NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

RIPARIAN FOREST BUFFER

(Acre)

CODE 391

DEFINITION

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

PURPOSES

- Create shade to lower water temperatures to improve habitat for aquatic organisms.
- Provide a source of detritus and large woody debris for aquatic and terrestrial organisms.
- Create wildlife habitat and establish wildlife corridors.
- 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.
- Provide a harvestable crop of timber, fiber, forage, fruit, or other crops consistent with other intended purposes.
- Provide protection against scour erosion within the floodplain.
- Restore natural riparian plant communities.
- Moderate winter temperatures to reduce freezing of aquatic over-wintering habitats.
- To increase carbon storage.

CONDITIONS WHERE PRACTICE APPLIES

On areas adjacent to permanent or intermittent streams, lakes, ponds, wetlands and areas with ground water recharge that are capable of supporting woody vegetation.

CRITERIA

General Criteria Applicable To All Purposes

The location, layout and density of the riparian forest buffer will accomplish the intended purpose and function.

Dominant vegetation will consist of existing, naturally regenerated, or planted trees and shrubs suited to the site and the intended purpose.

All buffers will consist of a Zone 1 that begins at the top of the bank or lake shoreline, and extends a minimum distance of 15 feet, measured horizontally on a line perpendicular to the water body.

Occasional removal of some tree and shrub products such as high value trees is permitted in zone 1 provided the intended purpose 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.

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

Site preparation shall be sufficient for establishment and growth of selected species and is done in a manner that does not compromise the intended purpose.

Livestock shall be controlled or excluded as necessary to achieve and maintain the intended purpose.

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.

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

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

An additional strip or area of land, Zone 2, will begin at the edge and up-gradient of Zone 1 and extend a minimum distance of 20 feet, measured horizontally on a line perpendicular to the water body. The minimum combined width of Zones 1 and 2 will be 35 feet.

Criteria for Zone 1 shall apply to Zone 2 except that removal of products such as timber, fiber, nuts, fruit and forbs is permitted and encouraged on a periodic and regular basis provided the intended purpose is not compromised by loss of vegetation or harvesting disturbance.

Zone 2 will be expanded 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 desired.

A Zone 3 shall be added to the riparian buffer when adjacent to cropland or other sparsely vegetated or highly erosive areas to filter sediment, address concentrated flow erosion, and maintain sheet flow. The Filter Strip standard (practice code 393) shall be used to design Zone 3. The minimum width of zone 3 will be 15 feet.

Additional Criteria To Provide Habitat For Aquatic Organisms And Terrestrial Wildlife

Width of Zone 1 and/or Zone 2 will be expanded to meet the minimum requirements of the wildlife or aquatic species and associated communities of concern.

Establish plant communities that address the target wildlife needs and existing resources in the watershed.

CONSIDERATIONS

The severity of bank erosion, concentrated flow erosion or mass soil movement and its influence on existing or potential riparian trees and shrubs should be assessed. Watershed-level or contributing area treatment or bank stability activities may be needed before establishing a riparian forest buffer.

When concentrated flow erosion and sedimentation cannot be controlled vegetatively, consider structural or mechanical treatments.

Favor tree and shrub species that are native, non-invasive, or have multiple values such as those suited for timber, biomass, nuts, fruit, browse, nesting, aesthetics and tolerance to locally used herbicides.

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.

Plants that deplete ground water should be used with caution in water-deficit areas.

Allelopathic impacts of plants should be considered.

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

PLANS AND SPECIFICATIONS

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, or other acceptable documentation.

OPERATION AND MAINTENANCE

The following actions shall be carried out to insure that this practice functions as intended throughout its expected life.

The riparian forest buffer will be inspected periodically and protected from adverse impacts such as excessive vehicular and pedestrian traffic, pest infestations, 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.

As applicable, control of concentrated flow erosion and sediment deposition shall be controlled by an adjacent filter strip.

Any use of fertilizers, pesticides and other chemicals to assure buffer function shall not compromise the intended purpose.

GENERAL SPECIFICATIONS

Procedures, technical details and other information listed below provides additional guidance for carrying out selected components of the named practice. This material is referenced from the conservation practice standard for the named practice and supplements the requirements and considerations listed therein.

Planted Riparian Buffers

PLANTING DENSITIES

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) from plant field guides or other suitable references.

Plant Types/Heights:	Plants per Acre	Plant-to-Plant Spacing in Feet:
• Shrubs less than 10 feet in height	4500 to 1200	3 to 6
• Shrubs and trees from 10 to 25 feet in height	1500 to 450	5 to 10
• Trees greater than 25 feet in height	1200 to 200	6 to 15

When establishing a planted buffer, a minimum of two (2) rows of trees or (2) rows of shrubs should be established alongside the water body for maximum shade, stabilization and nutrient uptake within the desired buffer width. The remaining area of the designated riparian zone should also be planted or left to meet natural regeneration requirements, plantings can be intermixed with open areas treated for natural regeneration and specific wildlife needs. These openings should not exceed 4,356 square feet (1/10 acre) in area. Open areas should not exceed 25% of the remaining planned riparian zone.

Naturally Regenerating or Direct Seeded Riparian Buffers

ESTABLISHMENT DENSITIES

A naturally regenerated riparian buffer is considered initially established when plant densities have reached the planted buffer recommended densities for trees and shrubs. A three (3) year growing season period is a reasonable amount of time in which to determine if natural regeneration would take place and be initially established.

Trees and shrubs are considered established when they have begun to dominate herbaceous plants and undesired shrubs that are competing with it for nutrients, water and sunlight.

All areas immediately adjacent to the watercourse should have trees and or shrubs growing near it. Open areas within the area designed as a buffer should not exceed 1/10th acre in size and should not exceed more than 25% of the total designated buffer area.

CARE, HANDLING, SIZE AND PLANTING REQUIREMENTS FOR WOODY PLANTING STOCK

Planting stock will be cared and handled as described in Standard and Specification 612.

DIRECT SEEDING OF WOODLAND SPECIES

Buffer areas can be direct seeded as described in National Standard and Specification 652.

PREPARATION OF PLANTING

Planting sites shall be properly prepared based on the soil type and vegetative conditions listed in Woodland Site Preparation, Code 490. For sites to be tilled, leave a 3-foot untreated strip at the edge of the bank or shoreline. Avoid sites that have had recent application of pesticides harmful to woody species to be planted. If pesticides are used, apply only when needed and handle and dispose of properly and within federal, state and local regulations. Follow label directions and heed all precautions listed on the container.

Fabric mulch may be used for weed control and moisture conservation for new plantings on all sites, particularly those with pronounced growing season moisture deficits or invasive, weedy species. Refer to Mulching, 484, for installation procedures.

BUFFER WIDTHS

Even minimum buffer widths provide some benefits to the stream ecosystem. In most instances additional width in excess of basic minimums provide less benefits for specific concern the further the distance from the stream or water body. It is best to base buffer widths on a large array of concerns, including social and economic needs of the landowner as well as other non-water quality related concerns, such as wildlife.

Range of Minimum Width for Meeting Specific Buffer Objective (Palone and Todd)

Concern	Range of Widths
Wildlife	15 to 600 Feet
Water Temperature	5 to 75 Feet
Flood Control	100 to 200 Feet
Streambank Stabilization	15 to 60 Feet
Sediment Control	50 to 200 Feet
Nutrient Removal	50 to 200 Feet

BUFFER WIDTH GUIDE FOR SELECTED WILDLIFE SPECIES

Widths below include the sum of buffer widths on one or both sides of water courses or water bodies and may extend beyond riparian boundaries (in such cases refer to Tree/Shrub Establishment, 612, for design of upland forests).

Species:	Desired Width in feet:
• Bald eagle, cavity nesting ducks, heron rookery, sandhill crane	600
• Common loon, pileated woodpecker	450
• Beaver, dabbling ducks, mink, salmonids	300
• Deer	200
• Lesser scaup, harlequin duck	165
• Frog, salamander	100

TABLE 1 - TREE AND SHRUB SPECIES FOR RIPARIAN AREAS

	HEIGHT AT AGE:		TOTAL	Shade Tolerance (1)	Shade Value (2)	Nutrient Uptake (3)	Inundation Tolerance (4)	Soil Saturation Tolerance (5)	Drought Tolerance (6)	Aesthetics (7)	Native Species (8)	Sediment Deposit Tolerance (9)	Root Depth (10)	Wildlife Value (11)
	10	20	HEIGHT	(L=low, M=med., H=high, Y=yes, N=no)										
COMMON AND SCI NAMES	(feet)	(feet)	(feet)											
Tree (Conifer)														
White Pine (Pinus strobus)	10	24	100	M	M	M	M	M	M	M	Y	M		M
Hemlock (Tsuga canadensis)	8	20	70	M	H	M	L	L	H	H	Y	L		H
White Spruce (Picea glauca)	8	22	80	M	L	M	M	M	H	M	Y	L		M
Black Spruce (Picea mariana)	8	22	70	M	L	M	H	H	M	M	Y	M		M
Tammarack (Larix laricina.)	10	32	60	L	L	M	M	M	L	H	Y	L		H
Northern White-Cedar (Thuja occ)	6	18	60	M	M	M	M	M	M	H	Y	H		H
Tree (Deciduous)														
Silver Maple (Acer saccharinum)	15	50	60	H	H	M	M	M	M	H	Y	M		L
Black Willow (Salix nigra)	12	30	60	H	M	L	H	H	L	L	Y	H		M
Bass Wood (Tilia americana)	18	26	100	H	M	H	M	M	L	M	Y	M		M
Grey Birch (Betula populifolia)	15	25	30	L	L	L	L	M	M	L	Y	L		L/M
White Birch (Betula papyiferia)	15	34	70	L	L	L	L	L	M	H	Y	L		H
White Ash (Fraxinus americana)	18	36	70	L	L	M	L	L	M	M	Y	L		H
Black Ash (Fraxinus nigra)	16	30	60	L	L	M	H	M	L	L	Y	M		H
Box Elder Maple (Acre negundo)	12	30	50	L	M		H	H		L	Y		H	L
Red Maple (Acer rubrum)	15	40	60	H	M		H	H	M	H	Y			H
Swamp White Oak (Quercus bicolor)		30			M		H	H		L	Y			H
Green Ash (Fraxinus pennsylvanica)		50	60		H		M	H		L	Y			M
American Elm (Ulmus americana)			100		H		H	H	M	H	Y			L
Eastern Cottonwood (Populus delt.)			80		H		H				Y		L	M
Shrub														
Speckled Alder (Alnus rugosa)	6	12	20	M	M	M	M	H	M	L	Y	H	L	H
Red Ozier Dogwood	6	15	15	L	L	M	M	H	M	H	Y	H	L	H
Alternate-leaf Dogwood (Cornus	6	15	20	M	L	M	M	H	M	M	Y	H		
Pussy Willow (Salix bicolor)	6	12	12	M	L	M	H	H	M	M	Y	H		H
Nannyberry (Virburnum lentago)	5	9	30	M	M	M	M	M	M	M	Y	H	L	M
Witch Hazel (Hammenilis viginian)	6	18	20	M	L	M	M	M	M	H	Y	M		
Streamco willow	6	8	12	M	L	M	M	M	M	M	N	H		
Bankers Willow	6	8	12	M	L	M	M	M	M	M	N	H		
Serviceberry (Amelanchier arborea)			30		L					M	Y			H
Erect Willow (Salix eriocephala)											Y		L	
Sand Bar Willow (Salix exiqua)		25		M	M		H				Y		L	L
American Elderberry (Sambucus c.)		12	15	M	L		H			H	Y			H
Smooth Alder (Alnus serrulata)		10	12	M	L		H				Y			M
Gray Dogwood (Cornus racemosa)		10		M	L		M			H	Y		L	H
Silky Dogwood (Cornus amomum)		10	10	M	L		M				Y		L	H

Buttonbush (Cephalanthus occiden.)		8	15	M	L		H			M	Y		M	M

Attributes: (codes include H = High, M = Medium, L = Low, Y = Yes, N = No, with special notes about individual species denoted by a letter, e.g. “a”)

(1) Shade Tolerance. The plant’s capacity to grow in a shaded condition. H = can grow in the shade of an overstory; M = can grow in partial shade; L = needs full or nearly full sunlight.

(2) Shade Value. The density or fullness of shade provided by an individual plant’s crown in a full leaf-out condition. H = provides full shade; M = a partially open crown that provides patchy or incomplete shade; L = a very open crown that provides little shade.

(3) Nutrient Uptake. The plant’s general capacity to use excess nutrients such as nitrate-nitrogen. H = can use large amounts; M = some excess nutrients used; L = plant is a low-nutrient user.

(4) Inundation Tolerance. General capacity of the plant to withstand standing water, low soil aeration conditions. H = can tolerate10 or more days of inundation; M = can tolerate 2-10day events; L = can tolerate 1-day or less of inundation.

(5) Soil Saturation Tolerance. The plant’s capability to grow in near or saturated soil conditions. H = plant can withstand “wet feet;” M = some tolerance to saturated conditions; L = little or no tolerance of water-saturated soil.

(6) Drought Tolerance. The plant’s capability to grow in droughty or dry soil conditions. H = plant can withstand or has physiology to survive droughty periods; M = some tolerance to drought or dry conditions; L = little or no tolerance of dry soil conditions.

(7) Aesthetics. A very general rating (H, M or L) that indicates some aspect of the plant, e.g., flowers, special foliage characteristic, or plant part color, that enhances the appeal or viewing of the planting.

(8) Native Species. Y indicates the plant is native to the state; N indicates it is introduced.

(9) Sediment Deposition Tolerance. H = plant can withstand repeated, deep deposits of sediment; M = plant can withstand repeated, shallow deposits of sediment; L = plant can withstand little or no sediment deposits.

(10) Root Depth. H = plant roots deeply provides stability to the site; M = plant roots to an intermediate depth or variably; L = a shallow rooting plant that providing less site stability.

(11) Wildlife Value. H = trees and shrubs that are a good source of food and/or cover for wildlife; M = trees and shrubs that provide some food and/or cover; L = trees and shrubs that provide very little food and/or cover.