

**NATURAL RESOURCES CONSERVATION SERVICE  
CONSERVATION PRACTICE STANDARD**

**RIPARIAN FOREST BUFFER**

(Ac.)

**CODE 391**

**DEFINITION**

An area predominantly trees and/or shrubs located adjacent to and up-gradient from watercourses or water bodies.

Dominant vegetation will consist of existing, naturally regenerated native, or seeded/planted native trees and shrubs suited to the soil and hydrology of the site and the intended purpose(s).

**PURPOSE**

- Create shade to lower or maintain water temperatures to improve habitat for aquatic organisms.
- Create or improve riparian habitat and provide a source of detritus and large woody debris.
- Reduce excess amounts of sediment, organic material, nutrients and pesticides in surface runoff and reduce excess nutrients and other chemicals in shallow ground water flow.
- Reduce pesticide drift entering the water body.
- Restore riparian plant communities.
- Increase carbon storage in plant biomass and soils.

The vegetation will extend a minimum width to achieve the purpose(s). At a minimum the width should be 35 feet. Measurement shall begin at and perpendicular to the normal water line, bank-full elevation, or the top of the bank as determined locally.

The riparian forest buffer should consist of a minimum of 2 zones, one of trees and a second of shrubs. If the riparian forest buffer is being installed immediately adjacent to actively cropped land the riparian forest buffer should include zones 1 and 2 AND a third zone of native herbaceous cover (grasses and forbs).

Overland flow through the riparian area will be maintained as sheet flow.

For sites to be regenerated or planted, excessive sheet-rill and concentrated-flow erosion will be controlled.

Excessive sheet-rill and concentrated-flow erosion will be controlled in the areas immediately adjacent and up-gradient of the buffer site.

Use only tree and shrub species that are native and non-invasive. Substitution with improved and locally accepted cultivars or purpose-specific species is allowed. For plantings and seeding, only viable, high-quality and adapted plant materials will be used.

Favor tree and shrub species that have multiple values such as those suited for timber, nuts, fruit, floral, browse, nesting, and aesthetics.

Periodic removal of some forest products such as high value trees, medicinal herbs, nuts, and fruits is permitted provided the intended purpose

**CONDITIONS WHERE PRACTICE APPLIES**

Riparian forest buffers are applied on areas adjacent to permanent or intermittent streams, lakes, ponds, and wetlands. They are not applied to stabilize stream banks or shorelines.

**CRITERIA**

**General Criteria Applicable to All Purposes**

The riparian forest buffer shall be positioned appropriately and designed to achieve sufficient width, length, vertical structure/density and connectivity to accomplish the intended purpose(s).

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is not compromised by the loss of vegetation or harvesting disturbance.

Necessary site preparation and planting shall be done at a time and manner to insure survival and growth of selected species for achieving the intended purpose(s).

Livestock shall be controlled or excluded as necessary to achieve the intended purpose. Refer to the standards Prescribed Grazing, 528, and/or Access Control, 472, as applicable.

Harmful plant and animal pests present on the site will be controlled or eliminated as necessary to achieve and maintain the intended purpose. If pesticides are used, refer to the standard Pest Management 595 for animal pests, Brush Management 314 for woody plant pests and Herbaceous Weed Control 315 if addressing invasive herbaceous species.

**Additional Criteria to Reduce Excess Amounts of Sediment, Organic Material, Nutrients and Pesticides in Surface Runoff and Reduce Excess Nutrients and Other Chemicals in Shallow Ground Water Flow**

The minimum width shall be at least 35 feet measured horizontally on a line perpendicular to the water body beginning at the normal water line, bank-full elevation, or the top of the bank as determined locally by conservation planner.

The width will be extended to greater than 35 feet in high nutrient, sediment, and animal waste application areas, where the contributing area is not adequately treated or where an additional level of protection is needed.

The riparian forest buffer should consist of a minimum of 2 zones, one of trees and a second of shrubs. If the riparian forest buffer is being installed immediately adjacent to actively cropped land the riparian forest buffer should include zones 1 and 2 AND a third zone of native herbaceous cover (grasses and forbs).

Existing, functional underground drains through the riparian area will pass pollutants directly to the outlet. To filter such pollutants, drains should be plugged, removed or replaced with perforated pipe/end plugs or water control structures (see Structure for Water Control - 587) to allow passage and filtration of drain water through the riparian forest root zone. Caution is advised that saturated conditions in the riparian and adjacent areas may limit existing land use and management.

**Additional Criteria to Create or Improve Riparian Habitat and Provide a Source of Detritus and Large Woody Debris.**

The width will be extended to meet the minimum habitat requirements of the wildlife or aquatic species of concern.

Establish plant communities that address the target aquatic and terrestrial wildlife and pollinator needs and have multiple values such as habitat, nutrient uptake and shading. The establishment of diverse native woody and herbaceous species will enhance wildlife and pollinator values. Establishing pollinator habitat should follow the requirements of Conservation Cover (327c) pollinator habitats. Refer to South Carolina Conservation Cover – Technical Guidance 327c, Pollinator Habitat, for a list of native species that provide seasonal food sources for pollinators.

Dominant vegetation will consist of existing, naturally regenerated, or planted trees and shrubs suited to the site and the intended purpose. The use of locally native species will be a priority. Plantings will consist of two or more species with individual plants suited to the seasonal variation of soil moisture within the planned buffer (see Figure 1 on page 2). Plant types and species shall be selected based on their compatibility in growth rates and shade tolerance. Select species from the Plant List, Table 1, based on the suitability for zone 1 and 2 as indicated.

To achieve the desired detritus and large woody debris, species from Section B, Hardwoods, of Table 1, with a minimum of a third in zone 1 being suitable oak species. Planting should begin 5 feet from the wetland line or streambank. There shall be a minimum of 2 rows in zone 1 if planted. Adapted shrub species may be added in zone 1 if desired. If natural regeneration is used, a minimum of 300 viable tree or woody shrub seedlings per acre of adapted species according to zone requirements, above, must be present.

All buffers will consist of a Zone 1 that begins at the normal water line, or at the upper edge of the active streambank (if incised), or shore, and extends a minimum distance of 15 feet, measured horizontally on a line perpendicular to the watercourse or water body (see exception relating to maintenance travel ways).

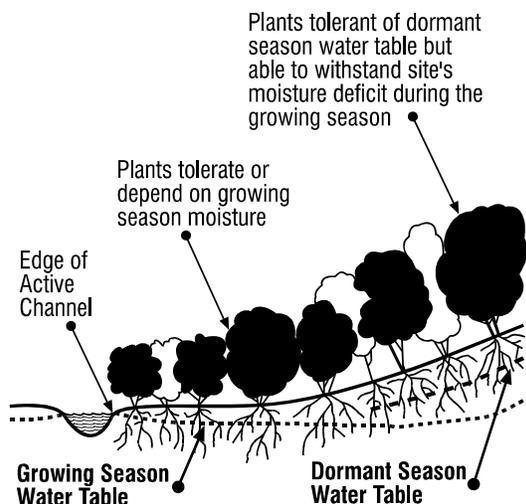


Figure 1. Plant adaptation to soil moisture.

Occasional removal of some tree and shrub products is permitted in Zone 1 provided the intended purpose is not compromised by the loss of vegetation or harvesting disturbance and provision is made to re-establish the trees or shrubs. Felling and skidding of trees shall be directed away from the watercourse or water body. Skidding will be done in a manner to prevent creation of ephemeral channels perpendicular to the stream.

Logging in the buffer will comply with forestry best management practices. Logging and other overland equipment shall be excluded from Zone 1, except for stream crossings and stabilization work. For unstable areas, streambank protection measures will be planned and conducted as needed in accordance with the standard for Streambank and Shoreline Protection (Code 580).

An adequate upstream or adjacent seed source must be present when using natural regeneration to establish a buffer.

Necessary site preparation and planting for establishing new buffers shall be done at a time and manner to insure survival and growth of selected species. Refer to General Specifications for care, handling, and planting requirements for woody planting stock found in the Tree and Shrub Planting Standard (612).

Only viable, high quality and adapted planting stock will be used.

The method of planting for new buffers shall include hand or machine planting techniques

and be suited to achieving proper depths and placement of planting stock roots.

Site preparation shall be sufficient for establishment and growth of selected species and be done in a manner that does not compromise the intended purpose. See General Specifications for detailed site preparation procedures.

Livestock shall be excluded to achieve and maintain the intended purpose. Stream crossings and livestock watering facilities shall be located and designed to minimize impact on buffer vegetation and shall be fenced. See standard for Fence (Code 382).

Harmful pests present on the site will be controlled or eliminated as necessary to achieve and maintain the intended purpose.

For optimal carbon storage, select plant species that are adapted to the site to assure strong health and vigor and plant the full stocking rate for the site. Adapted species will be native to the eco-region and suited to the soil characteristics and hydrologic regime found on site.

Comply with applicable federal, state and local laws and regulations during the installation, operation (including harvesting activities) and maintenance of this practice.

Initial plant-to-plant densities for trees and shrubs will depend on their potential height at 20 years of age. Heights may be estimated based on: 1) performance of the individual species (or comparable species) in nearby areas on similar sites, or 2) predetermined and documented heights using Conservation Tree/Shrub Suitability Groups, Section II of the Field Office Technical Guide. Planting density specifications:

Plant Types/Heights:	Plant-to-Plant Spacing in Feet:
• Shrubs less than 10 feet in height	3 to 6
• Shrubs and trees from 10 to 25 feet in height (includes columnar trees)	5 to 8

• Trees greater than 25 feet in height	6 to 15
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**TABLE 1. PLANT LIST FOR RIPARIAN FOREST BUFFERS**

**A. Softwoods (Conifers)**

Species	Geographic Region*	Riparian Zone Suitability	Minimum Spacing	Maximum Spacing
Atlantic White Cedar	CP	1,2	680 (8x8)	1210 (6x6)
Bald Cypress / Pond Cypress	CP	1,2	680 (8x8)	1210 (6x6)
Eastern Red cedar	Pied, Mtns	2	300 (12x12)	622 (7x10)
Eastern White Pine	Mtns	2	300 (12x12)	622 (7x10)
Loblolly Pine	CP, Pied	2	435 (10x10)	622 (7x10)
Longleaf Pine	Longleaf Pine range map	2	622 (7x10)	800 (6x9)
Pond Pine	CP	1,2	435 (10x10)	622 (7x10)
Eastern Hemlock	Mtns.	1,2	300 (12x12)	622 (7x10)

**B. Hardwoods**

Species	Geographic Region*	Riparian Zone Suitability	Minimum Spacing	Maximum Spacing
Black Walnut	Pied, Mtns	1,2	110 (20X20)	200 (15X15)
Cherrybark Oak	CP	1,2	302 (12x12)	435 (10x10)
Cottonwood	CP, Pied	1,2	302 (12x12)	435 (10x10)
Green Ash	CP, Pied	1,2	302 (12x12)	435 (10x10)
Hackberry/Sugarberry	CP, Pied, Mtns	1,2	302 (12x12)	435 (10x10)
Northern Red Oak	Mtns	2	302 (12x12)	435 (10x10)

Overcup Oak	CP	1,2	302 (12x12)	435 (10x10)
Red Maple	CP, Pied, Mtns	1,2	302 (12x12)	435 (10x10)
Swamp Chestnut Oak	CP	1,2	302 (12x12)	435 (10x10)
Sweetgum	CP, Pied	2	302 (12x12)	435 (10x10)
Sycamore	CP, Pied	1,2	302 (12x12)	435 (10x10)
Tupelo Gum	CP	1,2	302 (12x12)	435 (10x10)
White Ash	Pied	2	302 (12x12)	435 (10x10)
Willow/Water/Laurel Oak	CP, Pied	1,2	302 (12x12)	435 (10x10)
Yellow Poplar	CP, Pied, Mtns	1,2	302 (12x12)	435 (10x10)
White Oak	CP, Pied, Mtns	1,2	302 (12x12)	435 (10x10)
Swamp White Oak	CP, Pied	1,2	302 (12x12)	435 (10x10)

\*CP = Coastal Plain, Pied = Piedmont, Mtns = Mountains, Longleaf Pine = see Longleaf Range Map, found on the SC NRCS Sharepoint under Programs/WHIP/Longleaf Pine Initiative

**C. Shrubs** (Individual species may be selected based on soil and moisture characteristics of the site.)

<b>Small Trees</b>	<b>Shrubs</b>
Dogwood	Blueberry
Paw Paw	Chickasaw or American Plum
Serviceberry	Holly species
Crabapple	American Beautyberry
Persimmon	Wax myrtle
Eastern Redbud	Viburnum
Red Mulberry	Mountain Laurel (Mtns.)
Sassafras	Rhododendron (Mtns.)
Black or Laurel Cherry	Hawthorn

### **Additional Criteria for Increasing Carbon Storage in Biomass and Soils**

Maximize width and length of the riparian forest buffer.

Select plants that have higher rates of carbon sequestration in soils and plant biomass and are adapted to the site to assure strong health and vigor. Plant the appropriate stocking rate for the site.

### **CONSIDERATIONS**

Tree and shrub species, which may be alternate hosts to undesirable pests, should be avoided. Species diversity should be considered to avoid loss of function due to species-specific pests.

Using seed and/or seedlings collected or propagated from multiple sources can increase genetic diversity.

Consider selecting species with tolerance to herbicide leakage from adjoining fields.

Allelopathic impacts of plants should be considered.

The location, layout and density of the buffer should complement natural features, and mimic natural riparian forests.

For sites where continued function of drains is desired, woody root penetration may eventually plug the underground structure. In these cases, a setback of woody vegetation planted over the drain maintained in herbaceous cover or using rigid, non-perforated pipe will minimize woody root penetration.

Maximize widths, lengths, and connectivity of riparian forest buffers.

The species and plant communities that attain biomass more quickly will sequester carbon/ faster. The rate of carbon sequestration is enhanced as riparian plants mature and soil organic matter increases.

### **PLANS AND SPECIFICATIONS**

All necessary local, state, and federal permits shall be obtained by the landowner (or designee) prior to the restoration.

Specifications for applying this practice shall be prepared for each site and recorded using

- Approved specification sheets, job sheets, technical notes, and narrative statements in the conservation plan.
- Specifications that include the minimum width for each zone, (zone 1, 2 and 3, if adjacent to active cropland)
- Other acceptable documentation. Include the WHIG Summary sheet for the Riparian Area to document the benchmark habitat condition and the planned habitat condition.
- Method of planting, site preparation plans, list of plant species, number of plants, spacing
- Operation and maintenance requirements

### **OPERATION AND MAINTENANCE**

- The riparian forest buffer will be inspected periodically and protected from adverse impacts such as excessive vehicular and pedestrian traffic, pest infestations, concentrated flows, pesticides, livestock or wildlife damage and fire.
- Replacement of dead trees or shrubs and control of undesirable vegetative competition will be continued until the buffer is, or will progress to, a fully functional condition.
- Any manipulation of species composition, stand structure and stocking by cutting or killing selected trees and understory vegetation shall sustain the intended purpose(s). Refer to the standard Forest Stand Improvement, 666.
- Control or exclusion of livestock and harmful wildlife shall continue. Refer to the standards Prescribed Grazing, 528, and/or Access Control, 472, as applicable.
- Fertilizers, pesticides and other chemicals used to maintain buffer function shall not impact water quality.

greenways. Gen. Tech. Rep. SRS-109.  
Asheville, NC: Department of Agriculture,  
Forest Service, Southern Research Station.

## **REFERENCES**

Bentrup, Gary 2008. Conservation buffers:  
design guidelines for buffers, corridors, and