater runoff flowing into streets where it can cause flooding, rain gardens collect runoff and allow it to soak into the soil to filter pollutants and recharge groundwater supplies.

This bioretention area is located in the Stormwater Demonstration Site in Anne McCrary Park located on Randall Parkway. Bioretention areas are typically placed on commercial tracts of land or along highways and parking lots.

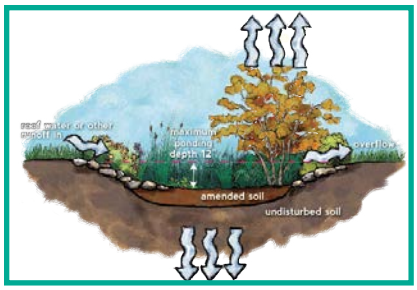
- **Protect and provide habitat for area wildlife**
  Polluted runoff is harmful to fish, birds and other wildlife that depend on clean water for survival. Rain gardens collect and filter pollutants from runoff before it reaches receiving waterways. Rain gardens provide beneficial habitat for wildlife, especially in urban areas.

Designing a Rain Garden

Consider the following before installing a rain garden:

Location

To be effective, a rain garden should be planted between the source of runoff (roof downspouts, driveway, parking lots) and the destination of runoff (storm drain, creek, street, ditch). To install a rain garden on your property, look for low-lying spots, areas that frequently flood, spots where water ponds after a rain or an area where erosion is already occurring. Be sure to consider site constraints such as utility lines and available land area before plotting out your rain garden. Do not place a rain garden near a septic system drainfield or well head.



Soils and Drainage

It is best to install rain gardens in well-drained or sandy soils. (For sites with heavy or clay soils, it may be better to install a backyard wetland, see page 5). Keep in mind that water should drain out of a rain garden within 48 hours after the rain ends to prevent mosquitoes from breeding. And the right kind of soil is important for a rain garden because it helps the plants grow and remain healthy; it is also a major component of the pollution-filtering process:

- Soils should be sandy, a sandy loam or a loam texture-type soil.
- When planting the garden, be sure to provide enough depth for plant root systems to become established and also to provide adequate moisture-holding capacity. Hard or compacted soils will need to be tilled to alleviate compaction and allow the plant root systems to penetrate the soil below.

Size

Rain gardens can be very small or very large. The size of your garden will depend on the yard space available, personal preference and the amount of money you want to spend. For commercial property, the size should be approximately 5% of the impervious (hard) surface area draining into it. However, keep in mind that any size rain garden will help reduce runoff and water pollution.

Plant and Flower Choices

Install plants that are able to withstand periods of heavy water and also times of drought. It's important to plant drought and disease-resistant plants to eliminate the use of pesticides and fertilizers. Plants can be watered initially until they are established.

Tip: Having a rain garden means not using fertilizers or pesticides and choosing plants that are adapted to your site conditions—

sun/shade, sand/clay, etc. Most residential rain gardens are a combination of native wildflowers, perennials, shrubs and ornamental grasses.

Budget
Of course, it is less expensive to build your own rain garden—the smaller the garden, the less expensive it will be. However, you may choose to hire a professional landscaper, build a larger garden or install more expensive plants. Therefore, the cost of installing a rain garden will vary.

Overall Landscape
Rain gardens should be designed with the overall landscape in mind so that it is an integral part of the entire landscape. For example, rain gardens can serve as an ornamental hedge or a perennial border.

This rain garden is in the Stormwater Demonstration Site in Anne McCrary Park off Randall Parkway. Rain gardens are typically placed on residential property.

Steps to Build a Successful Rain Garden

1. Determine the runoff sources on your property (i.e. roof, driveway) and note where the runoff is going (i.e. storm drain, creek) - plant the garden somewhere in between. Ideal places to plant rain gardens are next to hard surfaces, such as roads, driveways or near roof gutter downspouts. *Tip: A great way to locate runoff sources and destinations is to walk your property when it is raining.*

2. After deciding where to plant the rain garden, map out the shape with string or lawn chalk.

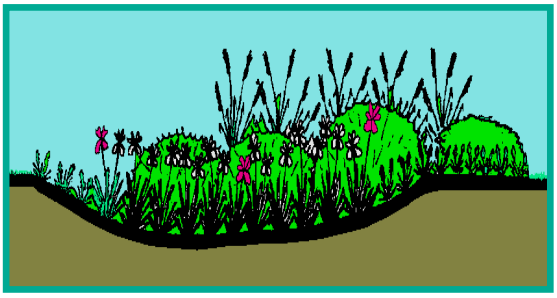
3. Dig the garden 4 to 6 inches deeper than the lawn itself with a slight slope (or depression) in the center. Depending on your soil's ability to soak up water, you may need to incorporate sand, gravel or mulch to improve infiltration. Hard, compacted soil will not soak up as much water and will not allow plants to grow. In areas with compacted soils, be sure to till the area first or you may want to install a backyard wetland instead of a rain garden. On the other hand, for very well-draining sandy soils, you may need to incorporate compost into the top layer of your rain garden to help retain water for a longer period of time.

Photo by Roger Bannerman

4. Use the dug out soil to create a berm along the back of the rain garden—this will increase the amount of water that can be retained and allowed to soak into the ground.

5. A rain garden contains **3 distinct planting zones:**
The **lowest** part of the garden is going to be the wettest area of the garden and should contain the most moisture-tolerant plants. Plants that are native to local wetlands and stream banks are most suitable for the **lowest** and **middle zones.** The **upper** rim of the garden can contain your average landscape plants. Plants in all 3 zones will be subject to drought spells as well. Plants can also be planted beyond the upper rim of the rain garden to help blend the garden into the existing landscape.

Incorporate berry and nectar-producing plants to create a habitat for birds and butterflies. Plants should be watered for the first growing season until they are established. ***Visit the following pages for plants that are suitable for rain gardens.***



Rain gardens contain 3 distinct planting zones.

6. Mulch, mulch, mulch! Mulch should be added immediately after planting the garden. Mulch plays a very important role in the pollution-removal process and in protecting plants, maintaining soil moisture and preventing erosion. However, not all mulches work in rain gardens. Lightweight mulch and flat wood chips will float when it rains. Instead, evenly spread 2-3 inches of shredded hardwood mulch or pinestraw in the garden.

7. Enjoy the beauty of your rain garden! Be proud that you are making a difference in your community by reducing stormwater runoff and water pollution.

Workshop participants install a bioretention area in the Stormwater Demonstration Site at Anne McCrary Park.

Rain Garden Maintenance and Considerations

- ***Do I need to hire a professional landscaper to build a rain garden?***
  Landscapers can probably get the job done faster, but they are not necessary to build or maintain a rain garden.

- ***Are rain gardens hard to maintain?***
  Maintaining a rain garden is similar to maintaining any other landscape bed. Maintenance includes inspecting and evaluating plant health, weeding, pruning, removing dead or diseased vegetation, adding new mulch periodically and cleaning out any muck or debris.

- ***Do rain gardens attract mosquitoes?***
  Mosquitoes need approximately 2-4 days of standing water to reproduce. A well designed rain garden will soak up excess water long before mosquitoes have a chance to breed.

Rain Garden/Bioretention Area Plants

Soil conditions in rain gardens alternate between wet and dry, making them tough places for many plants to grow. The following plants are adapted to these conditions, although some plants will tolerate more moisture than others. Each plant is marked with a 1, 2, or 3, according to its flooding or drought tolerance.

It is also important to note that the table lists plants that are native to the southeastern United States in wetland habitats and most are readily available at local nurseries. Wetland plants can generally grow well in moist or well-drained soils, whereas plants adapted to dry soils can rarely survive in soggy conditions. How wet a rain garden stays will vary considerably depending on the site where it is installed. Rain gardens created on sandy soils will rarely hold water for more than a few hours. On these sites it is most important to choose plants for their drought tolerance. Rain gardens created on loamy or silty soils could pond water for 2-4 days *(if your site ponds water for more than 4 days, you should consider creating a wetland)*. On these sites, choosing plants tolerant of extended flooding is critical to success. Many are also listed in the 'Plants for Backyard Wetlands' section.

1 = Can withstand considerable drought (3-4 weeks without rainfall), once established.

2 = Grow best in moist to average soils; will only tolerate short periods (1-2 days) of flooding.

3 = Will tolerate longer periods of flooding (3-5 days), but will also grow in moist to average soils.

**Establishment usually takes 1-2 years for trees and shrubs and 1 year for perennials.*

LARGE TREES (OVER 30' TALL)		
Deciduous		
Red Maple	*Acer rubrum*	2
River Birch	*Betula nigra*	1,3
Green Ash	*Fraxinux pennsylvanica*	3
Black Gum	*Nyssa sylvatica*	2
Willow Oak	*Quercus phellos*	1,2
Willows	*Salix species*	3
Bald Cypress	*Taxodium ascendens*	1,3
Nutall Oak	*Quercus nuttalii*	1,2
Evergreen		
Atlantic White Cedar	*Chamaecyparis thyoides*	1,3
Southern Magnolia	*Magnolia grandiflora*	1,2
Longleaf Pine	*Pinus palustris*	1,2
Swamp Laurel Oak	*Quercus laurifolia*	3
SMALL TREES (UNDER 30' TALL)		
Deciduous		
Redbud	*Cercis canadensis*	1,2
Fringe Tree	*Chionanthus virginicus*	2
Washington Hawthorn	*Crataegus phaenopyrum*	3
Possumhaw	*Ilex decidua*	1,3
Evergreen		
American Holly	*Ilex opaca*	1,2

Red Cedar	*Juniperus virginiana*	1,2
Sweet Bay	*Magnolia virginiana*	3
Red Bay	*Persea borbonia*	1,2
SHRUBS		
Deciduous		
Chokeberry	*Aronia arbutifolia*	1,3
Beautyberry	*Callicarpa americana*	2
Sweet Shrub	*Calycanthus floridus*	2
Buttonbush	*Cephalanthus occidentalis*	3
Pepperbush	*Clethra alnifolia*	2
Fothergilla	*Fothergilla gardenii*	2
Winterberry	*Ilex verticillata*	3
Virginia Willow	*Itea virginica*	3
Possumhaw	*Viburnum nudum*	3
Evergreen *(Evergreen shrubs that can be grown as small trees include Yaupon, Wax Myrtle, and Anise Shrub).*		
Inkberry	*Ilex glabra*	2
Yaupon	*Ilex vomitoria*	1,2
Anise Shrub	*Illicium parviflorum*	1,2
Wax Myrtle	*Myrica cerifera*	1,2
Dwarf Palmetto	*Sabal minor*	3
PERENNIALS		
Blue Star	*Amsonia tabernaemontana*	3
Swamp Milkweed	*Asclepias incarnata*	3
Climbing Aster	*Aster carolinianus*	3
False Indigo	*Baptisia species*	1,2
Boltonia	*Boltonia asteriodes*	3
Turtlehead	*Chelone glabra*	3
Tickseed	*Coreopsis lanceolata*	1,2
Joe Pye Weed	*Eupatorium dubium*	3
Swamp Sunflower	*Helianthus angustifolius*	3
Swamp Mallow	*Hibiscus moscheutos*	3
Texas Star	*Hibiscus coccineus*	3
Seashore Mallow	*Kosteletskya virginica*	3
Gayfeather	*Liatris spicata*	2
Cardinal Flower	*Lobelia cardinalis*	3
Garden Phlox	*Phlox paniculata*	2
Rudbeckia	*Rudbeckia fulgida*	1,2
Green Headed Coneflower	*Rudbeckia laciniata*	3
Goldenrod	*Solidago rugosa*	3

Stoke's Aster	*Stokesia laevis*	2
Ironweed	*Vernonia novaboracensis*	3
Verbena	*Verbena canadensis*	1,2
ORNAMENTAL GRASSES		
River Oats	*Chasmanthium latifolium*	1,3
Muhly Grass	*Muhlenbergia capillaris*	1,2
Panic Grass	*Panicum virgatum*	1,3
Indiangrass	*Sorghastrum nutans*	1,2
*Non-native perennials and ornamental grasses suitable for rain gardens include: Liriope (1,2) (*Liriope muscarii* and *L. spicata*), Siberian Iris (2) (*Iris sibirica*), Daylily (1,2) (*Hermerocallis* hybrids), Rain Lilies (3) (*Zephyranthes* species), Crinum Lilies (3) (*Crinum* species), and Maiden Grass (1,2) (Miscanthus cultivars).		
**Plant list courtesy of Charlotte Glen, Urban Horticulture Agent, North Carolina Cooperative Extension - New Hanover County Center.*		

Sources for This Section and Additional Rain Garden Info

Backyard Rain Gardens https://sustainability.ncsu.edu/changeyourstate/how-to-build-a-rain-garden/

NCSU Consumer Horticulture http://www.ces.ncsu.edu/depts/hort/consumer/

University of Wisconsin Extension http://clean-water.uwex.edu/pubs/pdf/gardens.pdf

http://clean-water.uwex.edu/pubs/pdf/rgmanual.pdf

Rain Gardens http://www.mninter.net/~stack/rain/

Bioretention Systems http://www.fxbrowne.com/html/gs-facts/gs-factsheet05v9.pdf

Designing Rain Gardens

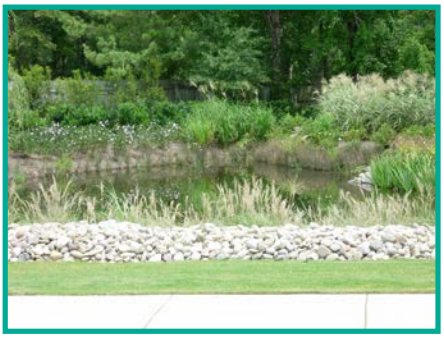
https://www.bae.ncsu.edu/extension/ext-publications/water/protecting/RainGardenManual2014.pdf

Bioretention Areas at NCSU

https://www.bae.ncsu.edu/extension/ext-publications/water/protecting/ag-588-03-designing-rain-gardens.pdf

RETENTION POND

If you've driven through Wilmington on your daily commute, you've probably noticed retention ponds adjacent to shopping centers, apartment complexes and homeowner communities. Retention ponds provide both water quality and water quantity benefits.



In addition to water quality benefits, retention ponds can serve as an aesthetic and recreational amenity.

Retention ponds, also called wet ponds, maintain a permanent pool of water in addition to temporarily storing stormwater runoff during rain events. The permanent pool of water, known as dead storage, is the principal distinguishing feature between retention ponds and detention ponds. Detention ponds, also known as dry ponds, do not have permanent dead storage and dry out between storms.

In addition to storing excess water, retention ponds play an important role by allowing settling and removal of pollutants contained in stormwater runoff such as sediment, nutrients, bacteria, toxins and heavy metals. Finally, if planted with aesthetics in mind, a retention pond can also serve as an amenity on residential or commercial property.

Retention Pond Benefits

- **Provide water storage capacity and reduce flooding**
  Retention ponds capture stormwater runoff from streets and property and retain it before slowly releasing it into streams or other receiving waterways. Retention ponds release the water at flow rates and frequency similar to ponds that exist under natural conditions. The flood volume held in a retention pond reduces impacts on downstream stormwater systems and waterways.
- **Improve local water quality**
  Retention ponds provide pollutant removal through settling and biological uptake. Properly maintained retention ponds can remove 30-80% of certain pollutants from water before it enters nearby streams. Common pollutants reduced are sediment, bacteria, greases, oils, metals, suspended solids, nutrients and trash.
- **Provide an attractive amenity**
  Retention ponds can be designed to serve as a visual, educational or recreational amenity for a neighborhood, park or commercial business.

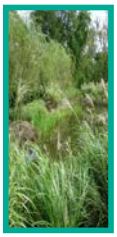
Maintaining a Retention Pond: *Property Owner Responsibility*

Routine maintenance is vital for the operation of a retention pond. Every pond is different, and maintenance needs will vary depending on the size, type and condition of the watershed that contributes runoff to the pond. Estimated annual operation and maintenance costs for retention ponds are 3-5% of construction costs. Responsible parties should establish a maintenance fund to operate and maintain a retention pond. As the owner or responsible party of a retention pond, the following are several things you should do to ensure your pond functions properly and is in compliance with the conditions of your permit. These include:

Inspections

- Inspect the entire pond (including inlet and outlet structures) frequently to ensure proper operation and to ensure they are free of trash and debris. A good time to inspect is after a major rainfall.
- Inspect for erosion of the pond slopes or sedimentation in the forebay; plant vegetation to stabilize banks if necessary.
- Check the condition of the spillway, pipes and other pond structures.
- Also inspect the upstream and downstream channel conditions that may affect the operation of the pond.
- Regular pond inspections should also include checking any valves, pumps, fence gates or mechanical components.

Vegetation Management



- Vegetation in and around the pond should be maintained on a regular basis to prevent erosion and aesthetic problems. Some in-pond vegetation is encouraged to help remove pollutants, but should be maintained so that it does not cover the entire surface of the pond. The use of fertilizers and pesticides in and around the pond should be minimized to avoid running off into the pond or downstream waters. *Beware of invasive aquatic species! They can overtake a pond in a short time period and are extremely difficult to eradicate.*
- Bank vegetation, particularly groundcover, should also be established on the pond banks to help stabilize the bank and prevent erosion and sediment from entering the pond. Bank vegetation also helps treat and filter polluted runoff.

Debris, Litter and Sediment Removal

- Debris and litter should be removed from inlet and outlet structures after rainfall events. Clogged structures can affect the pollutant removal process and cause water to back up, resulting in flooding.
- Periodically, accumulated sediment should be removed from the bottom of the outlet structure and pond depth should also be checked at various points. If depth has been reduced to 75% of the original design depth, sediment should be removed to original design depth to ensure adequate storage capacity. A forebay placed upstream or into the upper portion of the pond helps with sediment and debris removal and lessens maintenance costs.

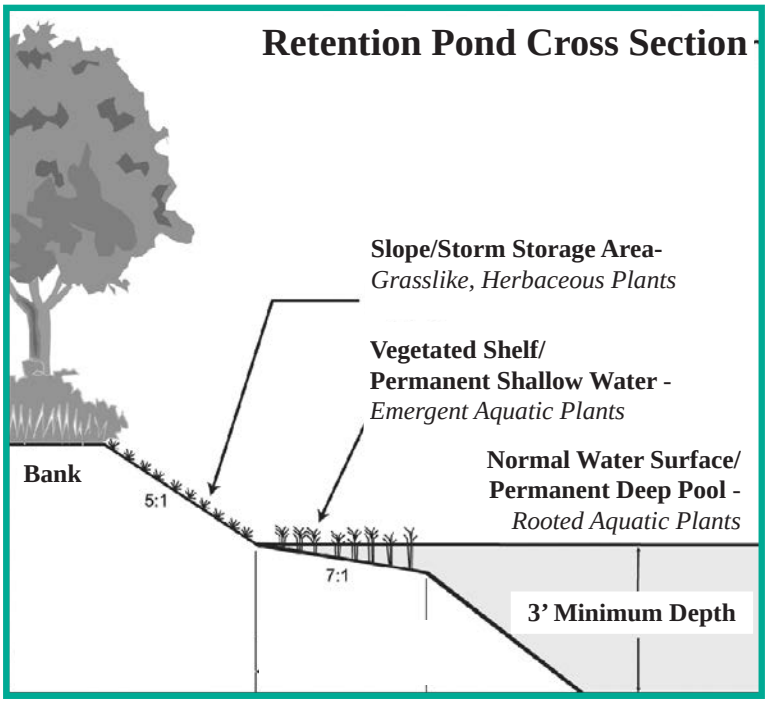
Enhancing a Retention Pond

Many existing retention ponds can be improved both functionally and aesthetically to improve water quality and serve as an amenity in a subdivision or place of business. Enhancing a retention pond, by planting the right plant in the right place, can achieve this because they help filter and remove pollutants and also provide habitat. Both the City of Wilmington and the State of North Carolina Division of Water Resources (DWR) have standards for installing, landscaping, and maintaining a retention pond. Be sure to follow their guidelines as well as those below:

- Any new landscaping should not impede runoff entering or leaving the pond.
- The new landscaping should not encroach on the existing maintenance access. This access is necessary for maintaining the banks, slope, vegetated shelf, outlet structures, landscaping, etc.
- Sediment introduced into the pond as a result of landscaping or maintenance should be removed immediately.
- New landscaping should not create impervious surface area.
- Landscaping should be maintained appropriately.

Plants for Retention Ponds

Visit the section on Backyard Wetlands for additional plants that are suitable for retention ponds.



FOREBAY - deep pools designed to collect sediment

Do not plant anything in the forebay. Forebays need to be cleaned out with a backhoe periodically and you will lose plants when this happens.

NORMAL WATER SURFACE/PERMANENT DEEP POOL - 3' or deeper of permanent water

Rooted Aquatic Plants

Spadderdock/Cow Lily	*Nuphar luteum*	Rooted floating leaved deepwater aquatic plant with yellow flowers.
White Water Lily/Fragrant Water-lily	*Nymphaea odorata*	Rounded, heart shaped leaves float on water's surface. Large, white sweetly fragrant flowers in summer.

VEGETATED SHELF/PERMANENT SHALLOW WATER - 1" to 6" of regular inundation

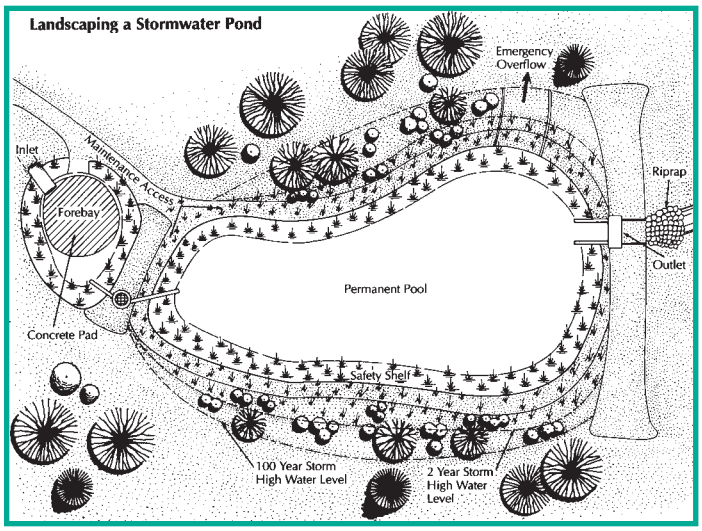
Emergent Aquatic Plants

Emergent plants are accustomed to periods of drought and tolerate them well. They cannot tolerate having their tops completely submerged for more than a day or two during the summer. A diverse mix of species is a very good idea. You want 1) some evergreen species which pump oxygen down to the soil during the winter, 2) some species that are tall enough to survive even if your water depths end up a touch deeper than planned, 3) species with pretty flowers and attractive winter foliage. All of these plants look best "massed" (i.e. planted as large groups of single species rather than all the species mixed up together).

Giant Cut Grass	*Zizaniopsis miliacea*	Large grass with graceful seed heads. Leaves turn tan but remain lovely in winter; tolerates deep water.

Water Willow	*Decodon verticillatus*	Graceful, arching stems, purple summer flowers; almost woody but never grows dense enough to block the sun.
Blue Flag Iris	*Iris virginica*	Our native wetland iris, gorgeous in spring.
Arrow Arum	*Peltandra virginica*	Large, deep green arrow-shaped leaves for sun or shade; interesting green flowers on a clump-forming plant.
Pickerel Weed	*Pontederia cordata*	Upright plant; intense blue flower spikes summer into fall; an essential component of any pond or wetland.
Bulltongue or Duck Potato	*Sagittaria lancifolia/ latifolia*	White flower spikes and attractive broad foliage.; reproduces rapidly.
Lizard Tail	*Saururus cemuus*	Cute, curvy white flower spikes, sun or shade.
Softstem Bulrush	*Scirpus validus*	Succulent, nearly evergreen "leaves" of deep green provide a strong vertical accent.
Burreed	*Sparganium americanum*	Long, strap-like leaves of pale green.
SLOPE/STORM STORAGE AREA - pond slope which is saturated with water during a storm event but infrequently flooded.		
This area of the pond can sustain a large number of different plant species and are particularly good at removing fecal coliform bacteria. Install grasslike, herbaceous plants (sedges, rushes, and cord grasses) to form a rough carpet over the wet area, then tuck showy, perennial flowers in between their mounds.		
Grass-like Plants		
Sedges	*Carex species*	Spreading mounds a foot or two tall, each with its distinct leaf color and texture, and showy seed heads.
Rushes	*Juncus species*	Narrow-leaved evergreens which provide a strong vertical accent.
Saltmeadow Cordgrass	*Spartina patens*	A very fine leaved salt-tolerant grass.
Perennials		
Swamp Milkweed	*Asclepias incarnata*	Mid-height perennial with lovely deep rose flower heads.
New York Aster	*Aster novi-belgii*	Sprawling mid-height perennial covered with masses of small purple asters.
White Turtlehead	*Chelone glabra*	Tall perennial with white "turtle heads" on tall stems.
Joe Pye Weed	*Eupatorium fistulosum*	Tall perennial with rosey masses of tiny flowers in late summer.
Scarlet Rose Mallow	*Hibiscus coccineus*	Tall perennial with huge, scarlet, tropical-looking blossoms.
Swamp Rose Mallow	*Hibiscus mosheutus*	Tall perennial with huge white to rose blossoms.
Seashore Mallow	*Kosteletskya virginica*	Tall perennial with shell pink ½-1" blooms.
Cardinal Flower	*Lobelia cardinalis*	Mid-height perennial with incredible cardinal red flower spikes.
Monkey Flower	*Mimulus alatus*	Mid-height perennial with small, blue "monkey face" flowers.
Goldenrod	*Solidago sempervirens*	Tall perennial with golden yellow flower spikes.
Ironweed	*Vernonia noveboracensis*	Tall perennial with majestic violet fall flowers.

Shrubs		
Hazel Alder	*Alnus serrulata*	Multiple stems have great architectural interest; tiny pine cone seed pods are relished by birds; grows best on wet land.
Red Chokeberry	*Aronia arbutifolia*	Fantastic red, fall foliage and berries; grows on wet land to uplands.
Buttonbush	*Cephalanthus occidentalis*	Grows well in shallow water and up into average moisture soils. Butterflies love it's white pom-pom flowers.
Summersweet	*Clethra alnifolia*	Summer spikes of sweetly scented flowers serve as hummingbird nectar; thrives on wet land to moist soils; forms large dense mounds without pruning.
Silky Dogwood	*Comus amomum*	Shrub dogwoods with porcelain blue berries.
Virginia Willow	*Itea virginica*	White flower spikes in spring and burgundy fall foliage; tolerates wide extremes in soil moisture.
Wax Myrtle	*Myrica cerifera*	Large evergreen, with gray-blue waxy berries in fall; occasional pruning; grows anywhere; provides privacy.
Possumhaw	*Vibumum nudum*	Tall, open shrub; tolerates wet to moist soils, blooms even in full shade; has blue-black fruit, lustrous leaves.
List courtesy of Ellen Colodney, M.D, Coastal Plain Conservation Nursery, 3607 Conners Drive, Edenton, NC 27932.		



Sources for This Section and Additional Retention Pond Info

Environmental Protection Agency https://www3.epa.gov/npdes/pubs/pondmgmtguide.pdf
Journal of Environmental Quality http://jeq.scijournals.org/cgi/content/full/31/2/654#FIG1
Invasive Aquatic Species http://www.ncwildflower.org/invasives/invasives.htm
Center for Invasive Species & Ecosystem Health http://www.invasive.org/

Invasive Aquatic Species (Plants to Avoid)

Some plants are highly invasive. Water hyacinth is a good example. This plant is illegal in Texas, Florida, and South Carolina. A single plant can cover a 5-acre pond in just a few years. Although Water Hyacinth is currently legal in North Carolina, extreme care should be taken when disposing of extra plants.

The North Carolina Secretary of the Department of Environment and Natural Resources (DENR) has determined that the following aquatic plants "exhibit characteristics which threaten or may threaten the health or safety of the people of North Carolina or beneficial uses of the waters of North Carolina". Check out the websites on the previous page for more information about invasive aquatic species.

COMMON NAME	SCIENTIFIC NAME
African Elodea	*Lagarosiphon major*
African elodea	*Lagarosiphon spp. (All sp)*
Alligatorweed	*Altemanthera philoxeroides*
Anchored water hyacinth	*Eichhornia azurea*
Arrowhead	*Sagittaria sagittifolia*
Arrowleaved monochoria	*Monochoria hastata*
Branched burreed	*Sparganium erectum*
Brazilian elodea	*Egeria densa*
Brittleleaf naiad	*Najas minor All.*
Common reed	*Phragmites australis*
Crab's-claw, water aloe	*Stratiotes aloides L.*
Eurasian watermilfoil	*Myriophyllum spicatum L.*
Giant salvinia	*Salvinia auriculata*
Giant salvinia	*Salvinia herzogil*
Giant salvinia	*Salvinia molesta*
Giant salvinia	*Savinia biloba*
Hydrilla	*Hydrilla verticillata*
Indian hygrophila	*Hygrophila polysperma*
Limnophila	*Limnophila sessiliflora*
Melaleuca	*Melaleuca quinquenervia*
Monochoria	*Monochoria vaginalis*
Pinnate mosquitofern	*Azolla pinnata*
Purple loosestrife	*Lythrum salicaria L.*
Swamp morningglory, water spinach	*Ipomoea aquatica*
Swamp stonecrop	*Crassula helmsii*
Uruguay waterprimrose	*Ludwigia uruguayensis*
Water Chestnut	*Trapa spp. (All species)*
Water fern	*Salvinia spp. (All except S. rotundifolia)*

SHADE TREE

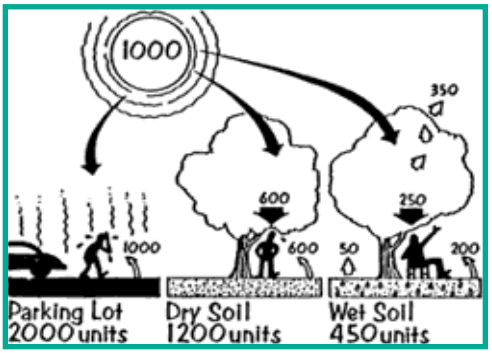
The City of Wilmington has grown tremendously over the past few years. New hotels, neighborhoods, restaurants and retail stores continue to replace acres of vegetated land that was once home to trees, plants and shrubs.

Trees are the environment's natural solution to air and water pollution. Trees and soils function together to reduce stormwater runoff. Trees reduce stormwater flow by absorbing and intercepting rainwater on leaves, branches and trunks. Some of the intercepted water evaporates back into the atmosphere and some soaks into the ground reducing the total amount of runoff that must be managed in urban areas. In addition, trees perform the important function of converting carbon dioxide into oxygen. Very simply, trees convert polluted air and water into clean air and water.

As our community continues to grow and develop, water quality problems will increase. Quite often, trees are cut down during construction and not enough are replanted. One of the most important things you can do to help the environment and reduce water and air pollution is to plant trees. Shade trees are particularly important because they benefit homeowners, businesses, wildlife and the environment as a whole.

Shade Tree Benefits

- **Prevent the "Heat Island Effect"**
  Unshaded pavement contributes to the "heat island effect." The heat island effect occurs when plants and soil are replaced with pavement, concrete and rooftops. For instance, urban areas are hotter than rural areas due to a lack of trees and vegetation. Most US cities are heat islands, with temperatures between 2 and 10°F hotter than their surroundings. In addition, runoff flowing off of heated pavement is detrimental to aquatic habitat, fish, and wildlife in streams and waterways.



Effects of shade on water loss.

- **Reduce Energy Costs**
  In the hot summer months, the heat island effect can cause surface temperatures to increase as much as 20˚F. Unshaded pavement also radiates heat back into the atmosphere and can cause air temperatures to rise as much as 12 degrees - causing home cooling costs to be higher. Fortunately, shade trees shield pavement from direct sunlight, thereby lowering the surface temperature of the pavement. In addition, during the summer, trees absorb heat from the atmosphere. In the winter, deciduous trees lose their leaves and allow sunshine to shine in, reducing

heating costs.

- **Improve Water Quality/Reduce Flooding**
  Tree root systems absorb and filter nutrients and pollutants contained in stormwater runoff. Tree roots hold soil in place that might otherwise wash into local streams and waterways during storms. When soil washes into waterways, they become more shallow, are more likely to cause flooding and adversely impact aquatic habitat and wildlife.

- **Improve Air Quality**
  Trees absorb carbon dioxide and convert it into oxygen; they also filter the air we breathe by removing dust and other particles.

- **Increase Property Values**
  Studies show that landscaping, especially with trees, can increase property values by as much as 20%.

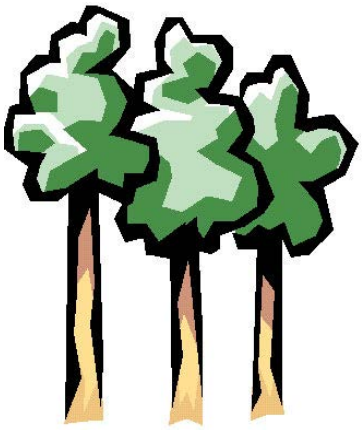
In this photo, trees shade the house, walkway and landscape. The US Forest Service reports that when trees are properly placed around buildings, they can reduce the need for air conditioning by 30% and can save 20-50% in energy used to heat a home.

Did you know... the US Department of Agriculture reports that 1 acre of forest absorbs 6 tons of carbon dioxide and produces 4 tons of oxygen. That is enough to provide 18 people with oxygen for an entire year!

Choosing Shade Trees

Some things to consider before choosing shade trees:

- Make sure to avoid trees that host destructive insects or diseases, are susceptible to storm damage or produce an abundance of tree fruit.
- Choose native species of trees whenever possible. Native trees are better suited to local weather and soil conditions and more beneficial to wildlife than non-native trees. ***(See the following pages for shade tree suggestions).***



Planting Shade Trees: Right Tree, Right Spot

Placement of a tree is critical. Know the maximum size the tree will grow to be and assume that it will get bigger! Learn how large the canopy and root systems can grow to be, and consider how they will affect the existing landscape and structures. For example, make sure the tree won't shade flowers or bushes that need sunlight to grow, and be sure that the tree's canopy won't cover utility lines.

Evergreen trees provide cover and shade year round. They may also be more effective barriers for wind and noise. In your house, deciduous trees will give you summer shade and allow the winter sun to shine in. These may be considerations for where to place a tree in your yard.

Shade Trees for Southeastern North Carolina

Species	Mature Size (Height/Width In Feet)	Exposure	Tree Form	Special Considerations
Atlantic White Cedar *Chamaecyaris thyoides*	40-85'/25-35'	Sun	Tall, pyramidal, evergreen	*Relatively problem-free. Prefers moist soils; freshwater, not saltwater.*
Bald Cypress *Taxodium distichum*	50-100'/20-30'	Sun	Pyramidal in youth; broad, open crown at maturity.	*No serious pests. Works well in wet to dry soils or poorly drained soils.*
Black Gum *Nyssa sylvitica*	40-60'/20-30'	Sun	Open, irregular	*Spectacular fall color; no serious pests.*
Dawn Redwood *Metasequoia glyptostroboides*	70-100'/25'	Sun	Pyramidal in youth; broad, rounded crown at maturity.	*No serious pest problems. Tolerant of various soil conditions. Light green foliage.*
Eastern Red Cedar *Juniperus virginiana*	40-60'/15-30'	Sun	Dense, evergreen	*Grows in any soil type. Drought tolerant, good screening plant. Not suited for wet sites.*
Fantasy Crape Myrtle *Lagerstroemia fauriei*	40-50'/25-35'	Sun	Vase-shaped, can be grown as single or multi-trunked.	*Great red/brown bark. White flowers – June. Street tree or small landscape tree.*
Lacebark Elm *Ulmus parvifolia*	40-50'/30-40'	Sun	Round-headed tree, pendulous branches	*Excellent, tough tree. Beautiful mottled bark.*
Longleaf Pine *Pinus palustris*	70-90'/30-40'	Sun	Horizontal with ascending branches; oval, rounded crown	*Fairly drought resistant; relatively problem-free.*
Oaks *Quercus species*	80-100'/50-80'	Sun	Broad crowns, thick trunks; horizontal structure	*Long-living tree, with majestic, spreading branches.* ***Species for our area:*** *Live Oak, Water Oak, Willow Oak, Nuttall Oak, Laurel*
River Birch *Betula nigra*	60-70'/30-50'	Sun	Single or multi-stemmed; pyramidal in youth, rounded at maturity	*Early defoliator when leaf spot is a problem. Keep away from house and drains or drain fields.*
Southern Magnolia *Magnolia grandiflora*	40-60'/25-30'	Sun	Symmetrical, sweeps to ground, evergreen	*Relatively problem-free. Wonderful bloom followed by interesting seedpods. Tree does best when lower limbs remain intact.*
Sugarberry ***Celtis laevigata***	60-80'/60-80'	Sun	Rounded with spreading branches	*Corky bark. Grows in moist soils but tolerates drier sites. Decay in older trees can be a problem.*

Shade Tree list courtesy of Jerry Dudley, Commercial Horticulture and Urban Forestry Agent, North Carolina Cooperative Extension. Original list by Mary Ann Metcalf.

When to Plant

Most bare root or packaged plants should be planted in the fall or early spring. Other than seedling-sized evergreens, only deciduous trees can be transplanted with bare roots and only when dormant or leafless. Visit the following websites for more information on planting trees and seedlings.

Digging and Planting a Tree

Be sure you have located underground utilities before you dig. (1-800-632-4949). To plant a tree, dig a hole 2-3 times as wide and only as deep as the root ball. Place the tree in the hole, then fill the hole with a generous mixture of native topsoil and compost to allow the roots a place to grow.

Shade Tree Maintenance

Water a newly planted tree, but do not over-water! Over-watering is the number one reason for plant death. Water deeply and infrequently. Do not fertilize until the next growing season so that the tree can deal with winter and the shock of being planted before beginning to grow. Stakes and guy wires should be used only if support is necessary.

Mulch is a young tree's best friend. Adding mulch around a newly-planted tree helps hold down competing weeds and grass, retains soil moisture, helps prevent soil compaction and prevents soil cracking that can damage new roots.

Trees provide houses with protection from winter winds and summer sun. Trees also reduce flooding and erosion, provide habitat for wildlife, provide shade for paved surfaces and rooftops, add aesthetic qualities to landscapes and increase property values.

Sources for This Section and Additional Shade Tree Info

NC Cooperative Extension	https://gardening.ces.ncsu.edu/plants-2/trees-3/
American Forests	http://www.americanforests.org/blog/creating-urban-forests-deserts-southwestern-u-s/
Arbor Day Foundation	http://www.arborday.org/trees/index.cfm
Cool Communities	http://www.coolcommunities.org/urban_shade_trees.htm

STREAMBANK RESTORATION

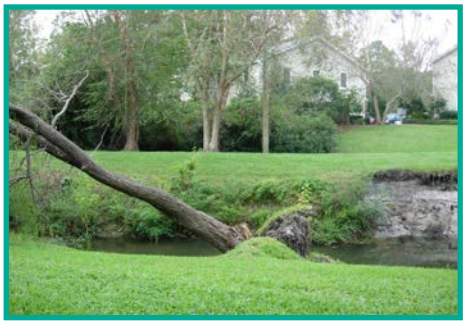
When streambanks erode, they carry soil and other debris into the water. A stream may fill in and become so shallow that it can no longer provide habitat for fish and other wildlife that depend on its water for survival. Streambank erosion can cause flooding, property loss and poor water quality.

Bank restoration is the process of building or rebuilding the banks of streams, creeks and other waterways with buffers to stabilize banks, prevent erosion and filter polluted stormwater runoff. Buffers are areas of vegetation located along waterways that help to stabilize banks, prevent soil erosion and act as a pollution filter and barrier between land and receiving waterways.

Sediment is washing into the creek and trees are falling into the water - a sure sign that the soil is unstable and the streambank is eroding.

Bank Restoration Benefits

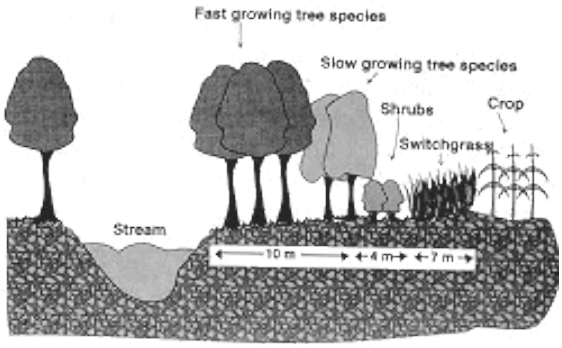
- **Improve local water quality**
  Restoring streambanks enables trees, shrubs and grasses to trap and remove sediment and pollution from stormwater runoff.
- **Save your property**
  Bank restoration reduces the risk of losing property to erosion.
- **Control flooding**
  Buffers help control the speed and amount of runoff and sediment entering our waterways, which reduces the risk of flooding and erosion.



- **Prevent soil erosion**
  Roots from trees, shrubs and grasses anchor soil in place making it less likely to wash away during heavy rains.
- **Provide habitat for wildlife**
  Restoring a streambank by installing a buffer helps to shade and cool waterways in the summer months. Cooler water has more oxygen, and shade is especially important for fish in shallow bodies of water.
- **Aesthetic values**
  Bank restoration preserves the natural character of a shoreline, can shield views of nearby development and provide privacy for waterfront homeowners.

Restoring Stream Banks with Buffers

Bank restoration involves planting vegetation to create a buffer. Buffers are areas of vegetation located along the banks of creeks and waterways that stabilize banks, prevent soil erosion and act as a pollution filter and barrier between land and receiving waterways. To perform a bank restoration, visit the section on **Buffers** (page 15) for information on how to install a buffer and what plants to use in the buffer.



The Pine Valley Stream Restoration Project restored this eroding section of stream (left) to a vegetated, functional, meandering stream on the Pine Valley Golf Course (right).

Sources for This Section and Additional Streambank Restoration Info

Pine Valley Stream Restoration Project
http://www.bae.ncsu.edu/programs/extension/wqg/sri/pinevalley/pinevalley.htm#VEGETATION%20CONCERNS

Native Plants for NC Stream Restoration
http://www.bae.ncsu.edu/programs/extension/wqg/sri/stream_rest_guidebook/appendix_f.pdf

Georgia Department of Natural Resources - EPD:

https://epd.georgia.gov/sites/epd.georgia.gov/files/related_files/site_page/Guidelines_Streambank_Restoration_GSWCC_Revised_2000.pdf

SWALE

Swales are often found alongside roads, streets and parking lots.

Swales, which appear as long, shallow, grassy depressions alongside roads, are often confused with ditches. How can you tell the difference? Swales are much wider than they are deep; in fact, swales have only slight depressions (no steep sides) and are designed to hold and convey large amounts of stormwater runoff.

Runoff from hard surfaces, such as roads and parking lots, is a main source of water pollution—that is why you will commonly find grassed swales next to highways, streets, sidewalks and parking lots.

Swales manage stormwater by slowing down the speed of runoff flowing to waterways. By doing this, grassy swales have time to allow water and pollutants to soak into the ground instead of running into local creeks, streams and waterways at a rapid rate.

Swales are designed to collect, filter and convey runoff. Swales slow the speed of runoff and allow water and pollutants to soak into the ground.

Swale Benefits

- **Slow down and filter runoff**
  Swales collect runoff from streets, roads and parking lots and hold the water long enough for the water and pollutants to soak into the ground.

- **Convey large amounts of water**
  Because swales are large, wide areas, they can capture, filter and move a large amount of stormwater runoff.

- **Prevent erosion**
  The grass root systems help keep soil in place to prevent erosion. Other materials may be used such as gravel, ornamental grasses or shrubs to stabilize the swale and help prevent erosion.

- **Cost-effective**
  Swales cost less to install than typical curb, gutter and underground storm drainage pipe systems. Costs to maintain swales are minimal.

- **Easy maintenance**
  Maintenance includes periodic mowing, watering and litter/debris removal.

Swale Design Considerations

Some things to consider when designing a swale:

Check dams are barriers within a swale that are used to slow the speed of runoff and minimize erosion.

- The ability to remove large amounts of pollutants such as nitrogen and phosphorus is directly related to how well a grassy swale is designed. Swales should be much wider than they are deep, so runoff can settle in the swale for an extended period of time. This way, the grass and soil can filter the pollutants out of the runoff. If the swale has a steep angle, water will flow too quickly through the swale and only a small amount of water will soak into the ground - where much of the pollutant removal process takes place.
- Generally, the speed of the water flowing through the swale should not exceed 1.5 feet per second. The slope of the swale should be between 1 and 4 % (1 to 2 % slopes are recommended by the EPA). Side slopes should not be steeper than 3:1 horizontal to vertical. *(Check local ordinances!).*
- Length of the swale should be at least 100 feet per acre of drainage area.
- While it is important to design swales to allow water to settle for a period of time, it is also important that they don't hold standing water long enough for mosquitoes to breed. Clay and sandy soils may require an underground drain or other adjustments to increase soil permeability. Swales should be constructed on permeable, non-compacted soils.
- Swales should not be designed to receive construction or post-construction site runoff with high sediment content.
- A check dam is a small barrier within a swale that is used to retain excess water during heavy rains and to slow the speed of runoff. Check dams help to minimize erosion and allow sediment to settle out. Check dams should be made of materials that will not erode such as lumber, rocks, logs or concrete blocks.

Swale Maintenance

- **Mowing**—Most maintenance includes mowing. It is suggested that the swale be mowed twice annually to a minimum height of 4" and grass clippings should be removed from the swale immediately so that they don't flow into receiving waterways.
- **Remove sediment and debris**—Litter, pet waste and sediment may find their way into the swale. Make sure to remove them as often as possible.
- **No fertilizers or pesticides—**Avoid using pesticides or fertilizers on the swale since they contribute to stormwater pollution.
- **Cleaning check cams—**Clogged check dams should be cleaned and maintained to ensure that water doesn't pond for more than 24 hours. Excess sediment should be removed. Water should be able to flow evenly through the swale.
- **Beware of erosion—**Make sure to check the swale for erosion. If significant erosion occurs, you may need to plant more grass or plants to anchor the soil in place.

Swale Grasses

Common Name	Tolerant of Shade	Propagation	Green Foliage	When to Plant
Common Bermuda	Poor	Sprigs or Seed	Spring, Summer, Fall	May - July
Tifway Bermuda (Tifgreen)	Poor	Springs, Plugs, Sod	Summer, Fall	
Carpet Grass	Fair	Seed	Spring, Summer, Fall	May - July
Centipede	Fair	Sprigs, Seeds, Plugs, Sod	Summer, Fall	May - July
St. Augustine	Excellent	Springs, Plugs, Sod	Spring, Summer, Fall	May - July
Zoysia	Good	Springs, Plugs, Sod	Spring, Summer, Fall	May - July
Swales can also be planted with ornamental grasses. Visit the Appendix for a listing of ornamental grasses that are suitable for Southeastern NC.				

Sources for This Section and Additional Grassy Swale Info

Environmental Protection Agency http://www.epa.gov/npdes/pubs/vegswale.pdf
City of Ft. Lauderdale http://ci.ftlaud.fl.us/public_services/swales/sos.htm
Spokane County - Swale Construction http://www.spokanecounty.org/utilities/stormwtr/swale.asp

WATER USE ZONES

The following pages list plants that are suitable for Southeastern North Carolina landscapes. The plant tables make reference to “hardiness zones” and “water use zones” which are discussed on the following pages.

Water Use Zones

Water use zones refer to a plant’s water needs. Some plants need more water than others. By grouping plants together that have similar water needs, less water is wasted to irrigate mixed plantings when half the plants don’t need the extra water.

Photo Credit: highcountrygardens.com

The philosophy is to only use high water use plants (most annuals, roses, some ornamentals) close to a house for impact. High water use plants need weekly irrigation throughout the growing season. ***The rest of the landscape should feature medium and low water use plants*** - medium use plants would need watering during drought, and low water use plants should thrive under natural rainfall except during times of extended drought. You can easily create these water use zones in your yard.

The placement of plants is a key element in efficient water use. Many of our common southern landscape plants survive drought and disease conditions. Once they are established, plants such as Crape Myrtle, Elaeagnus, Chinese Hollies, Glossy Abelia and Juniper can survive weeks without watering.

Turf (grass) requires much more water and care than landscaping with native plants. Turf is only practical in areas where it serves a function such as in recreational areas, on certain slopes to control erosion, or where it lends aesthetic value. Reducing turf reduces maintenance needs.

When you begin planning your landscape, locate plants according to their water needs. Create these water use zones in your yard: high water use zones (1), medium water use zones (2), and low water use zones (3). **Remember, it is best to create a landscape of low (3) and medium (2) water use plants!**

Additional information can be found online by searching for “plant water use zones”.

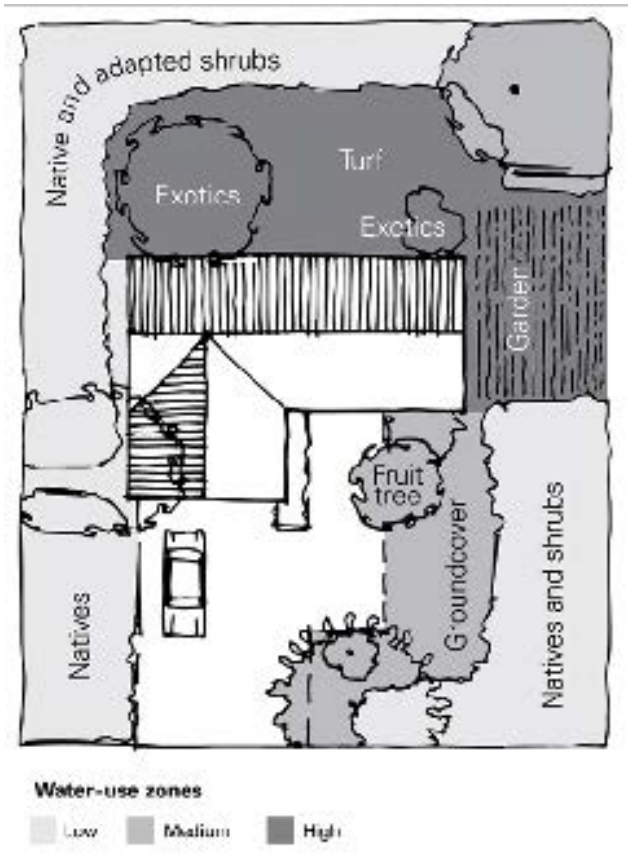
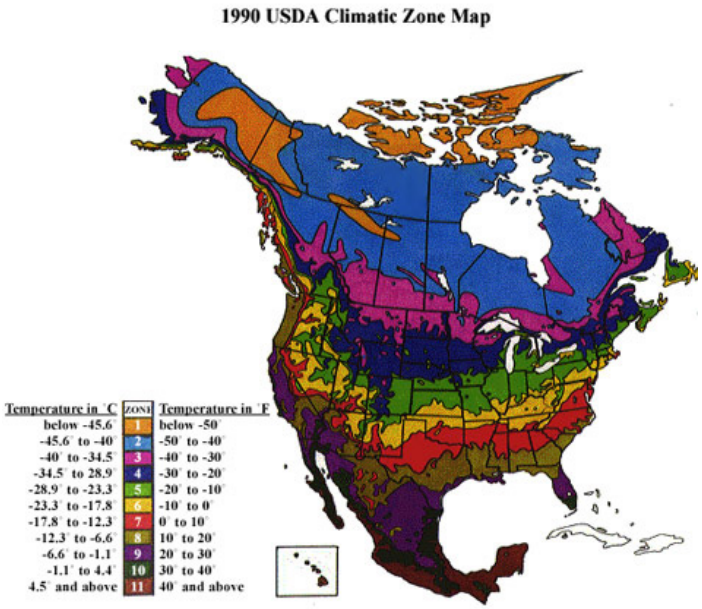


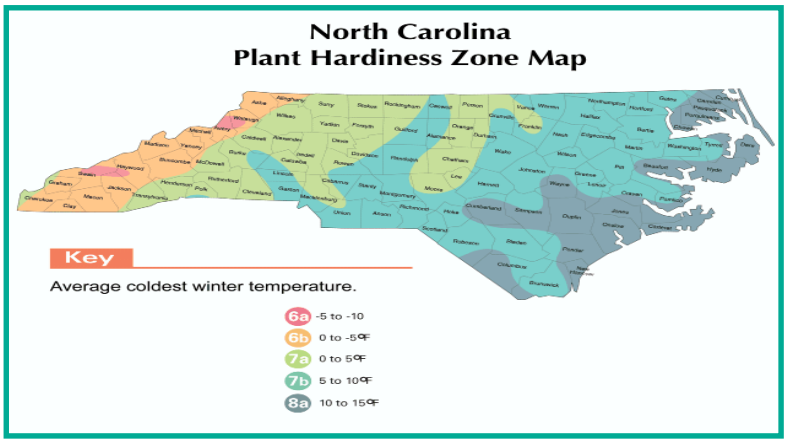
Photo Credit: yourhojme.gov.au

HARDINESS ZONES

Weather varies significantly from one part of North Carolina to another. Plants that flourish in one part of the state may do poorly or fail in another part of the state. The primary guide to determine plant hardiness is the USDA Hardiness Zone Map which is divided into ten zones based on average minimum temperatures. Each zone is further divided into states.

In North Carolina the zones tend to be aligned more East and West instead of North and South. A plant is said to be hardy if it can tolerate the lowest average winter temperatures that usually occurs in a zone. There is not a clear cut line between zones. A given location can be warmer or colder than the rest of a zone because of air drainage or elevation. Some plants can be grown in isolated areas north of their designated zone but may suffer from winter injury. A plant can often be grown in a warmer zone if growing conditions (rainfall, soil, summer heat) are comparable.





NC has hardiness zones (6,7 and 8) based on the average minimum temperature. Wilmington, NC is situated in Hardiness Zone 8A.

Hardiness is affected by duration and intensity of sunlight, length of growing season, amount and timing of rainfall, length and severity of summer drought, soil characteristics, proximity to a large body of water, slope, frost occurrence, humidity and cultural practices.

Plants can be classified as either hardy or non-hardy, depending upon their ability to withstand cold temperatures. Winter injury can occur to non-hardy plants if temperatures are too low or if unseasonably low temperatures occur early in the fall or late in the spring. For more information visit:

http://planthardiness.ars.usda.gov/PHZMWeb/#

http://www.plantmaps.com/list-of-hardiness-zones-for-north-carolina-cities.php

**This section adapted from Erv Evans, Consumer Horticulturalist, NC Cooperative Extension.*

Recommended Plants for New Hanover County Landscapes

Compiled by Charlotte Glen, Urban Horticulture Agent, NC Cooperative Extension

The following lists are plants recommended for landscape use in the Wilmington/New Hanover County area. All plants are hardy to **Zone 8a** (minimum temperature of 10-15 degrees Fahrenheit). These plants grow well in our local climate conditions, are relatively easy to grow, and are available at most local nurseries and garden centers. **The following plant tables are arranged with common names listed first, however plants are listed in alphabetical order according to their botanical/scientific name.** Several information codes accompany each plant list; these are explained below:

Native Plant (*) A plant native to SE USA implies a plant endemic to the Southeastern portion of the United States, from Virginia to Eastern Texas, including NC. These are indicated in the plant lists by an asterisk *****.

Drought-Tolerant Plants Extremely drought-tolerant plants are marked with an **underline**. When planted in their preferred soil type, these plants are able to withstand extended periods of drought (4-6 weeks) without supplemental irrigation once established. Most trees and shrubs take two to three seasons to become fully established. Perennials, grasses, and groundcovers usually require one to two seasons to become established.

Colors Plant and/or flower color is indicated by the following abbreviations:

W-white, Y-yellow, O-orange, B-blue, Pu-purple, P-pink, R-red, L-lavender

Water Use Zones Water Use Zones indicate the water needs of a plant. For irrigating and watering plants efficiently, it is best to group plants together in the landscape by the amount of water they require.

1 = High Water Use Zone, 2 = Medium Water Use Zone, 3 = Low Water Use Zone

Mature Size (Height or Height x Spread) Mature sizes of shrubs and trees are noted as height x spread/width. Other plants (annuals, perennials, groundcover, vines, grasses) include the height of a mature plant. Keep in mind that the mature size of a plant can vary depending on growing conditions and can take several years to reach mature size.

Recommended Plant Varieties For many plants, recommended varieties are listed. These are selections of a particular plant that either perform better in our area or are more suitable to landscape use than the plain species. Plant varieties, also known as cultivars, are listed using single quotes.

Exposure Exposure refers to the amount of sunlight or shade that a site receives and the needs of the plant:

- **Full Sun** indicates a site that receives at least 8 hours of direct sun each day.
- **Light Shade** indicates a site that is shaded less than half of the day by a light high shade, such as that cast by pine trees.
- **Part Shade** indicates a site that is shaded for half the day by a dense shade, such as that cast by buildings or shade trees.
- **Full Shade** indicates a site that is in the shade all day.

Soil Soil refers to soil condition at the site and needs of the plant:

- **Wet** indicates a site that stays moist most of the time and receives periodic flooding.
- **Moist** indicates a site that is moist most of the time with brief (less than 12 hours) periods of standing water.
- **Well Drained** indicates a site where water drains freely and rarely stands.
- **Xeric** indicates a site that is extremely dry and sandy with very little ability to hold water.

NC Cooperative Extension Website

For more detailed information about plants and to see images, visit **https://plants.ces.ncsu.edu/**

NC STATE UNIVERSITY A&T STATE UNIVERSITY COOPERATIVE EXTENSION *Helping People Put Knowledge to Work*

Visit the Cooperative Extension

To see many of these plants growing in a landscape setting, visit the **New Hanover County Arboretum**, which is part of the NHC Cooperative Extension. The Arboretum is located at 6206 Oleander Drive and is open seven days a week during daylight hours, free. To find out more, call **798-7660** or visit **https://newhanover.ces.ncsu.edu/**

Plant Information Clinic

For questions about plant selection and maintenance, lawn care, vegetable gardening or pest problems, call or visit the **New Hanover County Cooperative Extension Plant Information Clinic.** The Plant Clinic is staffed by trained Master Gardeners and Extension Horticulture agents. Call **910-798-7680** or **stop by during operating hours.**

GROUNDCOVERS

* = Indicates a plant native to the Southeastern USA
Underline = Indicates an extremely drought-tolerant plant
Colors = W-white, Y-yellow, O-orange, B-blue, Pu-purple, P-pink, R-red, L-lavender

Common Name	Botanical Name	Water Use Zone	Recommended Varieties	Height (in)	Type of Plant	Growth Rate	Exposure	Soil Conditions
Shade – part to full								
Carpet Bugle	*Ajuga reptans*	1,2		4 - 8	Evergreen Perennial	Moderate	Part to Full Shade	Moist to Well Drained
Pussytoes*	*Antennaria plantaginifolia*	1,2,3		4 - 8	Evergreen Perennial	Moderate	Light to Full Shade	Well Drained
Japanese Ardisia	*Ardisia japonica*	1,2		4 - 8	Evergreen Perennial	Moderate	Part to Full Shade	Well Drained
Green and Gold*	*Chrysogonum virginianum*	1,2		6 - 8	Semi-Evergreen Perennial	Moderate	Light to Part Shade	Moist to Well Drained
Holly Fern	*Cyrtomium falcatum*	1,2,3		24 - 30	Evergreen Fern	Moderate	Part to Full Shade	Well Drained
Dwarf Gardenia	*Gardenia jasminoides* 'Radicans'	1,2		12 - 24	Evergreen Shrub	Moderate	Light to Part Shade	Well Drained
Algerian Ivy	*Hedera canariensis*	1,2,3		12	Evergreen Vine	Moderate to Fast	Light to Full Shade	Well Drained
English Ivy	*Hedera helix*	1,2,3		6-12	Evergreen Vine	Slow to Moderate	Part to Full Shade	Well Drained
American Alumroot*	*Heuchera americana*	1,2,3	Many Available	6 - 12	Semi-Evergreen Perennial	Moderate	Light to Part Shade	Well Drained
Hosta	*Hosta* species and hybrids	1,2,3	Many Available	12 - 24	Herbaceous Perennial	Moderate	Part to Full Shade	Well Drained
Liriope	*Liriope muscarii*	1,2,3	Many Available	12 - 18	Evergreen Perennial	Moderate	Light to Full Shade	Moist to Well Drained
Creeping Jenny	*Lysimachia nummularia*	1,2	'Aurea'	2	Semi-Evergreen Perennial	Fast	Light to Full Shade	Moist to Well Drained
Mondograss	*Ophiopogon japonicus*	1,2		6 - 10	Evergreen Perennial	Slow to Moderate	Part to Full Shade	Well Drained
Creeping Raspberry	*Rubus calycinoides*	1,2		6 - 12	Evergreen Shrub	Moderate	Light to Part Shade	Well Drained
Sweetbox	*Sarcococca hookeriana* var. *humilis*	1,2		36	Evergreen Shrub	Moderate	Light to Full Shade	Well Drained
Strawberry Begonia	*Saxifraga stolonifera*	1,2		12	Evergreen Perennial	Fast	Light to Full Shade	Moist to Well Drained
Asiatic or Star Jasmine	*Trachelospermum asiaticum*	1,2,3		6 - 8	Evergreen Vine	Fast to Moderate	Light to Part Shade	Well Drained
Common Periwinkle	*Vinca minor*	1,2,3		5-6	Evergreen Vine	Fast	Light to Full Shade	Well Drained
Christmas Fern*	*Polystichum acrostichoides*	1,2		12 - 18	Evergreen Fern	Moderate	Part to Full Shade	Moist to Well Drained
Autumn Fern	*Dryopteris erythrosa*	1,2		18 - 24	Evergreen Fern	Moderate	Part to Full Shade	Moist to Well Drained
Japanese Painted Fern	*Athyrium nipponicum*	1,2		12 - 18	Herbaceous Fern	Moderate	Light to Full Shade	Moist to Well Drained
Spreading Liriope	*Liriope spicata*	1,2,3		8-15	Evergreen Perennial	Moderate	Light to Full Shade	Moist to Well Drained

Water Use Zones: 1 - High Water Use Zone, **2** - Medium Water Use Zone, **3** - Low Water Use Zone

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Common Name	Botanical Name	Water Use Zone	Recommended Varieties	Height (in)	Type of Plant	Growth Rate	Exposure	Soil Conditions
Sun								
Beach Wormwood*	*Artemisia stelleriana*	2,3	'Silver Brocade'	6 - 12	Evergreen Perennial	Moderate	Full Sun	Well Drained to Xeric
Hardy Ice Plant	*Delosperma cooperi* *Delosperma nubigenum*	2,3		4 - 6	Semi – Evergreen Perennial	Moderate	Full Sun	Well Drained to Xeric
Cheddar Pinks, Dianthus	*Dianthus gratianopolitanus* and hybrids of this species	2,3	'Bath's Pink' 'Firewitch' 'Greystone'	4 - 8	Evergreen Perennial	Moderate	Full Sun	Well Drained
Weeping Love Grass	*Eragrostis curvula*	2,3		24 - 36	Clumping Grass	Moderate	Full Sun	Well Drained to Xeric
Daylily	*Hemerocallis* hybrids	1,2,3	Many Available	18 - 48	Herbaceous Perennial	Moderate	Full Sun to Part Shade	Moist to Well Drained
Atlantic St. John's Wort*	*Hypericum reductum*	2,3		8 - 12	Semi-Evergreen Shrub	Moderate	Full Sun	Well Drained to Xeric
Candytuft	*Iberis sempervirens*	1,2,3		6 - 8	Evergreen Perennial	Moderate	Full Sun to Light Shade	Well Drained
Shore Juniper	*Juniperus conferta*	2,3	'Blue Pacific'	12-18	Evergreen Conifer	Fast	Full Sun	Well Drained to Xeric
Blue Rug Juniper	*Juniperus horizontalis* 'Wiltonii'	2,3		4-6	Evergreen Conifer	Moderate	Full Sun	Well Drained to Xeric
Andorra Juniper	*Juniperus horizontalis* 'Plumosa'	2,3		24	Evergreen Conifer	Moderate	Full Sun	Well Drained to Xeric
Creeping Juniper*	*Juniperus horizontalis*	2,3	'Bar Harbor' 'Blue Chip'	10 - 12	Evergreen Conifer	Moderate	Full Sun	Well Drained to Xeric
Dwarf Nandina	*Nandina domestica*	1,2,3	'Harbor Belle' 'Harbor Dwarf' 'San Gabriel'	24 - 36	Evergreen Shrub	Moderate	Full Sun	Well Drained
Moss Phlox or Thrift*	*Phlox subulata*	1,2,3	Many	4 - 6	Evergreen Perennial	Moderate	Full Sun to Light Shade	Well Drained
Orange Coneflower*	*Rudbeckia fulgida*	1,2,3	'Goldsturm'	24 - 30	Semi-Evergreen Perennial	Moderate	Full Sun to Part Shade	Moist to Well Drained
Stonecrops	*Sedum reflexum* *Sedum album* *Sedum tetractinum*	1,2,3	'Blue Spruce' 'Murale'	4 - 6	Evergreen Perennial	Moderate	Full Sun to Light Shade	Well Drained
Wooly Stemodia*	*Stemodia tomentosa*	1,2,3		4 - 6	Evergreen Perennial	Moderate	Full Sun	Well Drained
Prostrate Germander	*Teucrium chamaedrys*	1,2,3	'Prostratum' 'Nanum'	6 - 8	Evergreen Perennial	Moderate	Full Sun	Well Drained

Many ornamental grasses, perennials and low growing shrubs will make good groundcovers when planted in mass. View those lists for more possibilities. Evergreen plants retain enough foliage to remain dense and full during winter. Semi-evergreen plants retain at least half of their foliage through winter, but are not as dense as evergreens. Herbaceous plants go dormant during winter, losing all of their foliage.

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VINES

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Common Name	Botanical Name	Water Use Zone	Height	Flower Color/ Time of Bloom	Climbing Type	Soil	Exposure
Evergreen							
Evergreen Clematis	*Clematis armandii*	1,2	20’	White/Spring	Tendrils	Well Drained	Sun to Pt. Shade
Climbing Fig	*Ficus pumila*	1,2	30’+	Grown for foliage	Clinging	Well Drained	Sun to Shade
Carolina Jessamine*	*Gelsemium sempervirens*	1,2,3	10’-20’	Yellow/Spring	Twining	Moist to Well Drained	Sun to Pt. Shade
English Ivy	*Hedera helix*	1,2,3	50’+	Grown for foliage	Clinging	Well Drained	Sun to Shade
Coral Honeysuckle*	*Lonicera sempervirens*	1,2,3	10’-20’	Orange-Red-Yellow/ Spring	Twining	Moist to Well Drained	Sun to Pt. Shade
Goldflame Honeysuckle	*Lonicera x heckrottii*	1,2	10’-20’	Pink/Spring	Twining	Moist to Well Drained	Sun to Lt. Shade
Confederate Jasmine	*Trachelospermum jasminoides*	1,2,3	15’	White/Summer	Twining	Well Drained	Sun
Evergreen Wisteria	*Milletia reticulata*	1,2	10’+	Purple/Summer	Twining	Well Drained	Sun
Fatshedera	X *Fatshedera lizei*	1,2	8’	Grown for Foliage	Scrambler	Moist to Well Drained	Pt. Shade to Shade
Greenbriar	*Smilax laurifolia Smilax smallii*	1,2	15’+	Grown for Foliage	Scrambler	Moist to Well Drained	Sun to Shade
Deciduous							
Climbing Aster*	*Aster carolinianus*	1,2	10’	Lavender-Pink/Fall	Scrambler	Moist to Well Drained	Sun to Lt. Shade
Fiveleaf Akebia	*Akebia quinata*	1,2,3	30’+	Purple/summer	Twining	Well Drained	Sun to Pt. Shade
Cross Vine*	*Bignonia capreolata* ‘Tangerine Beauty’	1,2	30’+	Orange/Spring	Tendrils and Clinging	Moist to Well Drained	Sun to Lt. Shade
Large Flowered Clematis	*Clematis* hybrids	1,2	10’	Purple, pink, white/Spring	Tendrils	Well Drained	Sun to Pt. Shade
Climbing Hydrangea*	*Decumaria barbara*	1,2	20’	White/Summer	Clinging	Moist to Well Drained	Lt. Shade to Shade
Virginia Creeper*	*Parthenocissus quinquefolia*	1,2,3	30’+	Grown for foliage	Tendrils and Clinging	Moist to Well Drained	Sun to Shade
Boston Ivy	*Parthenocissus tricuspidata*	1,2,3	30’+	Grown for foliage	Tendrils and Clinging	Well Drained	Sun to Shade
Passionflower	*Passiflora* x *alato-caerulea* *Passiflora* x ‘Incence’	1,2	10’+	Purple/Summer	Tendrils	Well Drained	Sun to Lt. Shade
Lady Banks’ Rose	*Rosa banksiae* ‘Lutea’	1,2,3	20’	Yellow/Spring	Scrambler	Well Drained	Sun to Lt. Shade
Climbing Rose	*Rosa species*	1,2	10’	Many colors/Spring	Sprambler	Well Drained	Sun to Lt. Shade
Japanese Hydrangea Vine	*Schizophragma hydrangeoides*	1,2	20’-30’	White/Summer	Clinging	Well Drained	Pt. Shade to Shade
American Wisteria*	*Wisteria frutescens*	1,2,3	20’-30’	Lilac/Spring	Twining	Moist to Well Drained	Sun

“Climbing Form” refers to the way a vine climbs and helps determine the type of support structure needed:

- **Tendrils** – Tendrils are short curly stems that wrap around narrow structures like wire or bamboo. These vines need a support structure with small diameter elements and do very well on chain link fences or wires.
- **Clinging** – Clinging vines produce short root-like growths that act like adhesive pads. They easily climb trees, walls and wood fences with little assistance.
- **Twining** – Twining vines climb by wrapping their stems around and through their support structure. They grow well on lattice, chain link fence, or any structure they can weave through, but usually need a little help getting started.
- **Scrambler** – Scrambling vines produce long, supple stems that can be woven through the same type of support structures as twining vines. They generally need to be trained to climb up and through their support structure.

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ORNAMENTAL GRASSES

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Common Name	Botanical Name	Water Use Zone	Recommended Varieties	Height and Spread	Soil	Exposure
Feather Reed Grass	*Calamagrostis brachytricha*	1,2,3		4' x 3'	Moist to Well Drained	Sun to Pt. Shade
Japanese Sedge	*Carex morrowii*	1,2	'Goldband' 'Variegata'	1' x 1' 1' x 1'	Moist to Well Drained	Lt. Shade to Shade
Weeping Japanese Sedge	*Carex oshimensis*	1,2	'Evergold'	1' x 2'	Moist to Well Drained	Lt. Shade to Shade
Chinese Sedge	*Carex phyllocephala*	1,2	'Sparkler'	2' x 2'	Moist to Well Drained	Lt. Shade to Shade
River Oats*	*Chasmanthum latifolium*	1,2,3		4' x 2'	Wet to Well Drained	Sun to Shade
Pampas Grass	*Cortaderia selloeana*	1,2,3		8' x 6'	Moist to Well Drained	Sun
Maiden Grass	*Miscanthus sinensis*	1,2,3	'Adagio' 'Cosmopolitan' 'Morning Light' 'Strictus'	4' x 3' 8' x 4' 6' x 4' 6' x 3'	Moist to Well Drained	Sun – Lt. Shade
Muhly Grass*	*Muhlenbergia capillaris*	2,3		3' x 3'	Well Drained to Xeric	Sun
Panic Grass*	*Panicum virgatum*	1,2,3	'Cloud Nine' 'Northwind' 'Shenandoah'	8' x 5' 5' x 3' 4' x 2'	Moist to Well Drained	Sun to Lt. Shade
Fountain Grass	*Pennisetum alopecuroides*	1,2,3	'Hameln'	3' x 2'	Moist to Well Drained	Sun – Lt. Shade
Tall Fountain Grass	*Pennisetum orientale*	1,2,3	'Tall Tails'	6' x 4'	Moist to Well Drained	Sun
Indian Grass*	*Sorghastrum nutans*	1,2,3		6' x 3'	Moist to Well Drained	Sun

TURFGRASSES

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Common Name	Botanical Name	Water Use Zone	Recommended Varieties	Shade Tolerance	Propagation	Rate of Establishment	Fertilizer (lbs of Nitrogen/ 1,000 sq. ft./yr)	Mowing Frequency	Mowing Height
Centipede	*Eremochloa ophiuroides*	1,2,3	Common 'TifBlair'	Moderate	Seed for common, Plugs, Sod for both	Slow	0.5	Low	1"
St. Augustine	*Stenotaphrum secundatum*	1,2	'Raleigh' 'Mercedes' 'Palmetto'	Very Good	Plugs, Sod	Moderate	2 to 3	Medium-high	2" to 3"
Zoysia	*Zoysia* hybrids	1,2,3	'Emerald', 'Meyer' 'El Toro', 'Zenith' 'Crowne', 'Empire' 'GN-Z'	Good	Only 'Zenith' can be grown from seed. All other varieties must be established by sprigs, plugs, or sod.	Very Slow to Moderate depending on variety	2 to 4 depending on variety	Low-medium	0.75" to 1.5" depending on variety
Common Bermuda	*Cynodon dactylon*	1,2,3	'Princess' 'Jack Pot'	Very Poor	Seed. Springs, Plugs, Sod	Fast	4.5	Medium-high	1.0" to 1.5"
Hybrid Bermuda	*Cynodon dactylon* hybrids	1,2,3	'Tifway', 'Tifsport', 'Vamont', 'GN-1' 'Celebration' 'Tifton-10'	Very Poor	Springs, Plugs, Sod	Moderate	5 to 6	Very high	0.75" to 1.5"

All of the above are warm season grasses listed in order from low to high maintenance. Warm season grasses are well adapted to areas with hot summers and mild winters. They actively grow during spring, summer and fall and are dormant during winter. The best time to sow seed for these grasses is from spring to early summer (March/April-July). Plugs, sprigs, and sod establish best when planted in spring and summer (March-July).

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PERENNIALS

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Common Name	Botanical Name	Water Use Zone	Recommended Varieties	Height	Color	Time of Bloom	Exposure	Soil
SHADE–Part to Full								
Bear's Breeches	*Acanthus* species and hybrids	1,2	'Summer Beauty'	3 – 4 ft	Pu	Summer	Light to Part Shade	Moist to Well Drained
Carpet Bugle	*Ajuga reptans*	1,2		4 – 8 in	B,W,Pu	Spring	Light to Full Shade	Moist to Well Drained
Eastern Columbine*	*Aquilegia canadensis*	1,2,3		2-3 ft	R/Y	Spring	Light to Part Shade	Well Drained
Cast Iron Plant	*Aspidistra elatior*	1,2,3		2 – 3 ft	Foliage	Evergreen	Part to Full Shade	Well Drained
Japanese Painted Fern	*Athyrium nipponicum*	1,2		18 in	Foliage		Light to Full Shade	Moist to Well Drained
Hardy Begonia	*Begonia grandis*	1,2		15 in	P	Summer	Light to Full Shade	Well Drained
Green and Gold*	*Chrysogonum virginianum*	1,2		8 – 12 in	Y	Spring	Light to Full Shade	Moist to Well Drained
Southern Shield Fern*	*Dryopteris ludoviciana*	1,2		3 ft	Foliage		Part to Full Shade	Moist to Well Drained
Lenten Rose	*Helleborus* x *hybridus*	1,2		12-15 in	W,P,L	Winter/ Spring	Part to Full Shade	Well Drained
American Alumroot*	*Heuchera americana*	1,2,3	Many Available	8 – 12 in	W,P,R	Spring	Light to Full Shade	Well Drained
Hosta	*Hosta* species and hybrids	1,2.3		1-3 ft	Foliage	Spring/ Summer	Part to Full Shade	Well Drained
Leopard Plant	*Ligularia tussilaginea*	1,2		18 – 24 in	Y	Fall	Part to Full Shade	Moist to Well Drained
Creeping Jenny	*Lysimachia nummularia*	1,2	'Aurea'	2 in	Foliage	Evergreen	Light to Full Shade	Moist to Well Drained
Woodland Phlox*	*Phlox divaricata*	1,2		8 – 12 in	B,W,L	Spring	Light to Part Shade	Moist to Well Drained
Variegated Solomon's Seal	*Polygonatum odoratum* 'Variegatum'	1,2,3		18 – 24 in	W	Spring	Light to Full Shade	Moist to Well Drained
Strawberry Begonia	*Saxifraga stolonifera*	1,2		12 in	W	Spring	Light to Full Shade	Moist to Well Drained
Indian Pink*	*Spigelia marilandica*	1,2		12 – 18 in	R/Y	Spring	Light to Part Shade	Well Drained
Toad Lily	*Tricyrtis formosana*	1,2		12 – 24 in	W/Pu/L	Fall	Light to Part Shade	Moist to Well Drained
SUN – Full to Part								
Yarrow	*Achillea millefolium*	1,2,3		2 - 3 ft	W,P,Y,O	Summer	Sun	Well Drained to Xeric
Anise Hyssop	*Agastache foeniculum*	1,2,3	'Blue Fortune'	2 – 3 ft	B	Summer	Sun	Well Drained
Arkansas Blue Star*	*Amsonia hubrichtii*	1,2,3		3 – 4 ft	B	Spring	Sun	Well Drained
Blue Star*	*Amsonia tabernaemontana*	1,2,3		3 – 4 ft	B	Spring	Sun to Part Shade	Moist to Well Drained
'Powis Castle' Artemisia	*Artemisia* x 'Powis Castle'	2,3		2 – 3 ft	Foliage	Evergreen	Sun	Well Drained to Xeric
Butterfly Weed*	*Ascelpias tuberosa*	1,2,3		1-2 ft	O,Y	Summer	Sun	Well Drained to Xeric
Swamp Milkweed*	*Asclepias incarnata*	1,2	'Cinderella' 'Ice Ballet'	3 ft	W,P	Summer	Sun to Part Shade	Moist to Well Drained
Heath Aster*	*Aster ericoides*	1,2,3	'Monte Cassino' 'Pink Star'	2 – 4 ft	W,P	Fall	Sun	Well Drained to Xeric
Aromatic Aster*	*Aster oblongifolius*	1,2,3	'Fanny' 'October Skies'	2 – 4 ft	B,P	Fall	Sun	Well Drained
False Wild Indigo*	*Baptisia australis* *Baptisia alba* *Baptisia sphaerocarpa* *Baptisia* hybrids	1,2,3	'Carolina Moonlight' 'Purple Smoke'	2 - 3ft	B,W,Y,L	Spring	Sun/Partial Shade	Moist to Well Drained

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Common Name	Botanical Name	Water Use Zone	Recommended Varieties	Height	Color	Time of Bloom	Exposure	Soil
Canna Lily	*Canna* hybrids	1,2	Many Available	2 – 6 ft	P,R,O,Y	Summer	Sun to Part Shade	Moist to Well Drained
Leadwort	*Ceratostigma plumbaginoides*	1,2,3		12 in	B	Fall	Sun to Part Shade	Moist to Well Drained
Turtlehead*	*Chelone glabra* *Chelone obliqua*	1,2		2 – 3 ft	W,P	Fall	Sun to Part Shade	Moist to Well Drained
Mouse Ear Coreopsis*	*Coreopsis auriculata*	1,2	'Nana'	1 – 2 ft	Y	Spring	Sun to Part Shade	Moist to Well Drained
Threadleaf Coreopsis*	*Coreopsis verticillata*	1,2,3	'Golden Showers' 'Zagreb'	1 - 2 ft	Y	Summer	Sun	Well Drained
Crinum Lily	*Crinum* species and hybrids	1,2,3		2 – 4 ft	W,P	Summer	Sun to Part Shade	Moist to Well Drained
Hardy Ice Plant	*Delosperma cooperi* *Delosperma nubigenum*	2,3		6 in	P,Y	Spring	Sun	Well Drained to Xeric
Cheddar Pinks, Dianthus	*Dianthus gratianopolitanus*	1,2,3	'Bath's Pink' 'Firewitch' 'Greystone'	8 – 12 in	W,P	Spring	Sun	Well Drained to Xeric
Hummingbird Plant	*Dicliptera suberecta*	1,2,3		12 – 18 in	O	Summer	Sun	Well Drained
Purple Coneflower*	*Echinacea purpurea*	1,2,3	'Bravado', 'Kim's Knee High' 'White Swan', 'Magnus'	3-5 ft	P,W	Summer	Sun/Partial Shade	Well Drained
Joe Pye Weed*	*Eupatorium fistulosum* *Eupatorium dubium* *Eupatorium maculatum*	1,2		4 – 6 ft	P	Fall	Sun to Light Shade	Moist to Well Drained
Blanket Flower, Gaillardia	*Gaillardia x grandiflora*	1,2,3	'Goblin' 'Fanfare'	1 - 2 ft	Y,R,O	Summer-Fall	Sun	Well Drained to Xeric
Gaura*	*Gaura lindheimeri*	2,3	'So White' 'Pink Cloud'	2 – 3 ft	W,P	Summer	Sun	Well Drained to Xeric
Hardy Ginger Lily	*Hedychium* species and hybrids	1,2		4 – 6 ft.	W,Y,O,	Summer - Fall	Sun to Part Shade	Moist to Well Drained
Swamp Sunflower*	*Helianthus angustifolius*	1,2		6 ft	Y	Fall	Sun to Light Shade	Moist to Well Drained
Daylily	*Hemerocallis* species and hybrids	1,2,3	Many Available	1-4 ft	Y,O,R,W,P	Summer	Sun/Partial Shade	Moist to Well Drained
Red False Aloe	*Hesperaloe parviflora*	2,3		3 – 4 ft	R	Summer	Sun	Well Drained to Xeric
Hardy Hibiscus*	*Hibiscus moscheutos* *Hibiscus coccineus* *Hibiscus* hybrids	1,2	'Anne Arundel' 'Blue River II" 'Moy Grande'	4 – 5 ft	R,P,W	Summer	Sun to Light Shade	Moist to Well Drained
Confederate Rose	*Hibiscus mutabilis*	1,2		5 – 6 ft	P	Fall	Sun to Light Shade	Moist to Well Drained
Evergreen Candytuft	*Iberis sempervirens*	1,2,3		12 in	W	Spring	Sun to Part Shade	Well Drained
Bearded Iris	*Iris* hybrids	1,2,3		3 ft	P,O,Y,W,L,Pu,	Spring	Sun to Light Shade	Well Drained
Siberian Iris	*Iris sibirica*	1,2		2-4 ft	W,Y, B, Pu, L	Spring	Sun to Part Shade	Moist to Well Drained
Japanese Aster	*Kalimeris pinnatifida*	1,2,3		2 ft	W	Summer	Sun to Light Shade	Well Drained
Red Hot Poker	*Kniphofia* species and hybrids	1,2,3		2-4 ft	R,O,Y	Summer	Sun	Well Drained
Seashore Mallow*	*Kosteletzkya virginica*	1,2		4 – 5 ft	P,W	Summer	Sun to Par Shade	Moist to Well Drained
Lantana	*Lantana camara* *Lantana montevidensis* *Lantana* hybrids	2,3	'Miss Huff' 'Tangerine' 'New Gold' 'Radiation'	2 – 4 ft	W,L,P,Y,O,R	Summer to Fall	Sun	Well Drained to Xeric
Cardinal Flower*	*Lobelia cardinalis*	1,2		3 ft	R	Fall	Sun to Part Shade	Moist to Well Drained
Garden Phlox*	*Phlox paniculata*	1,2	'Robert Poore' 'David' 'Laura'	3 – 4 ft	W,P,L	Summer	Sun to Part Shade	Moist to Well Drained

Water Use Zones: 1 - High Water Use Zone, **2** - Medium Water Use Zone, **3** - Low Water Use Zone

PERENNIALS

* = Indicates a plant native to the Southeastern USA
Underline = Indicates an extremely drought-tolerant plant
Colors = W-white, Y-yellow, O-orange, B-blue, Pu-purple, P-pink, R-red, L-lavender

Common Name	Botanical Name	Water Use Zone	Recommended Varieties	Height	Color	Time of Bloom	Exposure	Soil
Moss Pinks, Thrift*	*Phlox subulata*	1,2,3	Many Available	6 – 12 in	W,P,L,B	Spring	Sun to Light Shade	Well Drained
Rudbeckia, Orange Coneflower*	*Rudbeckia fulgida*	1,2,3	'Goldsturm'	3 ft	Y	Summer	Sun to Part Shade	Moist to Well Drained
Dwarf Mexican Petunia	*Ruellia brittoniana* 'Katie'	1,2,3		6 in	W,P,Pu	Summer	Sun to Light Shade	Well Drained
Autumn Sage	*Salvia greggii* *Salvia microphylla* and hybrids	1,2,3		2 – 4 ft	R,P,W,Pu	Spring and Fall	Sun to Light Shade	Well Drained
Anise Sage	*Salvia guaranitica*	1,2	'Black and Blue'	3 – 4 ft	B,Pu	Summer	Sun to Part Shade	Moist to Well Drained
Mexican Bush Sage	*Salvia leucantha*	1,2,3	'San Carlos Festival'	3 – 5 ft	Pu	Fall	Sun	Well Drained
Sedum	*Sedum* hybrids	1,2,3	'Matrona' 'Autumn Fire'	2 –3 ft	P, R	Fall	Sun to Light Shade	Well Drained
Purple Heart	*Setcreasia pallida*	1,2,3		12 – 15 in	Pu	Summer	Sun to Light Shade	Well Drained
'Fireworks' Goldenrod*	*Solidago rugosa* 'Fireworks'	1,2,3		1-3 ft	Y	Fall	Sun to Part Shade	Moist to Well Drained
Stokes Aster*	*Stokesia laevis*	1,2	Several Available	1 –2 ft	B, L, W, Y	Summer	Sun to Part Shade	Moist to Well Drained
Verbena*	*Verbena canadensis*	1,2,3	'Homestead Purple' 'Snowflurry'	8 – 12 in	W,B,L,P	Spring and Summer	Sun to Light Shade	Moist to Well Drained
Creeping Veronica	*Veronica peduncularis*	1,2	'Georgia Blue'	8 in	B	Spring	Sun to Part Shade	Well Drained
Rain Lily	*Zephyranthes* species and hybrids	1,2	Several Available	1 ft	W,Y,P	Summer and Fall	Sun to Part Shade	Moist to Well Drained

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Common Name	Botanical Name	Water Use Zone	Height (inches)	Color	Exposure
Cool Season Annuals					
Snapdragon	*Anthirrhinum majus*	1,2	6-36	All but B	Sun
English Daisy	*Bellis perennis*	1,2	6 - 12	P, R, W	Sun to Pt. Shade
Swiss Chard	*Beta vulgaris*	1,2	24	Foliage	Sun
Ornamental Cabbage and Kale	*Brassica oleracea*	1,2	12	Foliage	Sun
'Giant Red' Mustard	*Brassica* species 'Giant Red'	1,2	18	Foliage	Sun
Calendula	*Calendula officinalis*	1,2	12 - 24	Y,O	Sun
Bachelor's Buttons	*Centaurea cyanus*	1,2	12 - 30	B, W, P	Sun
Cardoon	*Cynara cardunculus*	1,2,3	36	Foliage	Sun
Chinese Forget-me-not	*Cynoglossum amabile*	1,2	12	B	Sun to Pt. Shade
Delphinium	*Delphinium* x *elatum*	1,2	36 - 48	W, B, Pu, L, P	Sun to Pt. Shade
Sweet Williams	*Dianthus barbatus*	1,2	12 - 24	R, P, W	Sun to Pt. Shade
China Pinks	*Dianthus chinensis*	1,2	8 - 12	R, P, W	Sun
Foxglove	*Digitalis purpurea*	1,2	12-60	All but B	Sun to Pt. Shade

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ANNUALS

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Common Name	Botanical Name	Water Use Zone	Height (inches)	Color	Exposure
Wallflower	*Erysimum cheiri*	1,2	12	All but B	Sun to Pt. Shade
California Poppy	*Eschscholzia californica*	1,2,3	12-24	All but B	Sun
Dame's Rocket	*Hesperis matronalis*	1,2	36	Pu, W	Sun to Pt. Shade
Annual Candytuft	*Iberis umbellata*	1,2	12	P, Pu, L, W	Sun
Sweet Alyssum	*Lobularia maritima*	1,2	6	W,P,L	Sun to Pt. Shade
Stock	*Matthiola incana*	1,2	12 - 15	W, P, R, Pu	Sun
Forget-me-nots	*Myosotis sylvatica*	1,2	12	B	Sun to Pt. Shade
Parsley	*Petroselinum crispum*	1,2	12	Foliage	Sun
Dusty Miller	*Senecio cineraria*	1,2,3	6-12	Foliage	Sun
Pansy	*Viola x wittrockiana*	1,2	6	All	Sun to Pt. Shade
Warm Season Annuals - Shade					
'Dragonwing'Begonia	*Begonia* x 'Dragonwing'	1,2	15	R,P	Sun to Shade
Wax Begonia	*Begonia* x *semperflorens*	1,2,3	6-12	W,P,R	Sun to Shade
Caladium	*Caladium bicolor*	1	12 - 36	Foliage	Pt. Shade to Shade
Coleus	*Solenostemon scutellarioides*	1,2	24 - 36	Foliage	Sun to Shade
Polka Dot Plant	*Hypoestes phyllostachya*	1,2	15 - 24	Foliage	Pt. Shade to Shade
New Guinea Impatiens	*Impatiens hawkeri*	1	12 - 36	O,R,P	Pt. Shade to Shade
Impatiens	*Impatiens wallerana*	1	12-36	All but B	Pt. Shade to Shade
Yellow Shrimp Plant	*Pachystachys lutea*	1,2	24 - 30	Y	Pt. Shade to Shade
Wishbone Flower	*Torenia fournieri*	1,2	12	W,B,Pu,P	Pt. Shade to Shade
Warm Season Annuals - Sun					
Ageratum	*Ageratum houstonianum*	1,2	8 - 24	W,B,Pu	Sun to Pt. Shade
'Purple Knight' Alternanthera	*Alternanthera dentata*	1,2	24 - 30	Foliage	Sun to Pt. Shade
Joseph's Coat	*Alternanthera ficoidea*	1,2	8 - 12	Foliage	Sun to Pt. Shade
Angelonia	*Angelonia angustifolia*	1,2	24 - 36	W,Pu,P	Sun to Pt. Shade
Tropical Milkweed	*Asclepias curassavica*	1,2	36 - 48	O,R,Y	Sun
Asparagus Fern	*Asparagus densiflorus*	1,2,3	18 - 24	Foliage	Sun to Pt. Shade
Wax Begonia	*Begonia semperflorens*	1,2,3	12	R,W,P	Sun to Shade
Dragonwing Begonia	*Begonia* x 'Dragonwing'	1,2	15	R,P	Sun to Shade
Million Bells	*Calibrachoa* x *hybrida*	1,2,3	6 - 12	All but B	Sun
Ornamental Pepper	*Capiscum annum*	1,2,3	12 - 18	Fruit	Sun
Madagascar Periwinkle	*Catharanthus roseus*	1,2,3	6 - 18	W,P,L,Pu	Sun
Cockscomb	*Celosia cristata*	1,2,3	6 - 30	All but B	Sun

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Common Name	Botanical Name	Water Use Zone	Height (inches)	Color	Exposure
Spider Plant	*Cleome hasslerana*	1,2,3	24 - 48	W,P,L	Sun
Cosmos	*Cosmos bipinnatus*	1,2,3	18 - 48	P, R, W	Sun to Pt. Shade
Mexican Heather	*Cuphea hyssopifolia*	1,2,3	12	Pu	Sun to Lt. Shade
Mexican Cigar Plant	*Cuphea ignea*	1,2	12	R	Sun
Blue Daze	*Evolvulus pilosus*	1,2,3	6 - 8	B	Sun
Blanket Flower	*Gaillardia pulchella*	1,2,3	12-30	Y,O,R	Sun
Globe Amaranth	*Gomphrena globosa*	1,2,3	8 - 24	W,P,L,Pu	Sun
Ornamental Sweet Potato	*Ipomoea batatas*	1,2	12	Foliage	Sun to Pt. Shade
Lantana	*Lantana camara*	1,2,3	12 - 36	Y,O,P,R	Sun
Trailing Lantana	*Lantana montevidensis*	1,2,3	12	L,W	Sun
Melampodium	*Melampodium paludosum*	1,2,3	18 - 30	Y	Sun to Pt. Shade
Cat's Whiskers	*Orthosiphon stamineus*	1,2	24	Pu,W	Sun to Lt. Shade
Red Fountain Grass	*Pennisetum setaceum* 'Rubrum'	1,2,3	24 - 36	Foliage	Sun
Pentas	*Pentas lanceolata*	1,2,3	12 - 24	R,P,W,L	Sun to Lt. Shade
Petunia	*Petunia x hybrida*	1,2	6-12	All	Sun to Pt. Shade
Cuban Oregano	*Plectranthus amboinicus*	1,2	24 - 30	Foliage	Sun
Silver Plectranthus	*Plectranthus argenteus*	1,2	24	Foliage	Sun
'Mona Lavender' Plectranthus	*Plectranthus* x 'Mona Lavender'	1,2	24	L	Sun to Lt. Shade
Moss Rose	*Portulaca grandiflora*	1,2,3	4 - 6	All but B, Pu	Sun
Purslane	*Portulaca oleracea*	1,2,3	6	All but B, Pu	Sun
Texas Sage	*Salvia coccinea*	1,2,3	18 - 24	R,P,W	Sun to Lt. Shade
Mealycup Sage	*Salvia farinacea*	1,2,3	12 - 24	B,W	Sun to Lt. Shade
Scarlet Sage	*Salvia splendens*	1,2,3	12 - 18	R,W,O,Pu	Sun to Pt. Shade
Fan Flower	*Scaevola aemula*	1,2	8	W,Pu	Sun to Lt. Shade
Sun Coleus	*Solenostemon scutellarioides*	1,2	24 - 36	Foliage	Sun to Shade
Persian Shield	*Strobilanthus dyerianus*	1,2	24	Foliage	Sun to Pt. Shade
Marigold	*Tagetes erecta*, *Tagetes patula*	1,2	12 – 30	Y,R,O	Sun
Mexican Sunflower	*Tithonia rotundifolia*	1,2,3	36 - 48	O,Y	Sun
Verbena	*Verbena* x *hybrida*	1,2	6-12	All but Y	Sun to Lt. Shade
'Profusion' Zinnia	*Zinnia elegans*	1,2	12	W,O,P,R	Sun
Creeeping Zinnia	*Zinnia linearis*	1,2,3	12 - 18	Y, O, W	Sun

All annuals grow best in a well-prepared soil with good drainage. Cool season annuals should be planted from October through mid-November. Warm season annuals are best planted from mid-April through May.

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SMALL SHRUBS (2-4 feet)

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Common Name	Botanical Name	Water Use Zone	Recommended Varieties	Height x Spread (ft.)	Ornamental Characteristics	Soil	Exposure
Evergreen Shrubs							
'Rose Creek' Abelia	*Abelia* x 'Rose Creek'	1,2,3		2-3 x 2-3	Clusters of small white bell-shaped flowers summer and fall	Well Drained	Sun
Dwarf Aucuba	*Aucuba japonica*	1,2,3	'Nana'	3-4 x 2-3	Large, evergreen leaves	Well Drained	Part to Full Shade
Poet's Laurel	*Danae racemosa*	1,2,3		2-4 x 3-5	Graceful habit and handsome foliage. Slow growing	Well Drained	Part to Full Shade
Creeping Gardenia	*Gardenia radicans*	1,2		2-3 x 3-4	Fragrant white flowers in summer	Well Drained	Sun to Part Shade
Chinese Holly	*Ilex cornuta*	1,2,3	'Carissa' 'Rotunda'	3-4 x 4-5	Very tough. Glossy dark green foliage	Well Drained	Sun to Light Shade
Dwarf Yaupon Holly*	*Ilex vomitoria*	1,2,3	'Bordeaux' 'Schillings' 'Nana'	3-4 ft	Extremely tough. Small leaves, fine texture	Well Drained to Xeric	Sun to Part Shade
Winter Jasmine	*Jasminum nudiflorum*	1,2,3		3-4 ft	Yellow flowers in early spring	Well Drained	Sun to Part Shade
Chinese Juniper	*Juniperus chinensis*	2,3	'Old Gold' 'Gold Lace' 'Pfitzeriana'	2-3 x 4-5 3-4 x 5-6 3-5 x 5-10	Many varieties have golden foliage, others have bluish needles	Well Drained to Xeric	Sun
Dwarf Nandina	*Nandina domestica*	1,2,3	'Firepower' 'Moon Bay' 'Gulf Stream' 'Harbor Dwarf'	2-3 ft	All but 'Firepower' eventually produce red berries. Attractive foliage, red in winter	Well Drained	Sun to Part Shade
Dwarf Pittosporum	*Pittosporum tobira*	1,2,3	'Wheeler's Dwarf' 'Cream de Mint'	3-4 ft	Attractive foliage, 'Cream de Mint' is variegated	Well Drained to Xeric	Sun to Part Shade
Indian Hawthorne	*Rhaphiolepis indica*	1,2,3	'Olivia' 'Eleanor Taber' 'Indian Princess' 'Gulf Green'	2-4 ft	White or Pink flowers in May. These varieties have good resistance to leaf spot disease	Well Drained	Sun
Azaleas	*Rhododendron* hybrids	1,2	Satsuki Varieties 'Gumpo' Varieties	2-3 x 3-4	Later flowering than most Azaleas	Well Drained	Light to Part Shade
'Conoy' Viburnum	*Viburnum* x *utile* 'Conoy'	1,2		3-5 x 5-8	Fragrant white flowers in spring	Well Drained	Sun to Part Shade
Adam's Needle Yucca*	*Yucca filamentosa*	1,2,3	'Color Guard' 'Garland Gold' 'Bright Edge'	2-4 x 2-4	Interesting texture, all of these varieties have gold variegation	Well Drained to Xeric	Sun
Deciduous Shrubs							
Japanese Barberry	*Berberis thunbergii*	1,2,3	'Crimson Pygmy'	2-3 x 3-4	Crimson foliage throughout growing season	Well Drained	Sun to Light Shade
Sweet Pepperbush, Clethra*	*Clethra alnifolia*	1,2	'Hummingbird' 'Sixteen Candles'	2-3 x 4-6	Fragrant white flowers in mid-summer, yellow fall color	Moist to Well Drained	Sun to Part Shade
Dwarf Fothergilla*	*Fothergilla gardenii*	1,2		3-4 x 3-4	White flowers in spring, nice fall color	Moist to Well Drained	Sun to Part Shade
'Pia' Hydrangea	*Hydrangea macrophylla* 'Pia'	1,2		2-3 x 2-3	Pink or blue mophead flowers in summer	Well Drained	Sun to Part Shade
Virginia Sweetspire*	*Itea virginica*	1,2,3	'Little Henry	3-4 x 3-5	White flowers in spring, good autumn color	Moist to Well Drained	Sun/Shade
Japanese Spirea	*Spirea japonica* *Spirea x bumalda*	1,2,3	'Anthony Waterer' 'Goldflame' 'Shirobana' 'Gold Mound' 'Little Princess'	2-4 x 2-4	Pink flowers in summer. Some varieties have golden foliage	Well Drained	Sun to Light Shade
'Snowmound' Spirea	*Spirea nipponica* 'Snowmound'	1,2,3		3-5 x 4-5	White flowers in spring, bluish foliage in summer	Well Drained	Sun to Light Shade

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MEDIUM SHRUBS (4-8 feet)

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Common Name	Botanical Name	Water Use Zone	Recommended Varieties	Height x Spread (ft.)	Ornamental Characteristics	Soil	Exposure
Evergreen Shrubs							
Abelia	*Abelia x grandiflora*	1,2,3		4-8 x 4-6	Small white flowers in summer and fall, attracts butterflies	Well Drained	Sun to Part Shade
Japanese Aucuba	*Aucuba japonica*	1,2		5-8 x 4-6	Large, thick leaves. Some varieties spotted in gold	Well Drained	Part to Full Shade
Wintergreen Barberry	*Berberis julianae*	1,2,3		6-8 x 6-8	Yellow flowers in spring, leaves turn bronze to burgundy in winter	Well Drained	Sun
Bottlebrush	*Callistemon rigidus*	1,2,3	'Woodlander's Hardy'	5-6 x 5-6	Unusual red flowers in spring	Well Drained	Sun
Japanese Camellia	*Camellia japonica*	1,2	Many Available	6-12 x 4-8	Red, Pink, White or Rose flowers in winter and early spring	Well Drained	Light to Part Shade
Sasanqua Camellia	*Camellia sasanqua*	1,2	Many Available	6-10 x 4-8	Red, White, Pink or Rose flowers in fall and winter	Well Drained	Light to Part Shade
Dwarf Hinoki Cypress	*Chamaecyparis obtusa* 'Nana Gracilis'	1,2		4-6 x 3-4	Unusual foliage texture, often seen in Japanese Gardens	Well Drained	Sun to Part Shade
Mediterranean Fan Palm	*Chamaerops humilis*	1,2,3		5-6 x 5-6	Beautiful texture, very slow growing	Well Drained	Sun to Light Shade
King Sago Emporer Sago	*Cycas revoluta* *Cycas taitungensis*	1,2		4-8 x 6 4-6 x 10	Unique textural effect, both are slow growing palm like plants	Well Drained	Sun to Part Shade
Fatsia	*Fatsia japonica*	1,2		6-8 x 6-8	Large, glossy lobed leaves give a tropical effect	Well Drained	Part to Full Shade
Pineapple Guava	*Feijoa sellowiana*	1,2,3		6-10 x 5-8	Pink and crimson flowers in spring, gray foliage	Well Drained	Sun
Gardenia	*Gardenia jasminoides*	1,2	'Kleim's Hardy' 'Mystery' 'August Beauty'	4-8 x 4-8	Extremely fragrant white flowers in summer, glossy green leaves	Well Drained	Sun to Light Shade
Chinese Holly	*Ilex cornuta*,	1,2,3	'Dwarf Burford'	5-7 x 6-8	Glossy green leaves, red berries in fall and winter	Well Drained	Sun to Light Shade
Inkerry Holly*	*Ilex glabra*	1,2,3	'Shamrock'	5-8 x 5-8	Small, dark green leaves, similar to boxwood	Moist to Well Drained	Sun to Light Shade
Chinese Juniper	*Juniperus chinensis*	2,3	'Sea Green'	4-6 x 6-8	Fountain like, arching branches, mint green foliage	Well Drained to Xeric	Sun
Japanese Privet	*Ligustrum japonicum*	1,2,3	'Recurvifolium' 'East Bay' 'Lake Tresca'	5-6 x 4-6	Tough evergreen shrub, dark green glossy foliage	Well Drained	Sun to Light Shade
Loropetalum	*Loropetalum chinense*	1,2	'Ruby' 'Burgundy'	4-6 x 4-6 6-8 x 6-8	Hot pink fringy flowers in spring, burgundy foliage throughout the season	Well Drained	Sun to Light Shade
Leatherleaf Mahonia	*Mahonia bealei*	1,2,3		6-8 x 3-4	Upright shrub with coarse spiny leaves. Very shade tolerant	Well Drained	Part to Full Shade
Banana Shrub	*Michelia figo*	1,2,3		6-8 x 6-8	Glossy dark green leaves. Small cream colored, banana scented flowers in spring	Well Drained	Sun to Part Shade
Nandina, Heavenly Bamboo	*Nandina domestica*	1,2,3		5-8 x 3-4	Graceful foliage, large clusters of red berries in fall	Well Drained	Sun to Part Shade
Oleander	*Nerium oleander*	1,2,3	Several Available	6-10 x 4-8	Red, white, pink or salmon flowers in summer. All parts of this plant are poisonous	Well Drained to Xeric	Sun
Pittosporum	*Pittosporum tobira*	1,2,3	'Louisiana Compact' 'Variegata'	6-8 x 6-8	Small white fragrant flowers in spring	Well Drained to Xeric	Sun to Part Shade
Firethorn, Pyracantha	*Pyracantha coccinea* *Pyracantha koidzumii*	1,2,3	Many Available	6-10 x 4-8	Clusters of red or orange berries in fall and winter	Well Drained	Sun to Light Shade
Needle Palm	*Rhapidophyllum hystrix*	1,2,3		5-10 x 5-10	Slow growing, hardy palm	Well Drained	Sun to Part Shade
Azaleas - Southern Indica Varieties	*Rhododendron* hybrids	1,2	'Formosa' 'G.G.Gerbing' 'George Tabor'	6-8 x 6-8	Large growing, tough azaleas with white, magenta or pink flowers	Well Drained	Light to Part Shade

MEDIUM SHRUBS (4-8 feet)

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Common Name	Botanical Name	Water Use Zone	Recommended Varieties	Height x Spread (ft.)	Ornamental Characteristics	Soil	Exposure
Rosemary	*Rosmarinus officinalis*	2,3		3-6 x 3-6	Blue flowers in spring, culinary herb	Well Drained to Xeric	Sun
Dwarf Palmetto*	*Sabal minor*	1,2,3		4-6 x 4-6	Hardy, shrub like palm	Moist to Well Drained	Sun to Part Shade
Sandwanka Viburnum	*Viburnum suspensum*	1,2,3		4-8 x 4-8	Leathery, dark green foliage. White flowers in spring	Well Drained to Xeric	Sun
Tinus Viburnum, Laurustinus	*Viburnum tinus*	1,2	'Eve Price' 'Compactum' 'Spring Bouquet'	5-7 x 5-7	Dark green foliage, pink flower buds open to white in spring	Well Drained	Sun to Part Shade
Deciduous Shrubs							
'Brilliant' Chokeberry*	*Aronia arbutifolia 'Brilliantissima'*	1,2,3		6-8 x 6-8	White flowers in early spring, red berries persist all winter, excellent fall color	Moist to Well Drained	Sun to Light Shade
Butterfly Bush	*Buddleia davidii*	1,2,3	Many Available	4-8 x 4-6	White, Purple, Lavender, Rose, or yellow flowers in summer. Extremely fragrant, attracts lots of butterflies	Well Drained	Sun to Light Shade
American Beautyberry*	*Callicarpa americana*	1,2,3		4-6 x 4-6	Vibrant purple berries in fall, attracts songbirds	Moist to Well Drained	Sun to Part Shade
Sweetshrub, Carolina Allspice*	*Calycanthus floridus*	1,2,3	'Michael Lindsey'	6-8 x 6-8	Very fragrant maroon flowers in late spring	Moist to Well Drained	Sun to Part Shade
Sweet Pepperbush, Clethra*	*Clethra alnifolia*	1,2,3	'Ruby Spice' 'Chattanooga'	4-8 x 3-6	Extremely fragrant white or pink in summer. Yellow fall color	Moist to Well Drained	Sun to Part Shade
Dwarf Burning Bush	*Euonymous alatus* 'Compactus'	1,2,3		6-8 x 6-8	Excellent red fall color	Well Drained	Sun
Bigleaf Hydrangea	*Hydrangea macrophylla*	1,2	Many Varieties Avaliable	4-6 x 4-8	Large clusters of pink or blue flowers in summer. Flower color will vary depending on soil pH	Well Drained	Light to Part Shade
Oakleaf Hydrangea*	*Hydrangea quercifolia*	1,2	'Alice'	6-8 x 6-8	Large panicles of white flowers in summer, excellent fall color	Moist to Well Drained	Sun to Part Shade
Virginia Sweetspire, Itea*	*Itea virginiana*	1,2,3	'Henry's Garnet'	4-6 x 4-8	White flower s in spring. Excellent fall color	Moist to Well Drained	Sun to Part Shade
Japanese Kerria	*Kerria japonica*	1,2		4-6 x 4-6	Bright yellow flowers in springs, green stems in winter	Well Drained	Light to Full Shade
Double Reeves Spirea	*Spirea cantoniensis* 'Lanceata'	1,2,3		4-6 x 4-6	Abundant white flowers in early spring	Well Drained	Sun
Vanhoutte Spirea	*Spirea* x *vanhouttei*	1,2,3		6-8 x 8-10	Abundant white flowers in early spring	Well Drained	Sun
Possumhaw Viburnum*	*Viburnum nudum*	1,2	'Winterthur'	6-8 x 6-8	White flowers in spring followed by pink and blue berries in fall. Good fall color	Moist to Well Drained	Sun to Part Shade
'Mohawk' Viburnum	*Viburnum x burkwoodii* 'Mohawk'	1,2		6-8 x 6-8	Red buds open to pink blossoms, very fragrant	Well Drained	Sun to Part Shade
Weigela	*Weigela florida*	1,2	'Wine and Roses'	4-6 x 4-6	Cherry pink flowers in spring, purple foliage all season	Well Drained	Sun to Light Shade

Water Use Zones: 1 - High Water Use Zone, **2** - Medium Water Use Zone, **3** - Low Water Use Zone

LARGE SHRUBS (8 feet and up)

* = Indicates a plant native to the Southeastern USA
Underline = Indicates an extremely drought-tolerant plant
Colors = W-white, Y-yellow, O-orange, B-blue, Pu-purple, P-pink, R-red, L-lavender

Common Name	Botanical Name	Water Use Zone	Recommended Varieties	Height x Spread (ft)	Ornamental Characteristics	Soil	Exposure
Evergreen Shrubs							
Hedge Bamboo	*Bambusa multiplex*	1,2,3		15-20 x 6-10	Clump forming bamboo, interesting textural and vertical effect	Well Drained	Light to Part Shade
Pindo Palm, Jelly Palm	*Butia capitata*	1,2,3		10-15 x 10-15	Bluish palm with long arching leaves	Well Drained	Sun
Elaeagnus	*Elaeagnus pungens* *Elaeagnus x ebbingii*	2,3		10-15 x 10-15	Very tough, rapidly growing shrubs, tolerant of salt spray	Well Drained to Xeric	Sun to Part Shade
Chinese Holly	*Ilex cornuta*	1,2,3	'Burford' 'Fineline' 'Needlepoint'	8-15 x 6-12	Dark green glossy leaves, red berries in fall and winter	Well Drained	Sun to Light Shade
Yaupon Holly*	*Ilex vomitoria*	1,2,3		8-15 x 6-10	Translucent red or orange berries in fall and winter	Moist to Xeric	Sun to Part Shade
'Nellie Stevens' Holly	*Ilex* x 'Nellie R. Stevens'	1,2,3		15-25 x 10-15	Red Berries in Fall/Winter	Moist to Well Drained	Sun to Part Shade
Anise Tree*	*Illicium parviflorum*	1,2,3		8-12 x 6-10	Large, olive green leaves. Vigorous, evergreen shrub	Moist to Well Drained	Sun to Part Shade
Chinese Juniper	*Juniperus chinensis*	2,3	'Spartan' 'Hetzii Columnaris'	12-20 x 3-6	Upright, columnar shrubs with bright green needles	Well Drained to Xeric	Sun
Hollywood Juniper	*Juniperus chinensis* 'Kaizuka' also known as 'Torulosa'	2,3		15-25 x 8-15	Branches grow in upright twisting pattern, resulting in architectural, Japanese effect	Well Drained to Xeric	Sun
Loropetalum	*Loropetalum chinense*	1,2	'Zhuzhou Fuchsia'	10-15 x 8-12	Hot pink fringy flower in early spring, maroon-purple foliage in summer	Well Drained	Sun to Light Shade
Southern Waxmyrtle*	*Myrica cerifera*	1,2,3		8-15 x 8-15	Tough, fast growing shrub with olive green foliage	Moist to Xeric	Sun to Part Shade
Tea Olive, Osmanthus	*Osmanthus fragrans* *Osmanthus x fortunei*	1,2,3		10-15 x 10-15	Dark green foliage, exceptionally sweetly scented white flowers in fall	Well Drained	Sun to Part Shade
Chinese Podocarpus	*Podocarpus macrophyllus var. maki*	1,2		10-15 x 4-6	Dark green, narrow foliage, upright habit	Well Drained	Sun to Part Shade
'Majestic Beauty' Indian Hawthorn	*Rhaphiolepis umbellata* 'Majestic Beauty'	1,2,3		8-10 x 8-10	Clusters of pink flowers in early summer	Well Drained	Sun
Cleyera	*Ternstroemia gymnanthera*	1,2		8-12 x 5-6	Very dark green, shiny leaves, upright shrub	Well Drained	Sun to Full Shade
'Emerald' Arborvitae*	*Thuja occidentalis* 'Emerald'	1,2,3		10-15 x 3-4	Bright emerald green foliage held in vertical sprays, holds color in winter	Moist to Well Drained	Sun
'Chindo' Viburnum	*Viburnum awabuki* 'Chindo'	1,2,3		10-15 x 6-8	Dark green, glossy leaves, upright habit	Well Drained	Sun to Part Shade
Deciduous Shrubs							
Flowering Quince	*Chaenomeles speciosa*	1,2,3		6-10 x 6-10	Early spring flowers in shades of red, pink, orange and white. Dwarf varieties are available	Well Drained	Sun to Light Shade
Forsythia	*Forsythia x intermedia*	1,2,3		8-12 x 8-12	Bright yellow flowers in early spring	Well Drained	Sun to Light Shade
Rose of Sharon	*Hibiscus syriacus*	1,2,3	'Aphrodite', 'Diana', 'Helene', 'Minerva'	8-12 x 6-10	White, purple, or pink flowers in summer	Well Drained	Sun
Winterberry*	*Ilex decidua*	1,2	'Winter Red'	6-10 x 6-10	Branches covered in red berries in fall	Moist to Well Drained	Sun to Light Shade
Chinese Snowball Bush	*Viburnum macrocephalum*	1,2,3		12-15 x 10-15	Large, globe shaped clusters of white flowers in spring	Well Drained	Sun to Light Shade
Doublefile Viburnum	*Viburnum plicatum var. tomentosum*	1,2,3	'Shasta' 'Mariesii'	8-10 x 8-10	Horizontal branches covered with white flowers in spring	Well Drained	Sun to Part Shade

Water Use Zones: 1 - High Water Use Zone, **2** - Medium Water Use Zone, **3** - Low Water Use Zone

SMALL TREES (10-30 feet tall)

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Underline = Indicates an extremely drought-tolerant plant
Colors = W-white, Y-yellow, O-orange, B-blue, Pu-purple, P-pink, R-red, L-lavender

Common Name	Botanical Name	Water Use Zone	Recommended Varieties	Flowers/Fruit/ Fall Color	Height/ Spread (ft)	Growth Rate	Soil	Exposure
Evergreen Trees								
Loquat	*Eriobotrya japonica*	1,2,3		Fragrant W Flowers in Fall/Winter Edible Y Fruit in Spring	15-20/15-20	Medium	Well Drained	Sun to Light Shade
Lusterleaf Holly	*Ilex latifolia*	1,2,3		R Berries in Fall/ Winter	20-25/15-20	Medium	Well Drained	Sun to Part Shade
American Holly*	*Ilex opaca*	1,2,3		R Berries in Fall/ Winter	20-30/15-20	Slow	Moist to Well Drained	Sun to Part Shade
Yaupon*	*Ilex vomitoria*	1,2,3	'Hoskin's Shadow' 'Kathy Ann' "Katherine'	R,O,or Y Berries in Fall/Winter	15-20/10-15	Medium to Fast	Moist to Xeric	Sun to Light Shade
Topel Holly*	*Ilex x attenuata*	1,2,3	'Savannah', 'Fosters', 'Greenleaf'	R Berries in Fall/ Winter	20-30/10-15	Medium	Moist to Well Drained	Sun to Part Shade
'Nellie Stevens' Holly	*Ilex* x 'Nellie R. Stevens'	1,2,3		R Berries in Fall/ Winter	15-25/10-15	Medium	Moist to Well Drained	Sun to Part Shade
'Little Gem' Magnolia*	*Magnolia grandiflora* 'Little Gem'	1,2,3		Fragrant W Flowers in Summer	20-25/10-15	Slow to Medium	Moist to Well Drained	Sun to Part Shade
Sweet Bay*	*Magnolia virginiana*	1,2		Fragrant W Flowers in Spring	20-30/10-20	Medium to Fast	Moist to Well Drained	Sun to Part Shade
Waxmyrtle*	*Myrica cerifera*	1,2,3		Blue-Black Berries on Female Plants in Winter	10-20/10-20	Fast	Moist to Xeric	Sun to Light Shade
Carolina Cherrylaurel*	*Prunus caroliniana*	1,2,3		W Flowers in Spring	20-30/15-20	Fast	Well Drained to Xeric	Sun to Light Shade
Anise Tree*	*Illicium parviflorum*	1,2,3		Insignificant Flowers in Spring	10-15/10-15	Fast	Moist to Well Drained	Sun to Part Shade
Palmetto Palm*	*Sabal palmetto*	1,2,3		W Flowers in Summer	10-30/10-15	Slow	Moist to Well Drained	Sun to Part Shade
Deciduous Trees								
Southern Sugar Maple*	*Acer barbatum*	1,2,3		Y,O Fall Color	20-25/15-20	Medium	Moist to Well Drained	Sun to Light Shade
Trident Maple	*Acer buergerianum*	1,2,3		Y,O,R Fall Color	20-25/10-15	Medium	Well Drained	Sun
Japanese Maple	*Acer palmatum*	1,2	Many Available	R Fall Color	15-25/10-20	Slow	Well Drained	Sun to Part Shade
Red Buckeye*	*Aesculus pavia*	1,2		R flowers in Spring	10-20/10-15	Slow	Moist to Well Drained	Sun to Part Shade
Serviceberry*	*Amelanchier arborea*	1,2	'Autumn Brilliance'	W flowers in Spring, R fruit in Summer, Y,O Fall Color	20-25/10-15	Medium	Moist to Well Drained	Sun to Part Shade
Pawpaw*	*Asimina triloba*	1,2		Edible Fruit in Fall	15-20/10-15	Medium	Moist to Well Drained	Sun to Part Shade
Ironwood*	*Carpinus caroliniana*	1,2		Interesting Bark	20-30/15-25	Slow	Wet to Well Drained	Sun to Part Shade
Redbud*	*Cercis canadensis*	1,2,3	'Forest Pansy' 'Royal White' 'Oklahoma'	P or W Flowers in Spring	20-30/20-25	Medium	Moist to Well Drained	Sun to Part Shade

Water Use Zones: 1 - High Water Use Zone, **2** - Medium Water Use Zone, **3** - Low Water Use Zone

SMALL TREES (10-30 feet tall)

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Colors = W-white, Y-yellow, O-orange, B-blue, Pu-purple, P-pink, R-red, L-lavender

Common Name	Botanical Name	Water Use Zone	Recommended Varieties	Flowers/Fruit/ Fall Color	Height/ Spread (ft)	Growth Rate	Soil	Exposure
Chinese Fringetree	*Chionanthus retusus*	1,2,3		W Flowers in Spring	15-25/15-25	Slow	Well Drained	Sun to Part Shade
Fringe Tree*	*Chionanthus virginicus*	1,2		W Flowers in Spring	10-20/15-20	Slow to Medium	Moist to Well Drained	Sun to Part Shade
Flowering Dogwood*	*Cornus florida*	1,2	'Cloud 9' 'Cherokee Princess'	W Flowers in Spring, Red Berries in Fall, Burgundy Autumn Color	15-25/10-20	Slow to Medium	Moist to Well Drained	Sun to Part Shade
Kousa Dogwood	*Cornus kousa*	1,2		W Flowers in Spring	20-30/20-30	Slow to Medium	Well Drained	Sun to Light Shade
Washington Hawthorn*	*Crataegus phaenopyrum*	1,2,3		W Flowers in Spring, R Fruit in Fall, Thorny	25-30/20-25	Medium	Moist to Well Drained	Sun to Light Shade
Carolina Silverbell*	*Halesia tetraptera*	1,2,3		W Flowers in Spring	20-30/15-20	Medium	Moist to Well Drained	Sun to Part Shade
Possumhaw*	*Ilex decidua*	1,2,3	'Warren's Red' 'Council Fire'	R berries in Fall and Winter	15-20/10-15	Medium	Moist to Well Drained	Sun to Light Shade
Crape Myrtle	*Lagerstroemia* hybrids	1,2,3	'Osage' 'Sioux' 'Natchez' 'Tuskegee' 'Biloxi' 'Miami' 'Lipan'	W, P, L, Pu, or R Flowers in Summer depending on Variety.	15-30/10-25 Depending on Variety	Fast	Well Drained	Sun
Star Magnolia	*Magnolia stellata*	1,2,3		W or P Flowers in Spring	15-20/10-15	Slow	Well Drained	Sun to Light Shade
Saucer Magnolia	*Magnolia x soulangiana*	1,2,3		P to L Flowers in Spring	20-30/15-25	Medium	Well Drained	Sun to Light Shade
Sourwood*	*Oxydendrum arboreum*	1,2,3		W Flowers in Summer, R Fall Color	25-30/15-20	Slow	Well Drained	Sun to Part Shade
'Okame' Cherry 'Dreamcatcher' Cherry	*Prunus campanulata* hybrids	1,2,3		P Flowers in Spring	20-30/15-20	Medium	Well Drained	Sun to Light Shade
Japanese Flowering Apricot	*Prunus mume*	1,2		P,R, or W Flowers in Winter	15-25/15-25	Medium	Well Drained	Sun to Light Shade
Japanese Flowering Cherry	*Prunus serrulata*	1,2	'Kwanzan'	P Flowers in Spring	20-30/20-30	Medium	Well Drained	Sun to Light Shade
Higan Cherry	*Prunus subhirtella*	1,2	'Autumnalis'	P Flowers in Spring and Fall	20-30/15-25	Medium	Well Drained	Sun to Light Shade
Yoshino Cherry	*Prunus x yedoensis*	1,2		Light P Flowers in Spring	15-25/15-25	Medium	Well Drained	Sun to Light Shade
Japanese Snowbell	*Styrax japonicus*	1,2	'Emerald Pagoda' 'Pink Chimes'	W or P Flowers in Spring	20-30/20-30	Medium	Well Drained	Sun to Part Shade
Blackhaw Viburnum*	*Viburnum prunifolium*	1,2		W Flowers in Spring, Edible Black Fruit in Fall	10-20/10-15	Medium	Moist to Well Drained	Sun to Part Shade
Chastetree	*Vitex agnus-castus*	1,2,3		Pu,P, or L Flowers in Summer	15-20/10-15	Medium	Well Drained	Sun

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LARGE TREES (30 feet and up)

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Common Name	Botanical Name	Water Use Zone	Recommended Varieties	Ornamental Features	Height/ Spread (ft)	Growth Rate	Soil	Exposure
Evergreen Trees								
Deodar Cedar	*Cedrus deodora*	1,2,3		Grayish to Bluish Needles, Interesting Texture and Form	50-70/50-70	Medium	Well Drained	Sun
Atlantic White Cedar*	*Chamaecyparis thyoides*	1,2,3		Evergreen Needles	40-60/10-20	Medium	Moist to Well Drained	Sun
Japanese Cedar	*Cryptomeria japonica*	1,2,3	'Yoshino' 'Radicans'	Interesting Texture	40-60/20-30	Medium	Moist to Well Drained	Sun
Eastern Red Cedar*	*Juniperus virginiana*	2,3		Extremely Tough	30-50/10-20	Medium	Well Drained to Xeric	Sun
Southern Magnolia*	*Magnolia grandiflora*	1,2	'Alta', 'Hasse', 'D.D. Blanchard', 'Claudia Wannamaker'	Large, Fragrant W Flowers in Summer	60-80/30-50	Slow to Medium	Well Drained	Sun to Part Shade
Longleaf Pine*	*Pinus palustris*	1,2,3		Long Needles, Large Pinecones	50-60/15-20	Medium	Well Drained	Sun
Loblolly Pine*	*Pinus taeda*	1,2,3		Fast Growth	60-90/20-30	Fast	Moist to Well Drained	Sun
Laurel Oak*	*Quercus hemisphaerica*	1,2,3	'Darlington'	Small Leaves, Fine Texture	40-60/30-40	Medium	Well Drained	Sun
Live Oak*	*Quercus virginiana*	1,2,3		Wide Spreading, Drooping Branches	60-80/60-80	Medium	Well Drained to Xeric	Sun
Deciduous Trees								
Red Maple*	*Acer rubrum*	1,2	'October Glory' 'Red Sunset'	O to R Fall Color	40-50/25-35	Medium	Moist to Well Drained	Sun to Light Shade
River Birch*	*Betula nigra*	1,2,3	'Heritage' 'Dura-heat'	White Bark	40-70/40-60	Fast	Moist to Well Drained	Sun
Sugarberry*	*Celtis laevigata*	1,2,3		Smooth Gray Bark	60-80/50-70	Medium to Fast	Moist to Well Drained	Sun
American Beech*	*Fagus grandifolia*	1,2,3		Smooth Gray Bark, Tan Leaves in Winter	50-70/40-60	Slow	Well Drained	Sun
Green Ash*	*Fraxinus pennsylvanica*	1,2,3		Y Fall Color	50-60/40-50	Fast	Moist to Well Drained	Sun
Ginkgo, Maidenhair Tree	*Ginkgo biloba*	1,2,3	'Autumn Gold'	Y Fall Color	50-70/30-40	Slow	Well Drained	Sun
Japanese Crape Myrtle	*Lagerstroemia fauriei*	1,2,3	'Fantasy' 'Townhouse'	Dramatic Cinnamon Bark, Small W Flowers in Summer	30-40/25-35	Medium	Well Drained	Sun
Dawn Redwood	*Metasequoia glyptostroboides*	1,2		Ferny Foliage, Rusty Fall Color	60-100/20-25	Fast	Moist to Well Drained	Sun
Black Gum*	*Nyssa sylvatica*	1,2,3		R Fall Color	30-50/20-30	Slow to Medium	Moist to Well Drained	Sun
Water Oak*	*Quercus nigra*	1,2,3		Very Tough	50-80/30-60	Medium to Fast	Moist to Well Drained	Sun
Nutall Oak*	*Quercus nutallii*	1,2,3		R Fall Color	40-60/30-50	Medium	Moist to Well Drained	Sun
Willow Oak*	*Quercus phellos*	1,2,3		Dark Green Foliage, Fine Texture	80-100/40-50	Medium	Moist to Well Drained	Sun
Pond Cypress*	*Taxodium ascendens*	1,2,3		Unusual Texture	60-80/15-20	Medium	Moist to Well Drained	Sun
Bald Cypress*	*Taxodium distichum*	1,2,3		Lacey Foliage	50-70/20-30	Medium	Wet to Well Drained	Sun
Lacebark Elm	*Ulmus parvifolia*	1,2,3	'Bosque', 'Allee', 'Athena'	Bark Flakes in Patterns Exposing White, Brown, Green	40-50/30-40	Fast	Well Drained	Sun

What is a Watershed? River Basin?

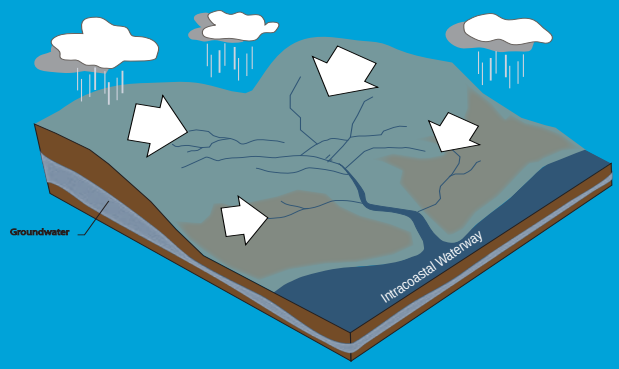


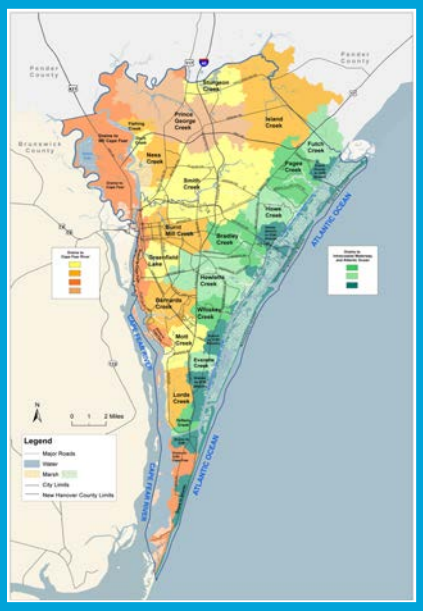
Diagram of a watershed

A watershed is an area of land that drains to a specific waterbody such as a creek, river, or ocean.

Everyone lives in a watershed, even if you don't live near water!

North Carolina River Basins

Wilmington area watersheds are part of the larger **Cape Fear River Basin AND the White Oak River Basin**. Wilmington's watersheds are smaller watersheds that lie *within* these larger river basins.



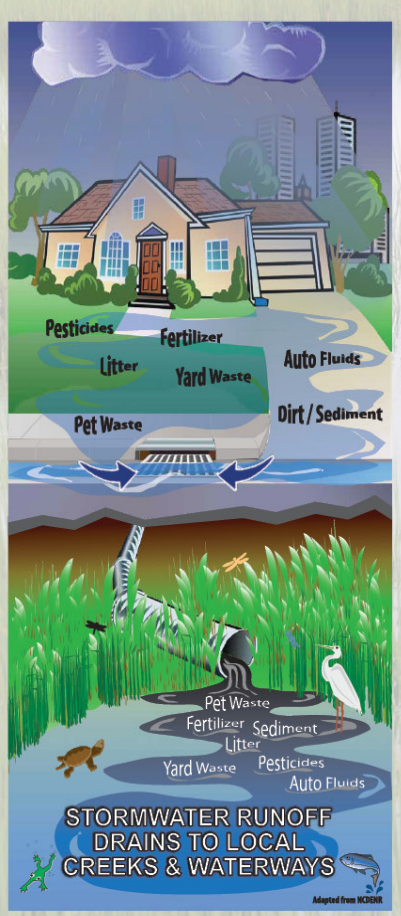
Wilmington Area Watersheds

Wilmington area watersheds drain polluted runoff into creeks, such as Hewletts Creek and Burnt Mill Creek, which eventually flow into the **Cape Fear River** or **Intracoastal Waterway**. Unfortunately, runoff picks up pollution like pet waste, litter, fertilizer, motor oil, and yard waste and carries it straight to our waterways - **untreated**.

Please do your part to protect our waterways...prevent stormwater pollution!

Watershed signs along Wilmington roadways help identify which watershed you're currently in.

Stormwater is Not treated!



Polluted stormwater runoff flows directly into where we fish, where we swim, and what we drink!

Stormwater is a DIRTY word!

What goes in here ...

Stormwater runoff is rainwater that flows over land and ultimately into waterways. Hard surfaces like driveways, roofs, streets, and parking lots prevent stormwater from naturally soaking into the ground.

... ends up here!

Pollution like pet waste, fertilizers, pesticides, grass clippings, litter and motor oil are carried by stormwater runoff into local waterways — ***untreated!***

Polluted stormwater runoff is the biggest source of water pollution, but you can make a difference!

Connect the drops...YOU are the solution to stormwater pollution!

Stormwater Pollution SIMPLE SOLUTIONS

Stormwater pollution is caused by human activities that occur on land and wash into our waterways when it rains. Polluted runoff harms fish, plants, wildlife, and humans. Fortunately, we can adopt simple solutions that will protect our waterways, our health, and our environment.

Pet Waste contains bacteria that can make humans sick and close waterways to swimming, fishing, and shellfishing, as well as nutrients that cause algae blooms.

- Always clean up after your pet on any public property, have the means to do so at all times, and dispose of pet waste in a closed trash can. It's the LAW! *($250 fine)*
- Don't forget to clean up pet waste in your own yard to prevent bacteria and nutrients from harming waterways and public health
- Use a covered litterbox for outdoor cats
- Don't flush pet waste down the toilet *(CFPUA Ordinance)*

Vehicle & pressure washing soaps destroy the natural oils on fish that protect them from harmful bacteria and help them move through water. Soaps and chemicals cause harmful algae to grow, which uses up oxygen that fish need to survive.

- Wash your car on the grass - the soapy, dirty water will be cleaned naturally by the soil. It won't harm the grass!
- Use a commercial car wash - dirty water goes to a wastewater treatment plant or is recycled on-site
- If you wash vehicles or boats or pressure wash on pavement, use plain water

Vehicle/boat fluids are toxic in water and harm fish, wildlife, and waterways.

- Recycle vehicle batteries, motor oil, and other fluids at an auto parts store or a suitable collection facility
- Keep vehicles and boats maintained
- Clean up any leaks or spills immediately

Sediment also known as "dirt", creates muddy water, buries fish eggs, and harms aquatic life.

- Re-seed or add mulch to bare soil or landscape beds
- Install plants to hold down soil and prevent erosion
- Collect sediment off of paved surfaces; don't hose off
- Report construction site violations: *1.800.STOP.MUD*

Fertilizers contain nutrients that cause algae to grow in water, which uses up oxygen and kills fish and aquatic life. Nutrients cause "dead zones" in waterbodies.

- Grasscycle! Leave grass clippings on the lawn - they conserve soil moisture and are a natural fertilizer
- Save money! Learn the exact nutrients your lawn needs by getting a free soil test from NHC Cooperative Extension, 798-7679, Oleander Drive
- Keep fertilizer off pavement; don't fertilize before rain

Pesticides are toxic chemicals that kill bugs, weeds, or fungus. However, pesticides are very harmful to humans, animals, and beneficial insects.

- Install native plants; they are adapted to the area and naturally resist pests and diseases
- Use natural methods to control pests or weeds (i.e., weed by hand, add mulch, use ladybugs, plant marigolds, etc.)
- Use pesticides as a last resort; never before it rains

Yard waste *(pinestraw, leaves, and grass clippings)* clogs storm drains, causes flooding, and pollutes our waterways with too many nutrients.

- Don't blow or leave yard waste in a street, storm drain, ditch, or waterway. It's the LAW! *($250 fine)*
- Grasscycle! Leave grass clippings on the lawn to conserve moisture and act as a natural fertilizer
- Compost yard waste; use in the landscape and garden
- Contain waste for City Yard Waste Collection Service

Litter is ugly and clogs storm drains. Wildlife mistake litter for food and eat it or become entangled in it. Cigarette butts are litter too!

- Place litter, gum, and cigarette butts in the trash
- Reduce, reuse, recycle, and refuse

Household hazardous waste (HHW) such as paint, cleaners, and electronics have toxins and heavy metals that shouldn't end up in our waterways.

- Contact county government or visit *Earth911.com* for dates/locations of collection events and HHW facilities.

Things You Can Do in Your Own Backyard

The following best management practices (BMPs) can be used on your property to clean and slow down polluted runoff and allow it to soak into the ground, as nature intended.

RAIN BARRELS & CISTERNS

are designed to capture and store rainwater from your roof to irrigate your yard, garden and house plants. Several rain barrels can be connected together to store additional water. A tight lid and screen will prevent mosquitoes from breeding. Cisterns store larger amounts of water and can be buried underground.

RAIN GARDENS

are shallow depressions designed to capture runoff and allow it to soak into the ground. Rain gardens are placed between sources of runoff *(i.e. roofs, driveways)* and runoff destinations *(i.e. storm drain, street, creek)*. They are planted with native trees, shrubs, and perennials which clean runoff, provide habitat, and beautify your yard.

Photo courtesy Maplewood, MN

NATIVE PLANTS

are adapted to the region's weather and soil conditions. Native plants provide nectar, pollen, berries and seeds for birds and wildlife. These plants help filter runoff, prevent erosion, reduce flooding, provide habitat and beautify your yard. Native plants eliminate the need for toxic pesticides, fertilizers, and excess watering.

TREES

soak up and clean polluted runoff, improve air quality, provide food for wildlife, prevent erosion, increase property values, and help cool the climate. They save money by reducing heating and cooling costs in homes and buildings. Trees are also important for shading pavement to help cool runoff before it flows into waterways.

HABITAT GARDENS

have plants that attract birds, butterflies, beneficial insects, and wildlife. Habitat gardens should have sunlight, shelter, food sources, and water. Habitat gardens are especially important for wildlife in urban areas where natural resources tend to be more limited. Plants in a habitat garden soak up polluted stormwater.

PERVIOUS SURFACES

also called porous or permeable surfaces, allow runoff to soak into the ground instead of running into waterways. Pervious surfaces reduce runoff, recharge groundwater, and lessen flooding. They can be used for driveways, walkways and low flow parking areas.

BACKYARD WETLANDS

should be located in a naturally-occurring wet area on your property. Wetlands temporarily store, filter, and clean polluted runoff, replenish groundwater, provide wildlife habitat, and help prevent flooding. They should have plants that thrive in wet conditions and attract insects and wildlife that prey on mosquitoes and other pesky insects.

BUFFERS

are areas of native trees, shrubs, and grasses located next to a waterway. Buffers act as filters to clean polluted runoff before it reaches a waterway. They also stabilize shorelines, prevent erosion, and provide habitat and travel corridors for wildlife. Buffers can also provide privacy and increased property values for homeowners.

RE-ROUTE YOUR DOWNSPOUT

Downspouts on homes and buildings often drain rainwater directly onto pavement. This allows polluted runoff to flow straight to our waterways.

There is a solution! You can help our creeks out if you **re-route your downspout** and let water soak in, instead of running off! It's simple, here's what to do:

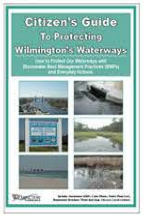
Redirect downspouts away from pavement to landscaped areas like lawns, flower beds, and rain gardens.

If a downspout can't be turned, attach a flexible gutter extension or a splash block underneath which can re-route rainwater to a landscaped area.

Redirect downspouts into rain barrels and collect free rainwater for your landscape, garden, and house plants.

Get the Free Guide!

The Citizen's Guide to Protecting Wilmington's Waterways



Learn how to install these BMPs in your own yard. The guide contains photos and native plant lists too!

To download, visit www.wilmingtonnc.gov/stormwater and click on "Publications & Videos".

More Information?

City of Wilmington Stormwater Services

wilmingtonnc.gov/stormwater
910.343.4777

Report Stormwater Pollution

CALL 910.341.1020 **(Hotline)**
CLICK wilmingtonnc.gov/reportstormwaterpollution

GLOSSARY

Algal bloom - Algae that occurs in waterways and can be hazardous to humans and aquatic life. Typically caused by excess nutrients like phosphorous and nitrogen found in fertilizers.

Annual Plant - A plant that completes its entire life cycle in a single growing season.

Best Management Practice (BMP) - Any action or on-the-ground landscaping practice that reduces stormwater pollution and/or the amount of stormwater flowing into local waterways. Examples: picking up after your pet or a rain garden.

Buffer - An area of trees, shrubs, and plants along a waterway that's designed to protect it from sediment and other pollutants contained in stormwater runoff. Buffers also function as excellent habitat for migratory birds and aquatic and terrestrial wildlife.

Check Dam - A small barrier built across the direction of water flow in a swale to retain excess water during heavy rains and to slow the speed of runoff traveling through the swale.

Deciduous plant - A plant that sheds or loses its foliage at the end of each growing season.

Evergreen plant - A plant that remains green and retains its foliage throughout the year.

Groundwater - Water below the earth's surface, often between saturated soil and rock, that supplies drinking wells and springs. In areas where there is no impervious surface, runoff can soak into the ground and recharge groundwater supplies.

Habitat - The specific area or environment where a plant or animal lives. A habitat must provide all of the basic requirements for life (food, water, shelter) and should be free of harmful contaminants and pollution.

Impervious surface - Any surface that water cannot penetrate into (i.e. parking lots, streets, sidewalks, rooftops).

Native plant - A plant that is adapted to the weather, temperature and soil conditions of a region and tend to be disease and drought-tolerant. Once established, native plants generally do not require fertilizers, pesticides, or irrigation.

Non point source pollution (NPS) - Pollution from many different sources that is carried by stormwater runoff into local waterways. Typical NPS pollutants are pet waste, lawn fertilizer, pesticides, car washing soap, litter and sediment.

NPDES - National Pollutant Discharge Elimination System Phase II Stormwater Program is an effort to preserve, protect and improve the nation's water resources from polluted runoff. The program requires municipalities with storm sewer systems serving urban areas (population under 100,000) that discharge runoff directly into surface waters to obtain a federal stormwater permit.

Perennial plant - A plant that grows and persists for more than one year. Perennial plants persist as vegetation from year to year or re-sprout from their rootstock annually.

Pervious materials - Pervious materials allow water to soak into the surface by virtue of their porous nature or by "void" spaces in the material. Examples include undeveloped land, pervious or porous concrete, eco-stone, or grid pavers.

Point source pollution - Water pollution entering the environment from a single point (i.e. industrial factory pipe).

Pollution - Any substance that exists in the environment that is undesirable or harmful for that environment.

Sediment - Soil or dirt that washes off the land and into a waterway. Bacteria & nutrients can be attached to sediment. Sediment often comes from construction sites, eroding streambanks, or bare lawns. Sediment is North Carolina's #1 pollutant.

Sanitary sewer system - The system that collects and transports wastewater from building plumbing systems and sends it to a wastewater treatment plant for treatment (i.e. wastewater from toilets, showers, sinks, water fountains, etc).

Storm sewer (drainage) system - The drainage system that collects and transports stormwater runoff from streets and property. Consists of natural and man-made features such as storm drains, drainage ditches, pipes, culverts, retention ponds, swales, wetlands, and creeks. Anything that flows into the storm drainage system flows directly into local waterways -untreated!

Stormwater runoff - Rainwater or irrigation water that does not soak into the ground. Runoff flows off impervious (hard) surfaces such as streets, roads, and parking lots and carries pollutants directly into waterways.

Watershed - The area of land that drains to a particular waterway such as a stream, river, or ocean. Example: if you live in the Hewletts Creek Watershed, runoff from your property will drain into Hewletts Creek, and then into the Intracoastal Waterway.

LOCAL RESOURCES

For more information about stormwater, Best Management Practices (BMPs), or to get involved in water quality protection efforts in the Wilmington area, contact the following organizations:

City of Wilmington NC
Stormwater Services Outreach/Education & Heal Our Waterways Program
910-343-4777
www.wilmingtonnc.gov/stormwater
www.healourwaterways.org

Visit the Stormwater Demonstration Site featuring BMPs
Located in Anne McCrary Park off Randall Parkway in Wilmington, North Carolina *(look for the two gazebos)*

New Hanover Soil & Water Conservation District
910-798-7130
http://soilwater.nhcgov.com

North Carolina Coastal Federation
910-509-2838
https://www.nccoast.org

Cape Fear River Watch, Inc.
910-762-5606
http://www.cfrw.us/

Airlie Gardens Environmental Education
910-798-7564
http://airliegardens.org/education/

New Hanover County Cooperative Extension, Arboretum & Plant Clinic/Hotline
910 798-7660
http://newhanover.ces.ncsu.edu
Master Gardener- Plant Information Clinic & Hotline
910 798-7680, 6206 Oleander Drive, Wilmington, NC