Coastal Riparian Buffer Guidance Manual

A Companion to the Model Coastal Buffer Ordinance

Prepared by:

UGA River Basin Center

Prepared for:

Georgia Department of Natural Resources
Environmental Protection Division
Coastal Nonpoint Source Management Program

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The Guidance Manual at a Glance:

How can I most effectively protect riparian buffers on my property?

Managing Vegetation:

- Never plant grass or turf in the buffer zone and never mow in the buffer zone. Instead, let the buffer zone develop naturally.
- Plant appropriate native vegetation in the buffer zone. See Appendix A for a list of native species for the riparian areas of coastal Georgia.
- Replace vegetation that is destroyed as a result of authorized land disturbance activities in the buffer with native trees and shrubs. The area of vegetation replacement or enhancement must be equal to the area of encroachment
- Use pesticides and fertilizers sparingly on your property and not at all in the buffer.
- Selective pruning may be used to create keyhole view corridors. Pruning should occur at the maximum height that still allows for the view. Types of selective limb removal permitted include "windowing," "interlimbing," and "skirting up."

Paving in the Buffer:

- Use pervious paving materials. A pervious paving material is one with high enough porosity and permeability to allow rainwater to pass through it, thereby reducing the runoff from a site and surrounding areas. Check with your jurisdiction to determine if paving in the buffer is allowed or if a buffer encroachment permit or variance must be obtained before conducing paving activities in the buffer.
- Access paths to water dependent uses constructed in the buffer should take a direct route perpendicular to the marsh line, while avoiding impacts to the natural vegetation of the buffer.

Constructing Decks, Boardwalks, and other Accessory Uses in the Buffer:

- Check with your jurisdiction to determine if accessory uses may be constructed in the buffer, or if a buffer encroachment permit or variance must be obtained before conducing such activities in the buffer.
- Minimize the extent to which the structure encroaches into the buffer. The total surface area of any part of the structure that is located within the buffer may not exceed 100 square feet.
- Any vegetation that is destroyed as a result of the structure's encroachment into the buffer must be replaced and/or enhanced with native trees and shrubs.
- To minimize land disturbance, a deck should be cantilevered or attached to the building on one or more sides whenever possible.
- Structures must be designed so that stormwater runoff from the structure falls directly on surrounding, adjacent stable vegetation and not upon unstable, bare earth.

Protecting Water Quality:

- Keep septic systems in good working order to prevent contamination of the marsh and tidal creeks.
- Use appropriate best management practices in adjacent upland areas to prevent and minimize the amount of stormwater pollution that enters the marsh.

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I. Introduction

The coast is one of the fastest growing regions of the State of Georgia, second only to metropolitan Atlanta (Center for Quality Growth and Regional Development 2006). Development of coastal areas has also become a trend across America. According to the National Oceanic and Atmospheric Administration (NOAA), 50 percent of America's population now lives within 50 miles of the coast. This has created many pressures on the unique coastal environment. Development increases the amount of pollution entering the coastal waterways, including fragile marshlands. One of the ways this problem is currently being addressed is through the implementation of coastal riparian buffers.

Buffers are naturally vegetated areas that are located adjacent to waterways and marshlands. Riparian buffers serve as the protective zone between upland development and the salt marsh and open water beyond. Buffers reduce erosion and capture pollutants such as nitrogen, phosphorous, pesticides, fertilizers, and sediments before they reach the water or marsh. Buffers also serve as wildlife habitat corridors and increase the aesthetic appearance of the marsh. All of these functions ultimately help to protect the adjacent marsh from the effects of development. For more information on coastal buffer functions, see the companion document entitled *Protecting Riparian Buffers in Coastal Georgia: Management Options.*

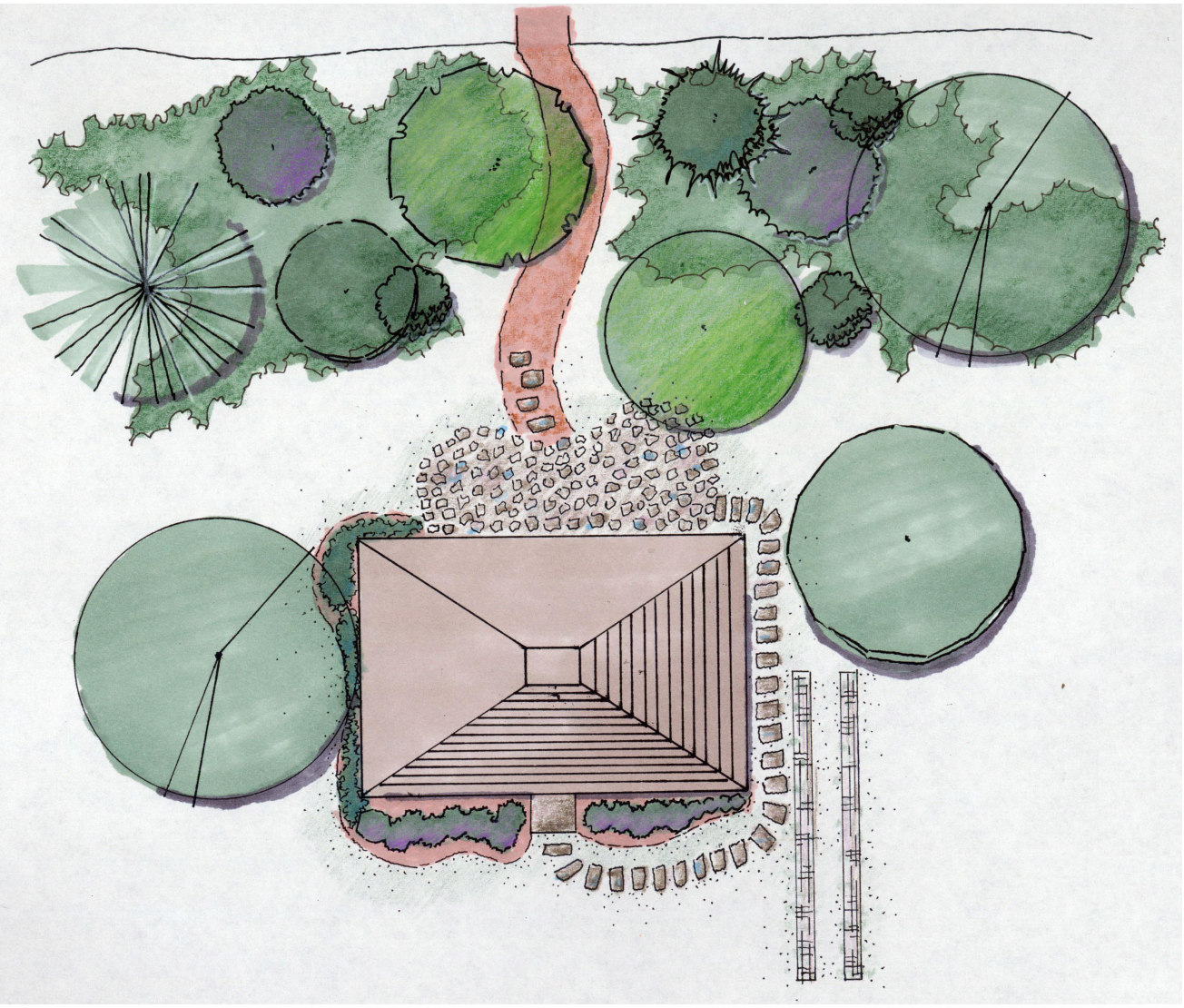
Intact buffer. *Photo by Sandra Glaze.*

Both the State of Georgia and many of Georgia's local governments have developed regulations to help protect riparian buffers. In 1975, the Georgia legislature passed the Georgia Erosion and Sedimentation Control Act. The purpose of the Act is to protect our waters and marshes from the effects of soil erosion. One of the ways the Act aims to accomplish this goal is by establishing a statewide, 25-foot buffer along all creeks, streams, rivers, saltwater marsh, and most lakes and ponds. Inside the buffer, no land disturbance activities or trimming/removal of vegetation may occur.

Cleared buffer. *Photo by Sandra Glaze.*

Under the Georgia Erosion and Sedimentation Control Act, local governments are allowed to adopt their own buffer regulations, as long as they are not less stringent than the State buffer regulations. Many localities have adopted their

own buffer ordinances in order to provide for wider buffers in their communities or to provide for buffers that perform a wider variety of functions than does the statewide buffer. This Coastal Riparian Buffer Guidebook is a companion to the Model Coastal Buffer Ordinance, which was developed for Georgia's coastal communities. Therefore, the prohibitions and requirements listed and described in this guidebook correlate with those found in the Model Coastal Buffer Ordinance. The purpose of this guidebook is to establish best management practices for building in and around the buffer and provide information to landowners about how to best preserve or enhance the ecological functions of the buffer. Please refer to the locality's ordinances to determine the specific activities permitted in the buffer in the jurisdiction.



A functioning coastal riparian buffer on a residential lot. Landscaping near the house captures rainwater runoff from the roof. Large shade trees provide a cooling effect. The buffer contains trees, shrubs, and groundcover to stabilize the bank, manage and treat stormwater, and provide habitat. The access path is oriented around significant vegetation. Illustration by Katherine Rowe.

II. Vegetation in the Buffer

In its undisturbed, natural state, the buffer consists of native vegetation that occurs naturally in areas adjacent to the coastal marsh. In such vegetated buffers in Georgia's coastal areas, there are typically an overstory of canopy trees, an understory of shrubs, and a ground layer of grasses and herbs. This native vegetation stabilizes the bank and prevents erosion, traps sediment and other pollutants found in surface runoff, and provides habitat and foraging areas for wildlife. It also protects the marshlands' scenic value and maintains the character of the coastal region.

Intact buffer. *Photo by Sandra Glaze.*

A. Non-Disturbance of the Buffer's Vegetation

The presence of intact vegetation in the buffer is essential to the buffer's functioning. In buffer areas in which natural, native vegetation exists, it should be left undisturbed, and the buffer should not be converted to a lawn or other landscaped condition.

B. Vegetation Replacement

In non-vegetated areas of the buffer that were previously disturbed, such as areas in which lawns or other types of non-native vegetation already exist, landowners are encouraged to remove these surfaces or exotic species and replace them with native vegetation. Such removal and replacement is a management technique that can enhance wildlife habitat and other buffer functions. If such removal and replacement is not feasible, landowners should allow the buffer area to passively return to a natural state by leaving the area un-mowed and generally not disturbing the buffer's vegetation.

Vegetation that is destroyed as a result of authorized land disturbance activities in the buffer must be replaced with native trees and shrubs either inside the buffer or directly adjacent to the buffer, whichever is preferable based upon the site characteristics. The area of vegetation replacement must be equal to the area of encroachment. To determine the density and composition of the replacement vegetation, landowners should refer to the characteristics of the nearest undisturbed buffer area. It may be possible to hold and transplant some of the species that are uprooted from the disturbed area of the buffer to another spot within the buffer or to an upland area outside of the buffer. For a list of native vegetation for coastal Georgia, see Appendix A. Appendix B contains a list of identified invasive exotics for coastal Georgia.

The size, at maturity, of selected plants should be considered when planting native vegetation. Generally, groundcovers should be planted 1-3 feet apart, shrubs 3-5 feet apart, small trees (up to 25 feet at maturity) 15 feet apart, and large trees 25 feet apart (Georgia Department of Community Affairs). However, if available, species-specific requirements for planting should be followed. The Georgia Cooperative Extension Service agent for the community may have additional information. Please visit *www.caes.uga.edu/extension.*

C. Use of Fertilizers, Irrigation, and Herbicides

Use of herbicides in the buffer is prohibited by the Model Coastal Buffer Ordinance. Please check with the local government to determine if it has adopted this prohibition.

A soil test can determine how much nitrogen, phosphorus, potassium, and lime the soil needs for healthy plant growth (U.S. EPA 2006). Healthy soils, however, will not require the addition of fertilizer (U.S. EPA 2006). Improper use of fertilizers can damage healthy soils and plants and contaminate surface water and groundwater. Under the Model Coastal Buffer Ordinance, fertilizers may be used in the buffer only during establishment when planting or replanting native vegetation. The U.S. Environmental Protection Agency recommends looking for fertilizers that contain "organic ingredients" or that are "slow release," in order to reduce leaching of chemicals and run off of nutrients (U.S. EPA 2006). Compost, peat, and manure treatments are other alternatives.

Vegetation may be irrigated initially after planting. Beyond establishment, native plants do not require fertilization or additional irrigation to grow when matched appropriately to site conditions (Georgia Native Plants Society).

D. Selective Tree Removal

If they do not threaten structures or driveways, trees or snags that are dead or damaged should be left in place, as they serve as perches and nesting and roosting sites for birds and as a source of insects for birds to feed upon. If the damaged or diseased tree is in close proximity to a dwelling, or where it poses danger to life and/or property, selective tree removal in the buffer is permitted. If applicable, the local tree ordinance must be followed in identifying trees necessitating removal. This may require the oversight of an arborist or other certified official. Tree stumps and roots of felled trees, and the felled tree itself, should be left in place in order to prevent erosion and provide for regeneration of the soil when decomposition occurs. The felled tree may be removed only if necessary to make space for an access path or other structure that the landowner is permitted to place within the buffer, and its removal must not disturb intact vegetation or cause erosion. Landowners should institute applicable best management practices to prevent erosion from occurring when felled trees are removed. See the Manual for Erosion and Sediment Control in Georgia, available at *http://www.gaepd.org/Documents/esc_manual.html* for a list and description of best management practices.

E. Creating Keyhole View Corridors

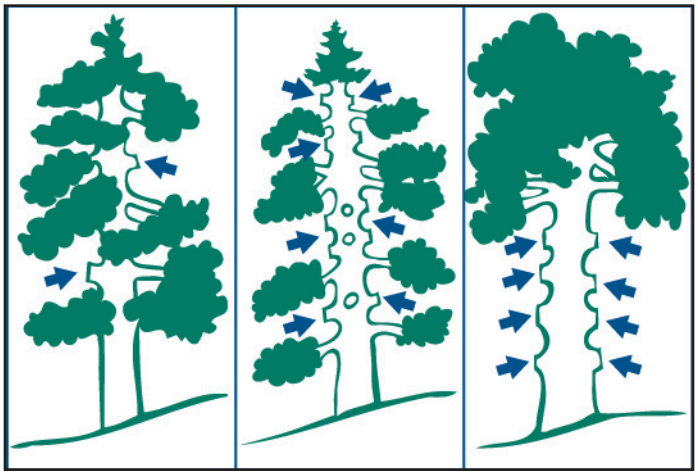
Selective pruning and thinning of the existing vegetation in the buffer is permitted for the purpose of creating and maintaining a keyhole view corridor. "Keyhole" views provide sightlines extending to the marsh or open water beyond the buffer. Vegetation frames the view and can enhance privacy, aesthetics, and a sense of place while providing necessary buffer functions. On residential lots of 2 acres or less, there may be only one view corridor. In any case, the view corridor should not affect more than 25% of the length of the buffer area on an individual parcel.

Selective Pruning of Tops of Shrubs and Undergrowth

A keyhole view corridor. *Photo by Jennifer Spangler.*

Selective pruning may be used to create keyhole view corridors in appropriate situations. Pruning shall not occur below 4 feet from level ground and, on a descending slope, pruning should occur at the maximum height that still allows for the view. Trees may not be topped, though selective limb removal is permitted when the health of the tree is not jeopardized. Types of selective limb removal permitted include "windowing," "interlimbing," and "skirting up." "Windowing" refers to the removal of a single limb or limbs as needed to create a specified keyhole view. "Interlimbing" is the removal of one of two limbs of the same height, in segments, up a tree in order to create a keyhole view. "Skirting up" refers to the removal of all limbs from the base of the tree up to the minimum height needed to create the keyhole view (Puget Sound Action Team 2006).

Pruning large and/or high limbs requires the enlistment of a professional arborist to prevent personal injury and property damage as well as to ensure the health and proper growth habit of the tree. Smaller limbs that can be pruned using a handsaw should be cut at the branch collar or the area of the branch where it extends beyond the main trunk. The cut, then, is not flush with the trunk but protrudes slightly. This allows the tree to heal more quickly and completely. Limbs thicker than 1 1/2 inches should receive a three-part cut so that the break does not peel or harm the bark of the trunk. The first cut extends about 6-12 inches on the limb from the trunk and is an undercut about one-third of the way through the branch. The second cut is approximately 3 inches further out from the trunk, cut from the top of the limb downward. The limb should then fall from its own weight. The final cut is at the branch collar, removing any excess length. Again, the cut is not flush with the trunk (Janne and Welsh).



Windowing *Interlimbing* *Skirting up*

Reprinted from the "Puget Sound Shoreline Stewardship Guidebook" with permission from the Puget Sound Action Team.

Selective Thinning of Vegetation

Selective thinning may also be used to create view corridors. Removal of saplings under 4" in diameter, shrubs, and undergrowth is permitted only when present within the identified view corridor and only to the extent necessary to create the keyhole view. It is optimal to first remove weak or damaged branches. Selective thinning shall not be conducted during dry periods, as new growth demands use of additional water (Brown 2000).

III. Land Disturbance in the Buffer

A. Grading

Depending on the locality's laws, some grading in the buffer may be allowed for certain listed purposes by local ordinance or if a buffer encroachment permit or variance has been granted to the landowner. Grading within the 25' Erosion and Sediment Act buffer will require a buffer variance from the Environmental Protection Division of the Georgia Department of Natural Resources (DNR.) If grading is allowed in the buffer by one of these avenues, it should be completed using hand tools and equipment that require no electric power. Shovels, dirt rakes, and hand tamping are options for excavating, moving, and compacting materials. Use of machine-powered grading equipment should be avoided to the extent feasible due to the extensive impacts on vegetation and soil compaction caused by construction and the transporting of equipment.

Vegetation that is destroyed as a result of grading activities in the buffer must be replaced or enhanced with native trees and shrubs either inside the buffer or directly adjacent to the buffer, whichever is preferable based upon the site characteristics. The area of vegetation replacement or enhancement must be equal to the area of encroachment. A list of suggested native plants is provided in Appendix A.

B. Pervious Surfaces

Depending on the locality's laws, some paving in the buffer may be allowed for certain listed purposes by local ordinance, or if a buffer encroachment permit or variance has been granted to the landowner. If paving within the buffer is permitted, pervious surface treatments shall be used so as to maintain the functions of the riparian buffer and the integrity of the adjacent salt marsh. A pervious surface is one with high enough porosity and permeability to allow rainwater to pass through it, thereby reducing the runoff from a site and surrounding areas. It serves both as a stable, load-bearing surface as well as a means to manage stormwater. As rain filters through the surface to the native soil below, the rainwater is retained and pollutants are removed before the water enters the natural hydrologic cycle. The use of impervious surfaces in the buffer is not permitted by the Model Coastal Buffer Ordinance. Types of impervious surfaces include traditional materials such as concrete, asphalt, and compacted soils, which limit or eliminate the infiltration of stormwater. Impervious surfaces alter flow patterns, increase runoff, and eliminate the natural filtration of pollutants before they enter the marsh.

Vegetation Replacement

Vegetation that is destroyed as a result of installing pervious surfaces in the buffer must be replaced or enhanced with native trees and shrubs either inside the buffer or directly adjacent to the buffer, whichever is preferable based upon the site characteristics. The area of vegetation replacement or enhancement must be equal to the area of encroachment. A list of suggested native plants is provided in Appendix A.

Aggregate parking surface. Photo by Bruce K. Ferguson.

Types of Pervious Surfaces

Pervious surface treatments vary according to both the type of construction material and design technology used. A combination of materials and technologies may be implemented to enhance the effectiveness of the pervious surface. Examples of types of pervious surface treatments are as follows:

Soft Porous Surfaces

- Materials such as mulch or gravel, used in combination with an aggregate base of native, uncompacted soil are appropriate for low impact uses where traffic is lightweight (pedestrian, equestrian, non-motorized bicycles, possibly some low-ground-pressure vehicles) or where volume is low (occasional-use parking, private driveways). These surfaces are best suited for settings where traffic is too high to leave a surface in grass or native soil but too low to require hard porous surfacing. In addition, these surfgaces should only be used where slope is <5% or cross-slope <2%, and runoff from adjacent areas can be kept from flowing across the surface. Use of these surfaces requires long-term routine maintenance (Ferguson 2005).

Hard Porous Surfaces

- Modular porous pavers are structural units, such as concrete blocks or reinforced plastic mats, with void areas that are filled with pervious materials to achieve a load-bearing permeable surface. The pervious fill materials include sand, grass turf, and gravel (ARC 2001). An effective way to utilize modular pavers for access through the buffer is as wheel strips only, with remaining surfaces of another pervious material. If greater surface area is needed, paver blocks have the capacity to provide an attractive and functional surface (ARC 2001).

Tire strips. *Photo by Bruce K. Ferguson.*

- Porous asphalt and porous concrete consist of open-graded coarse aggregate bonded together by asphalt cement or Portland cement and water, respectively. The void spaces between aggregate particles allow water to infiltrate to a gravel bed receptacle below. After filtering through the gravel base, water flows into the underlying soil (ARC 2001). A certified professional must install porous asphalt and porous concrete.

Three examples of modular pavers.
Photos by Bruce K. Ferguson.

Installing pervious surfaces

Soft Porous Surfaces

The granules should be laid at least 3 to 4 inches thick and up to 12 inches thick if impact attenuation is desired. In many settings, edge restraint is necessary to contain the particles and define the perimeter (Ferguson 2005).

Hard Porous Surfaces

Each of these surfaces is typically placed over a highly permeable layer of open-graded gravel and crushed stone (U.S. EPA 1999). This base serves as a reservoir for stormwater runoff where water is allowed to infiltrate to underlying soils or is redirected through an overflow drain system (Ferguson 2005). Filter fabric is placed beneath the aggregate subgrade to prevent fine particles from moving into the soil bed (U.S. EPA 1999). A certified professional must install porous asphalt and porous concrete.

Porous asphalt. *Photo by Bruce K.. Ferguson.*

C. Pervious Access Paths

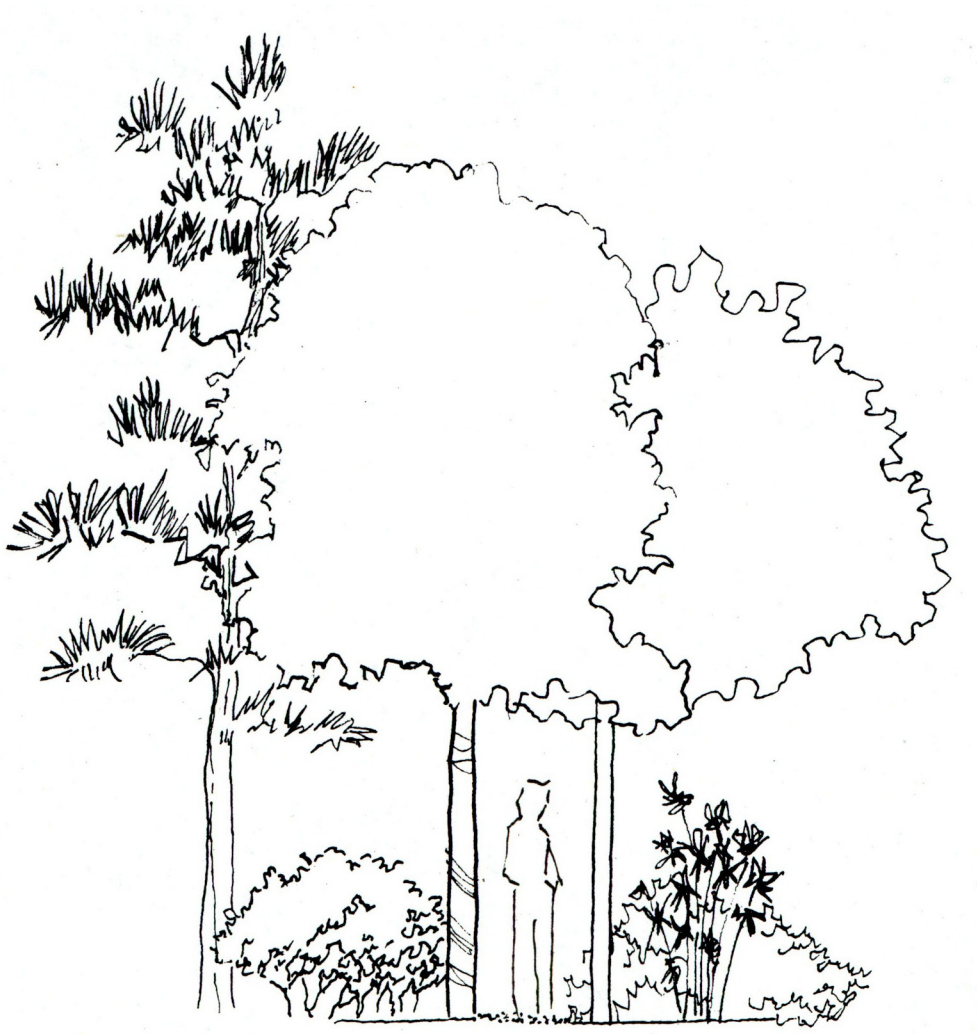
Depending on the locality's laws, installation of a pervious access path in the buffer may be allowed for certain listed purposes by local ordinance or if a buffer encroachment permit or variance has been granted to the landowner. A pervious access path is a path designed, constructed, and maintained to provide access through the buffer to water-dependent uses while allowing for water to permeate through it. Access paths paved with impervious surfaces are not permitted in the buffer.

Path Surfaces

For infrequently used paths, mulch or gravel provide low-cost, low-maintenance support while allowing surface water to infiltrate freely. For more information on these types of surfaces, see the previous section entitled "Pervious Surfaces." Stepping-stones are another option as a surface material for infrequently used paths. The stones should be placed as needed upon one of the pervious materials listed above. No mortar, grout, or adhesive treatments should be used in the buffer. For frequently or intensively used access paths, a boardwalk should be constructed through the buffer to prevent channelization of stormwater runoff that occurs with the types of path surfaces listed above. For more information on building materials, construction, and design of boardwalks, see the following section entitled "Decks, Porches, Boardwalks, and other Accessory Uses."

Planning the Path's Route

The path should be planned through site inventory and analysis, taking note of trees, significant vegetation, and slopes. To the extent possible, the path should take a direct route perpendicular to the marsh line, while avoiding impacts to the natural vegetation of the buffer. This includes orienting the route around established trees and shrubs. The removal of trees less than 4 inches in diameter and smaller shrubs is permitted on a limited basis to create the path. Access path width should be as minimal as possible, generally not more than 2 feet, with 5 feet permitted for wheelchair access.



The access path should be oriented around significant vegetation and should be constructed of mulch, gravel, crushed shell, or other pervious material.

Illustration by Katherine Rowe.

The natural topography of the buffer should be taken into account when planning the route to prevent erosion and sedimentation. The path should not create a flow channel for stormwater. Slopes of 5% or less can generally handle straight paths without causing channeling or rutting. Ideally, paths should be routed around slopes of 5-10%. If re-routing is not feasible, a boardwalk should be constructed over such slopes. At the very least, access paths over slopes of 5 -10 % should be reinforced with mulch, gravel, or shell, and maintenance should be performed regularly. Paths over slopes of 10% or more must either be routed around the slope, or a boardwalk must be constructed over the slope. Steeper slopes may require the use of ramping or stepping to create a path. In each of these cases, however, the path may not cause erosion, and therefore a significant removal of vegetation is prohibited (Baird and Westmore 2006).

Constructing the Path

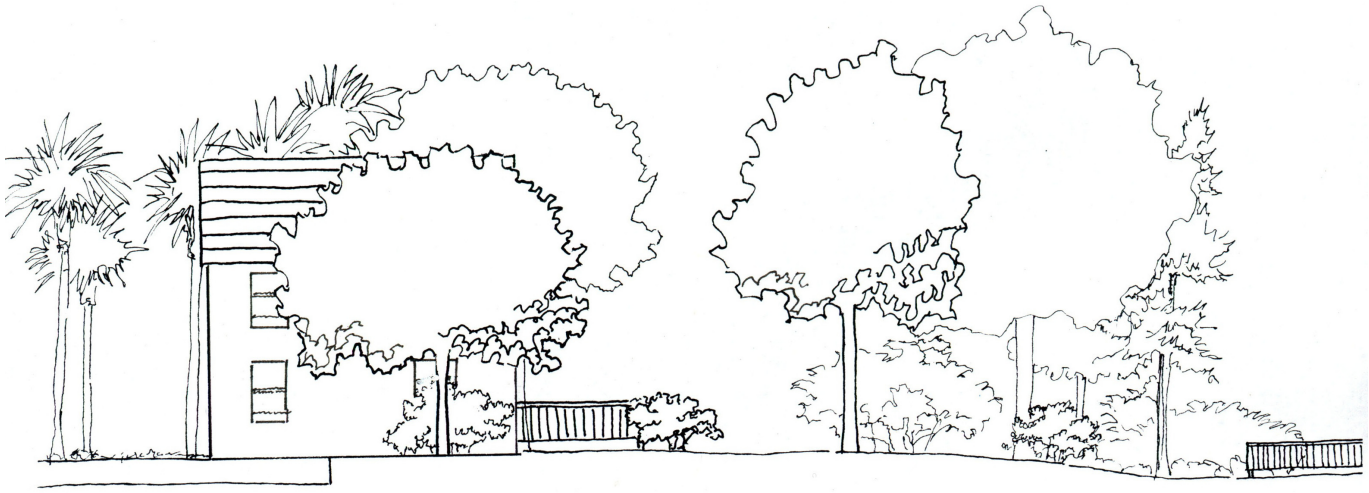
When constructing the path, the area should be staked and marked with string to denote the clearing area. Vegetation and the first few inches of topsoil should be cleared and relocated to prevent erosion and provide a stable base for the path material. If the natural soil is not

stable enough to contain the path material, edging should be placed on both sides. Wood or plastic landscape edgings are commonly used materials, inserted into a narrow trench dug with a sharp spade. The pervious surface may then be put in place. Mulch, gravel or other introduced materials shall not be allowed to drift into the salt marsh.

D. Decks, Porches, Boardwalks, and other Accessory Uses

Depending on the locality's laws, installation of an accessory structure may be allowed in the buffer for certain listed purposes by local ordinance or if a buffer encroachment permit or variance has been granted to the landowner. Accessory structures include decks, porches, boardwalks, or similar structures that are accessory uses to a residential or commercial dwelling. If allowed in the buffer, every effort should be made to minimize the extent to which the structure encroaches into the buffer. The total surface area of any part of an accessory structure that is located within the buffer may not exceed 100 square feet.

Private docks are regulated through DNR Coastal Resources Division and the U.S. Army Corps of Engineers, and before any landowner may construct a dock from her property into the marsh, a permit and a revocable license must be issued by DNR. There are two types of permits available – individual and general permits. The requirements for both types of permits can be found at *http://crd.dnr.state.ga.us*.



A view of a minimally intrusive deck structure and dock in the buffer on a residential lot.

Illustration by Katherine Rowe.

Vegetation Replacement

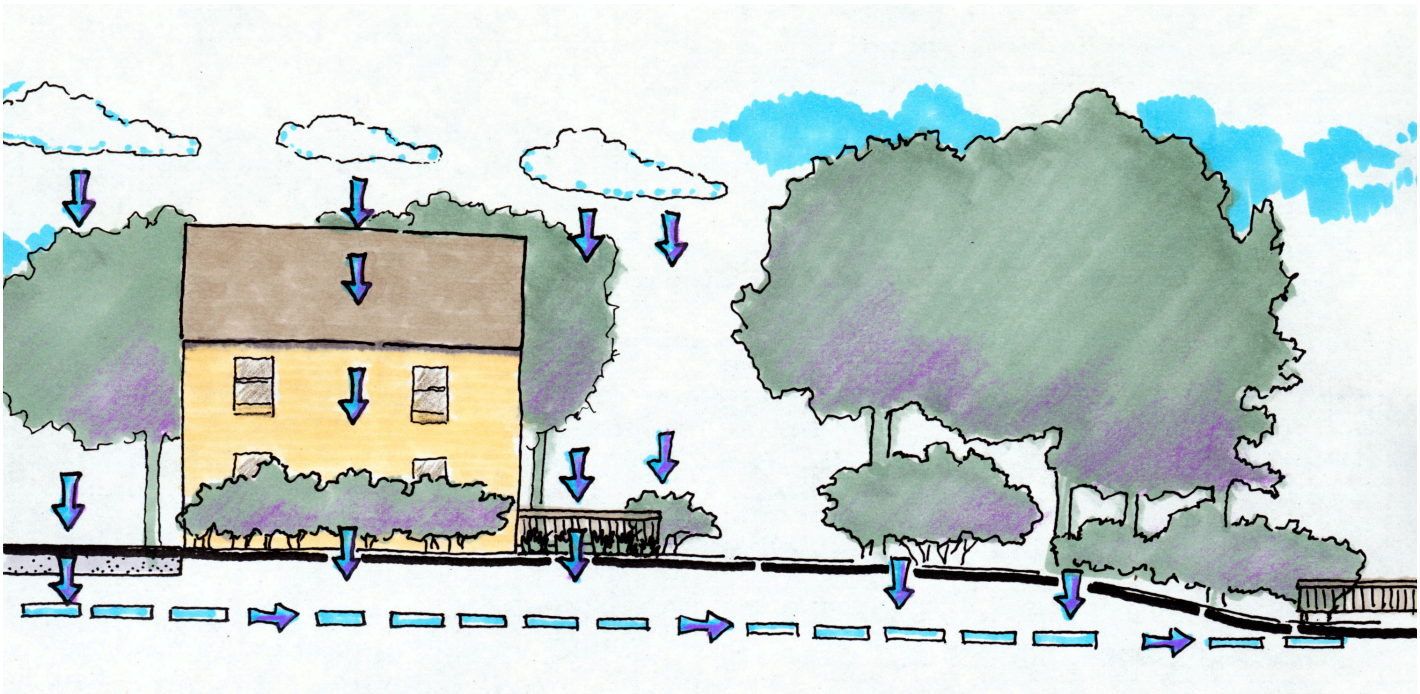
Accessory structures generally shade the ground surface they occupy and may preclude or significantly limit the growth of vegetation underneath or directly adjacent to them (Alber and Flory 2005). This, in turn, causes erosion. Therefore, any vegetation that is destroyed as a result of the structure's encroachment into the buffer must be replaced and/or enhanced with native trees and shrubs either inside the buffer or directly adjacent to the buffer, whichever is preferable based upon the site characteristics. The area of vegetation replacement or enhancement must be equal to the area of encroachment. A list of suggested native plants is provided in Appendix A.

Decks can result in removal and shading of vegetation.
Photo by Jennifer Spangler.

Design of Accessory Structures

A north/south orientation of the structure should be used when possible, as this orientation has potential to minimize shading so as to avoid vegetation death (Shaefer and Lundin 1999). All accessory structures shall be designed so that stormwater runoff from the structure falls directly on surrounding, adjacent stable vegetation and not upon unstable, bare earth. Installation of roofing on accessory structures, which blocks stormwater flow and causes additional shading, is not permitted. Planks should be spaced between one half inch to an inch apart depending on specific designs and area building regulations. Plank spacing is effective in allowing stormwater to reach the plants below or adjacent to the structure.

To minimize land disturbance, a deck should be cantilevered or attached to the building on one or more sides whenever possible. If a deck is to be constructed adjacent to a residence, for example, securing the deck to the house itself will decrease the number of posts required. The deck is sufficiently supported, and land disturbance is somewhat decreased on this side of the structure. If a deck is to be freestanding, posts and footings should be of the smallest size required to support the structure.



A pervious deck and dock and native landscape plants placed strategically near the deck help prevent erosion underneath the deck and allow for stormwater infiltration when it rains. Runoff should enter the buffer as sheet flow.
Illustration by Katherine Rowe.

Docks and boardwalks should be as narrow as possible, and according to standards of the Georgia DNR for general dock permits, a walkway may not exceed six feet in width. Reducing the footprint to 3 to 4 feet in width to limit disturbed area and save money is recommended Pilings should be spaced no less than 10 feet apart to insure the flow of water is not altered.

Building Materials

All decks, porches, boardwalks, and similar structures should be constructed of certified lumber or recycled or sustainable materials such as composite decking. Any lumber used shall not be pressure-treated with CCA (Copper Chromium Arsenic). In addition, oil-based preservatives, creosote, and pentachlorophenois are banned from use due to their environmental impacts.

A cantilevered deck. *Illustration by Katherine Rowe.*

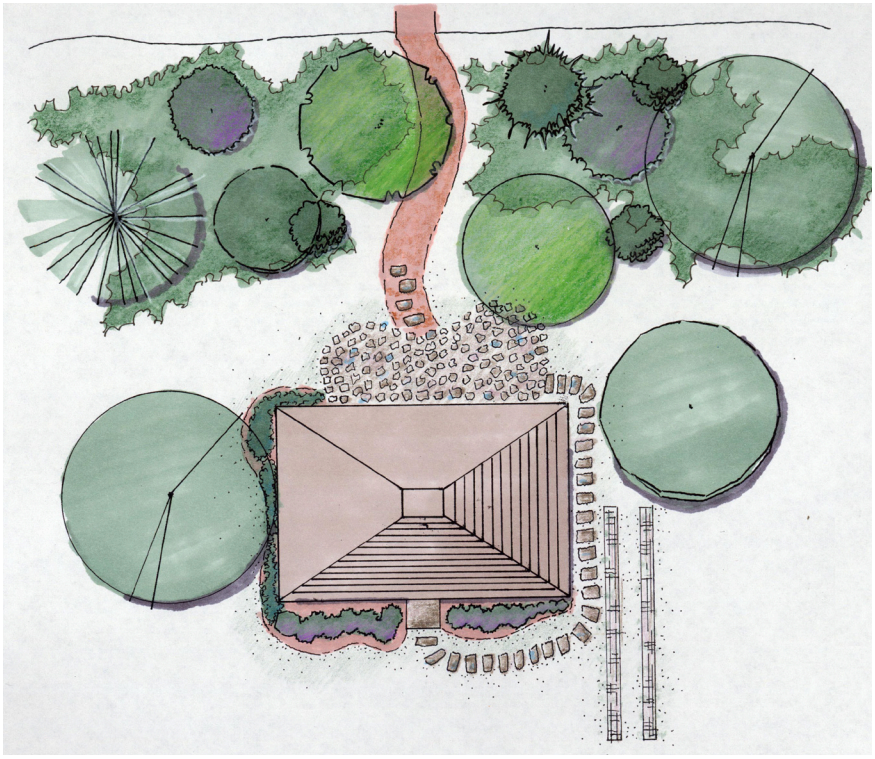
Composite wood, plastic products, and hardwoods that are resistant to decay are now readily available and provide lasting alternatives to traditional wood decking. They are often more resistant to water and light degradation than traditional materials, are free of pests, and are non-toxic (EarthCraft House 2005). Fiberglass grating is another recommended alternative building material, and it has been proven to reduce the shading effects on plants below the deck (Shaefer and Lundin 1999). Fiberglass is approximately 20 percent more expensive than the use of wood; however it tends to last longer than traditional building materials (NOAA 2006). In addition, the reduced shading effects of fiberglass may offset the need to fulfill the vegetation replacement requirement.

It has been shown that 99 percent of all leaching occurs within the first 90 days of contact with water (Sanger and Holland 2002). Therefore, any wood that contains environmentally harmful chemicals should be presoaked to limit the amount of pollutants that enter the marsh. Sleeves (usually made of steel) should be placed over wood pilings to reduce leaching. Structures should not be washed with soap or other cleaning materials. These will be flushed into the marsh and can harm plant and animal life. One study found that cleaning with sea or lake water was as effective as using soaps or solvents (NOAA 2006). Any painting or treatment of wood should be completed prior to installation of the structure and take place outside of the buffer to prevent leakage or spills.

Construction

Construction and installation of an accessory structure shall not impact buffer vegetation beyond the footprint of the structure. Heavy machinery and equipment is not allowed in the buffer and should also be kept off the marsh face. The only exception is equipment that exerts two pounds of pressure or less per square inch to the marsh face. Construction should be done from walkways or floating platforms whenever possible. Also, displaced sediment from piling installation should not be placed over vegetation.

Piles and pillars should be installed using methods which reduce the amount of impact on the buffer. Driven piles have less impact on bottom sediments and submerged vegetation than do piles that are installed using jetting techniques (Shaeffer and Lundin 1999). High pressure jetting kills a large area of vegetation around the site and should not be used unless there is no other feasible way to install the piles (Shaeffer and Lundin 1999). Therefore, use of drop hammers or other pile driving techniques should be used whenever possible, and only low pressure jetting is allowed. In addition, the ends of the piles should be sharpened for easier installation. This reduces the amount of soil compaction (Shaeffer and Lundin 1999).



Example of pervious driveway, walkway, seating area and access path. Landscaping near the house captures rainwater runoff from the roof. Large shade trees provide a cooling effect. The buffer contains trees, shrubs, and groundcover to stabilize the bank, manage and treat stormwater, and provide habitat. The access path is oriented around significant vegetation. Illustration by Katherine Rowe.

E. Utility Lines

Depending on the locality's laws, utility lines may be allowed in the buffer for certain listed purposes by local ordinance, or if a buffer encroachment permit or variance has been granted to the landowner. If allowed in the buffer, utility line installation should disturb the smallest area as possible and as little vegetation as possible. If utility lines are below ground, the original grade shall be restored. If the utility line is above ground, it should cross the buffer in an area that does not require pruning. If pruning is necessary to avoid interference with the utility line, it should follow the guidelines in the preceding section of the guidebook entitled "View Corridors."

Vegetation that is destroyed as a result of installation of utility lines must be replaced or enhanced with native trees and shrubs either inside the buffer or directly adjacent to the buffer, whichever is preferable based upon the site characteristics. The area of vegetation replacement or enhancement must be equal to the area of encroachment. A list of suggested native plants is provided in Appendix A.

F. Septic Tanks

Improper use of septic tanks has led to many known cases of water contamination. Thus, in accordance with the Model Coastal Buffer Ordinance and the regulations of the Georgia Department of Human Resources, Ga. Comp. R. & Reg. r.290-5-26 (2006), septic tanks and septic drainage fields are prohibited in buffer areas.

G. Miscellaneous Structures

Ponds and other water features are not permitted in the buffer. Structures like small birdhouses are permitted if their installation does not require removal of vegetation. Outdoor fireplaces or fire pits should be constructed using only pervious materials. Children's play areas and structures are permitted in the buffer if no alternative area is available. However, these structures shall not contain roofs or impervious materials or require heavy equipment for installation.

Vegetation that is destroyed as a result of installation of one of the above mentioned miscellaneous structures must be replaced or enhanced with native trees and shrubs either inside the buffer or directly adjacent to the buffer, whichever is preferable based upon the site characteristics. The area of vegetation replacement or enhancement must be equal to the area of encroachment. A list of suggested native plants is provided in Appendix A.

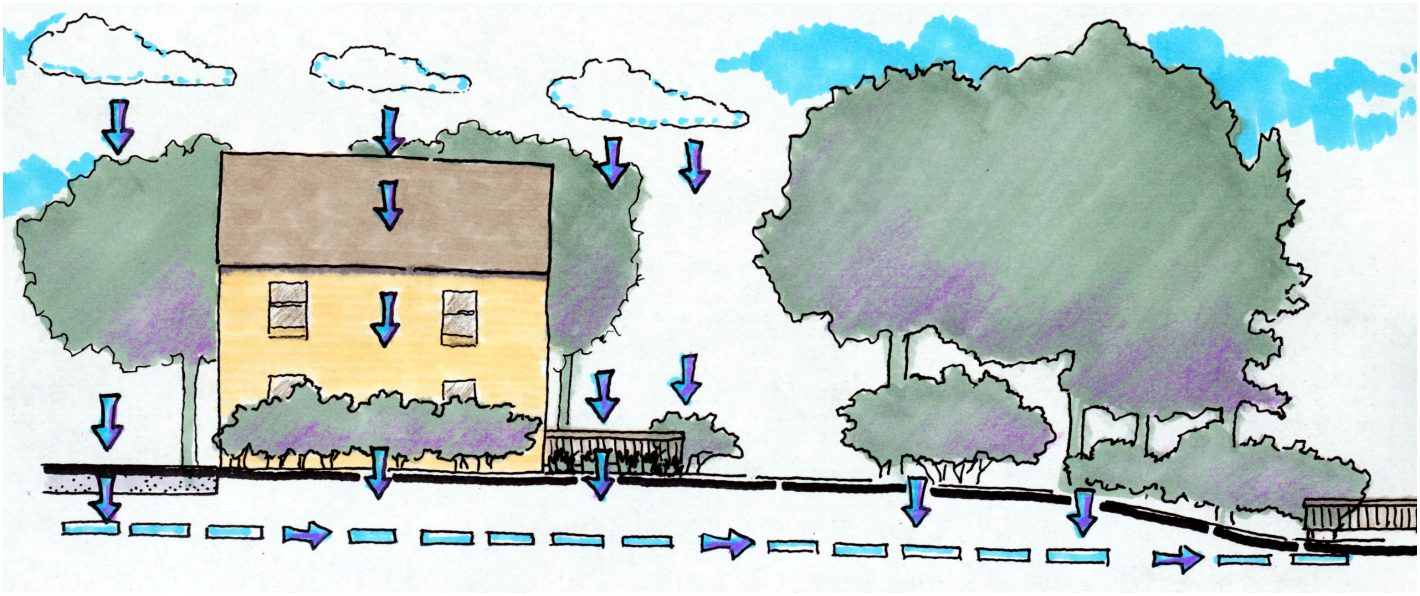
IV. Best Management Practices in Adjacent Upland Areas

The land use of areas directly adjacent to buffer zones impacts how effective buffers are at removing pollutants before they enter the waterway. The following are suggestions to further improve the effectiveness of the buffers. These suggestions should be followed whenever possible in upland areas adjacent to the buffer:

- The presence of impervious surfaces directly adjacent to and around buffer areas impacts the amount and speed of water running into the buffer. An increase in the stormwater runoff due to impervious surfaces ultimately increases erosion and the amount of pollutants that enter coastal waters. The amount of impervious surfaces such as driveways, sidewalks, paths, patios, etc. should be reduced as much as possible. Pervious materials such as gravel, modular pavers, or porous pavement should be used whenever available. Examples of pervious material that should be used are provided in Section III of this Guidance Manual entitled "Land Disturbance in the Buffer."

In areas adjacent to the buffer, landscaping can be designed to effectively manage stormwater from nearby impervious surfaces.
Photo by Sandra Glaze.

- The impacts of impervious surfaces can be mitigated by the use of raingardens, swales, and bioretention areas. These areas collect rainwater after a storm event and allow it to slowly enter the ground, removing pollutants before it enters a water body. For more information on these and other stormwater best management practices, see the *Georgia Stormwater Management Manual* at *www.georgiastormwater.com*.
- Many times fertilizer is over-applied to landscaping. This allows the excess fertilizer to run off into the marsh. Fertilizer use adjacent to the buffer should be kept at a minimum to prevent this runoff. Plants have varying nutrient needs that should be considered whenever fertilizer is applied. A soil test should also be completed before any fertilizer is applied. This test will determine the makeup of the natural soil and which nutrients need to be applied and at what amount.
- Areas adjacent to buffer zones should also consider landscaping which utilizes xeriscaping to reduce the use of water. Xeriscaping is the use of plants that are drought resistant and don't require a lot of water to become established or maintain (Wade and Midcap 2003). The use of native vegetation is also strongly suggested for adjacent areas.
- For more information about these and other BMPs that should be used in upland areas, please refer to Georgia Green Growth Guidelines of the Georgia DNR Coastal Resources Division at *http://crd.dnr.state.ga.us/content/displaynavigation.asp?TopCategory=237*



A pervious driveway, walkway and deck and native landscape plants near the house allow for stormwater infiltration. Runoff should enter the buffer as sheet flow. *Illustration by Katherine Rowe.*

V. Conclusion

Riparian buffers serve as the protective zone between upland development and the salt marsh and open water beyond. These guidelines aim to provide solutions for minimizing the impacts of common encroachments into the buffer that have been approved by the appropriate governing body. The management of buffer areas should continue to evolve as research progresses, so as to continually achieve a balance between land use activities and shoreline and water quality protection.

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Appendix A: Native Riparian Forest Species in Coastal Georgia

(*Source: Georgia Dept. of Natural Resources, Natural Heritage Program)*

Table 1. Overstory Trees

BOTANICAL NAME	*COMMON NAME*	*NOTES*
Acer spp.	Maple	Rare in overstory
Carya spp.	Hickory	*Carya aquatica* is a good Georgia coastal plain example ; nuts are food source for wildlife
Carya tomentosa	Mockernut Hickory	Nuts are food source for wildlife
Fraxinus spp.	Ash	
Juglans nigra	Black Walnut	Nuts are food source for wildlife
Liquidambar styraciflua	Sweet Gum	Found in understory also
*Liriodendron tulipifer*a	Tuliptree	
Magnolia grandiflora	Southern Magnolia	
Nyssa biflora	Swamp Tupelo	Fruits are food source for wildlife
Nyssa ogeche	Tupelo	Fruits are food source for wildlife
Nyssa sylvatica	Black Gum	Fruits are food source for wildlife
Pinus elliottii	Slash Pine	Seeds are wildlife food source; habitat for small mammals and birds
Pinus taeda	Loblolly Pine	Seeds are wildlife food source; habitat for small mammals and birds
Pinus glabra	Spruce Pine	Seeds are wildlife food source; habitat for small mammals and birds
Quercus laurifolia	Laurel Oak	Acorns are wildlife food source
Quercus lyrata	Overcup Oak	Acorns are wildlife food source
Quercus michauxii	Swamp Chesnut Oak	Acorns are wildlife food source
Quercus nigra	Water Oak	Acorns are wildlife food source
Quercus phellos	Willow Oak	Acorns are wildlife food source
Quercus shumardii	Shumard Oak; Shumard Red Oak	Acorns are wildlife food source
Quercus virginiana	Live Oak	Acorns are wildlife food source
Taxodium distichum	Bald Cypress	
Tilia americana	Linden	
Ulmus rubra	Slippery Elm	Usually found on slopes, not riparian areas

Table 2. Understory Trees

BOTANICAL NAME	*COMMON NAME*	*NOTES*
Acer rubrum	Red Maple	Seeds are food source for wildlife
Alnus spp.	Alder	
Asimina triloba	Pawpaw	Fruits are food source for mammals and birds; foliage for butterflies
Carpinus caroliniana	Ironwood	
Cercis canadensis	Redbud	Not usually found in riparian areas
Chionanthus virginicus	Fringe Tree	
Cornus florida	Flowering Dogwood	Fruits are food source for wildlife
Diospyros virginiana	Persimmon	Fruits are food source for wildlife
Gordonia lasianthus	Loblolly Bay	
Hamamelis virginiana	Witch Hazel	Not a wetland species, but found on steeper terraces ; seeds eaten by small mammals and birds
Ilex opaca	American Holly	Fruits important winter food source for birds
Ilex vomitoria	Yaupon Holly	Fruits important winter food source for birds
Juniperus virginiana	Red Cedar	Fruits are food source for wildlife
Liquidambar styraciflua	Sweet Gum	Found in overstory also
Magnolia virginiana	Sweetbay Magnolia	Fruits are food source for wildlife; trees are habitat for birds
Persea borbonia	Redbay	
Persea palustris	Swampbay	
Prunus caroliniana	Cherry Laurel	Fruits are food source for wildlife; trees are habitat for birds
Prunus serotina	Black Cherry	Fruits are food source for wildlife; trees are habitat for birds
Sabal palmetto	Cabbage Palmetto	Fruits eaten by songbirds, some game birds, and small mammals; trees provide nesting habitat for birds
Sassafras albidum	Sassafras	
Styrax grandifolia	Bigleaf Snowbell	

Table 3. Shrubs

BOTANICAL NAME	*COMMON NAME*	*NOTES*
Aesculus pavia	Red Buckeye	Foliage and seeds toxic; flowers important nectar for hummingbirds
Baccharis halmifolia B. halimifolia	Salt Myrtle	
Callicarpa americana	Beauty Berry	Fruit important food source for songbirds, small mammals; foliage food source for deer
Cephalanthus occidentalis	Button Bush	Seeds important food source for waterfowl and songbirds; nesting habitat for wood ducks; flowers provide nectar to insects; leaves toxic
Clethra alnifolia	Sweet Pepperbush	Foliage a preferred deer browse
Halesia carolina	Carolina Silverbell; Snowdrop Tree	
Ilex cassine	Dahoon holly	Fruit food source for birds
Ilex coriacea	Large Gallberry	Fruit important food source for birds
Ilex decidua	Possumhaw	Fruit important food source for birds
Ilex glabra	Inkberry Holly	Important deer browse
Ilex vomitoria	Yaupon	Fruit important winter food source for birds
Illicium floridanum	Florida Anise	Leaves toxic to livestock
Itea virginica	Virginia Sweetspire	Flowers used by butterflies; foliage is deer browse
Leucothoe racemosa	Leucothoe	Dense colonies provide wildlife cover
Lyonia ferruginea	Staggerbush	Flowers important nectar source
Lyonia lucida	Fetterbush Lyonia	Flowers important nectar source
Myrica cerifera	Wax Myrtle	Fruits have high fat content and are and important winter food source for songbirds and game birds
Nolina brittoniana	Beargrass	Not usually found in riparian areas
Osmanthus americanus	Devilwood; Wild Olive	
Rhododendron atlanticum	Coastal Azalea	Frequented by butterflies
Serenoa repens	Saw Palmetto	Inconsistent fruiting, but eaten by bear, deer, and feral hogs; important honey plant
Vaccinium arboreum	Sparkleberry	Fruits important summer food source for mammals and birds
Vaccinium corymbosum	Highbush Blueberry	Fruits important summer food source for mammals and birds
Viburnum spp.	Viburnum	Fruits eaten in late summer by small mammals and birds
Yucca aloifolia	Spanish Bayonet	Flowers visited by ruby throated hummingbirds
Yucca filamentosa	Bear Grass	Flowers visited by ruby throated hummingbirds

Table 4. Flowering Perennials

BOTANICAL NAME	*COMMON NAME*	*NOTES*
Asclepias tuberosa	Butterfly Weed	Not usually found in riparian areas
Coreopsis lanceolata	Coreopsis	Seeds consumed by songbirds and rodents
Helianthus angustifolius	Swamp Sunflower	Seeds consumed by songbirds and rodents
Hibiscus moscheutos	Swamprose Mallow	
Iris virginica	Blue Flag Iris	
Liatris spicata	Blazing Star	
Oenthera speciosa	Evening Primrose	Important nectar source for moths and butterflies; seeds eaten by songbirds
Rudbeckia hirta	Black-Eyed Susan	
Salvia coccinea	Scarlet Sage	
Verbena canadensis	Pink Verbena	Flowers attract butterflies

Table 5. Grasses, Herbs, and Vines

BOTANICAL NAME	*COMMON NAME*	*NOTES*
Andropogon virginicus	Broomsedge	Excellent producer of nectar
Bignonia capreolata	Cross Vine	Excellent hummingbird plant; foliage eaten by deer
Carex spp.	Sedges	Seeds consumed by birds, foliage provides cover and nesting habitat
Chasmanthium sessiliflorum	Longleaf Woodoats	Seeds consumed by birds
Chasmanthium laxum	Slender Woodoats	Seeds consumed by birds
Cyperus spp.	Sedges	Seeds important waterfowl food
Gelsemium sempervirens	Yellow Jessamine	Early-spring nectar source, especially for hummingbirds and spicebush swallowtail butterfly
Malaxis unifolia Michaud	Green Adder's Mouth	Not a common species
Mitchella repens	Partridge Berry	Fruits are occasional winter food for birds and small mammals
Parthenocissus quinquefolia	Virginia Creeper	Fruits eaten by songbirds
Rhynchospora spp.	Whitetop Sedge	In Georgia, probably find *R. colorata*

Appendix B: Non-Native Invasive Plant Species in Georgia

(Source: Georgia Exotic Pest Plant Council, April 2006).

Table 1. Non-native Plants: Serious Threats.*

BOTANICAL NAME	*COMMON NAME*
Achyranthes japonica	Japanese chaff flower
Ailanthus altissima	Tree of heaven
Albizia julibrissin	Mimosa
Alliaria petiolata	Garlic mustard
Alternanthera philoxeroides	Alligator weed
Arthraxon hispidus	Small carpgrass
Celastrus orbiculatus	Oriental bittersweet
Eichhornia crassipes	Water hyacinth
Elaeagnus umbellate	Autumn olive
Hedera helix	English ivy
Hydrilla verticillata	Hydrilla
Imperata cylindrica	Cogongrass
Lespedeza bicolor	Shrubby lespedeza
Lespedeza cuneata	Chinese lespedeza
Ligustrum sinense	Chinese privet
Lonicera japonica	Japanese honeysuckle
Lygodium japonicum	Japanese climbing fern
Melia azedarach	Chinaberry tree
Microstegium vimineum	Nepalese browntop
Murdannia keisak	Marsh dewflower
Paederia foetida	Skunk vine
Paulownia tomentosa	Princesstree
Polygonum cuspidatum	Japanese knotweed
Pueraria Montana	Kudzu
Rosa multiflora	Multiflora rose
Salvinia molesta	Giant salvinia
Triadica sebifera	Tallow tree
Wisteria sinensis	Chinese wisteria

** These non-native plants are serious problems in Georgia because they extensively invade native plant communities and displace native species. Every effort should be made to remove them from buffer areas.*

Table 2. Non-native Plants: Moderate Threats.*

BOTANICAL NAME	*COMMON NAME*
Ardisia crenata	Coral ardisia
Cinnamomum camphora	Camphortree
Cynodon dactylon	Bermudagrass
Dioscorea oppositifolia	Chinese yam
Egeria densa	Brazilian waterweed
Elaeagnus pungens	Thorny olive
Leucanthemum vulgare	Oxeye daisy
Ligustrum japonicum	Japanese privet
Lonicera maackii	Amur honeysuckle
Miscanthus sinensis	Chinese silvergrass
Myriophyllum aquaticum	Parrotfeather watermilfoil
Nandina domestica	Nandina
Nasturtium officinale	Watercress
Paspalum notatum	Bahiagrass
Phyllostachys aurea	Golden bamboo
Sesbania herbacea	Bigpod sesbania
Sesbania punicea	Rattlebox
Spiraea japonica	Japanese spirea
Tamarix gallica	French tamarisk
Vinca major	Bigleaf periwinkle
Vinca minor	Common periwinkle

** Non-native plants that are a moderate problem in Georgia. These plants invade native plant communities and displace native species, but to a lesser degree than do Category 1 species. Efforts should be made to remove these species from buffer areas if feasible.*

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