

**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.

PURPOSE

- 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.
- Restore riparian plant communities.
- Create or improve riparian habitat and provide a source of detritus and large woody debris.
- Reduce pesticide drift entering the water body.
- Create shade to lower or maintain water temperatures to improve habitat for aquatic organisms.
- Increase carbon storage in plant biomass and soils.

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 and designed to achieve sufficient width, length, vertical structure/density and connectivity to accomplish the intended purpose(s).

Use only viable, high-quality and adapted plant materials.

Dominant vegetation will consist of existing, naturally regenerated, or seeded or planted trees

and shrubs suited to the soil and hydrology of the site and the intended purpose(s). Refer to Table 1 for a list of suitable woody species for riparian forest buffers.

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

If tree roots threaten to clog any existing, functional subsurface tile lines the portion of the drainage system that passes under the buffer can be replaced with non-perforated pipe to alleviate root intrusion and to sustain the drainage system functionality. A constructed wetland at the outflow of the drainage system will intercept tile flow and replace the loss of filtering function of the altered drainage system. Alternatively; herbaceous cover may be planted on the part of the buffer that is over the tile drains.

Plant tree and shrub species that have multiple values such as those suited for timber, biomass, nuts, fruit, browse, nesting, cover, aesthetics or tolerance to locally used herbicides.

Prior to harvesting forest products such as high value wood, medicinal herbs, nuts, fruits or florals, assess the amount to be removed and determine that periodic harvesting of these products does not compromise the intended purpose by the loss of vegetation or harvesting disturbance.

Necessary site preparation and planting shall be done at a time and in a manner to insure survival and growth of selected species for achieving the intended purpose(s). Use the NRCS Conservation Practice Standard Tree/Shrub Site Preparation, Code 490; for guidance. Livestock shall be controlled or excluded as necessary to achieve the intended purpose. Refer to the NRCS Conservation Practice Standards: Prescribed

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Grazing, Code 528; and/or Use Exclusion, Code 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 NRCS Conservation Practice Standard Pest Management, Code 595. Use plant protection methods as appropriate including bud capping, plastic protectors, fencing and spray-on chemical inhibitors.

Buffer Establishment

Planting

Planting densities for trees and shrubs will depend on the species and 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 the Conservation Tree and Shrubs Groups found in Section I of the eFOTG under Plant Selection Tools.

Refer to NRCS Conservation Practice Standard Tree/Shrub Establishment, Code 612, for additional information on the spacing, density, age, size, handling, storage and quality of planting stock.

Natural Regeneration

Where frequent flooding makes tree planting impractical, or where sufficient seed trees of desirable species are present revegetation can be accomplished by enhancing or allowing natural succession to occur. For more information on establishment by natural regeneration refer to NRCS Conservation Practice Standard Tree/Shrub Establishment, Code 612.

Site Preparation

Site preparation shall be sufficient for tree/shrub establishment and growth of selected species. Refer to NRCS Conservation Practice Standard Tree/Shrub Site Preparation (formerly Forest Site Preparation), Code 490.

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 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.

A minimum width of 50 feet is recommended 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.

For slopes equal to or greater than 10%; the minimum width is 50 feet and for each 1% increase in slope, add 2 feet to the minimum width.

When excessive sheet-rill and concentrated flow erosion from the area immediately adjacent and upslope of the proposed buffer site is greater than 10 tons/acre/year; use NRCS Conservation Practice Standards: Filter Strip, Code 393, Field Border, Code 386, Critical Area Planting, Code 342, Grassed Waterway, Code 412 or another suitable practice to lower the amount of upslope runoff and soil erosion.

When greater than 50 percent of the runoff from the buffer site is or will remain concentrated in gullies or other channelized flow mechanisms use any suitable device such as level spreaders, grading and shaping, vegetative barriers upslope from the riparian buffer, vegetative barriers within the riparian buffer, contour furrows, contour buffers or other suitable practices to disperse the concentrated flow. Also, use any of the above practices where combined sheet, rill and wind erosion from areas contributing sediment to the buffered area exceeds 3 tons/acre/year and the area contributing that sediment is greater than or equal to 60 times the area of the riparian buffer ($\geq 60:1$ upland to riparian buffer ratio).

Existing, functional subsurface drains through the riparian area will pass pollutants directly to the outlet. To filter such pollutants, drains can be plugged, removed or replaced with perforated pipe and end plugs to allow passage and filtration of drain water through the riparian forest root zone.

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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 by Creating Shade or Lowering Water Temperatures, Restore Riparian Plant Communities and Provide a Source of Detritus and Large Woody Debris.

Extend riparian buffers widths to enhance wildlife habitat according to the widths shown in the chart below. Widths are for one-side of the river, stream, creek, ditch, slough, etc.

These widths represent minimums and are not site specific.

| Species | Width in Ft. |
|---|--------------|
| Bald eagle, cavity nesting ducks, heron | 600 |
| Common loon, pileated woodpecker | 450 |
| Beaver, dabbling ducks, mink and to | 300 |
| Deer | 200 |
| Lesser scaup, harlequin duck, muskrat | 165 |
| Frog, salamander | 100 |

Establish plant communities that address the target aquatic and terrestrial wildlife needs and have multiple values such as habitat, nutrient uptake and shading. Plant at the appropriate stocking rate for the targeted species and site conditions.

To provide coarse woody debris, avoid disturbing existing large downed logs and stumps. If a snag must be dropped, leave it where it falls whenever possible. To create coarse woody debris cut 2-5 bark-on logs greater than 12 inches in diameter per acre. Preferably select hollow butt sections of at least 6 feet in length or other defective logs at least 6 feet in length. Cut sound logs only if there is not enough defective material available.

For shading streams and rivers, the buffer canopy at maturity shall be established to achieve at least 50 percent crown cover with average canopy heights equal to or greater than the width of the water body or 30 feet for larger water bodies. See Figure 1.

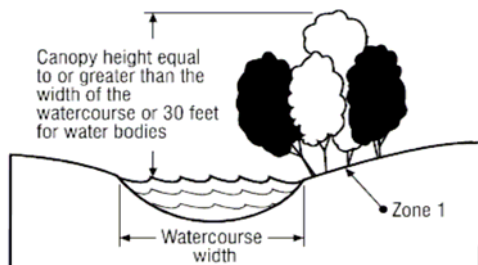


Figure 1: Canopy height for water temperature control.

Additional Criteria for Increasing Carbon Storage in Biomass and Soils

The minimum width shall be 15 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.

Maximize width and length of the riparian forest buffer to take full advantage of carbon sequestration capability.

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

Use plant species that accumulate biomass quickly since they also sequester carbon faster. The rate of carbon sequestration is enhanced as riparian plants mature and soil organic matter increases. Trees that have the potential to store a significant amount of carbon are: Eastern cottonwood, hybrid poplar, black willow and other large willows, green ash, silver maple, American basswood, aspen and red and white pines; in general, hardwood species provide more carbon sequestration capability than conifers.

Use the NRCS Conservation Practice Standard Forest Stand Improvement, Code 666, to manage buffers for producing large and/or long-lived trees that store carbon.

CONSIDERATIONS

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

Native, non-invasive plants are preferable over non-native, introduced or invasive plants. Improved stock should be used if desired such as using disease resistant white pine in areas of high white pine blister rust areas.

Complex ownership patterns of riparian areas may require group planning for proper buffer design, function and management.

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. Use the NRCS Conservation Standard Tree/Shrub Establishment, Code 612 to select appropriate trees and shrubs.

Allelopathic impacts of plants should be considered. Walnut, hickory, sugar maple, hackberry, cottonwood, black locust, black cherry, red oak, and American elm are known to have allelopathic effects on nearby plants including other woody species.

Use species that resprout or that can be propagated by layering when establishing new rows nearest to water courses or bodies to improve the filtering capacity of the buffer.

Joining of existing and new buffers increases the continuity of cover and will further moderate water temperatures. A mix of species with growth forms that are tall and wide-crowned or drooping will increase moderation effects. For water courses, buffers established on both sides will enhance multiple values.

The location, layout and density of the buffer should complement natural features. Avoid designs or locations that would concentrate flood flows or return flows. Flexible-stemmed shrubs will minimize obstruction of local flood flows. Avoid establishing buffers in windthrow prone locations.

If circumstances permit, expand the buffer beyond the minimum width to enhance the benefits and values of wildlife habitats.

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/or narrative statements in the conservation plan, or other acceptable documentation.

These documents are to specify the requirements for installing the practice, such as the plant species, amount and quality of materials to be used and the timing or sequence of installation activities. Requirements for operation and maintenance of the practice shall be incorporated into site specifications.

OPERATION AND MAINTENANCE

The following actions shall be carried out to insure that this practice functions as intended throughout its expected life. These actions include normal repetitive activities in the application and use of the practice and repair and upkeep of the practice.

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.

As applicable, control of concentrated flow erosion shall be continued in the area up-gradient of the riparian area to maintain buffer function.

Following severe storms check for evidence of sediment deposits, erosion or concentrated flow channels. Prompt corrective action needs to be taken to stop erosion and restore sheet flow.

Replacement of dead trees or shrubs and control of undesirable vegetative competition will be continued until the buffer is in a fully functional condition.

The following should be avoided within the buffer strips: excess use of fertilizers, pesticides, or other chemicals and removal or disturbance of vegetation and litter inconsistent with erosion control and buffering objectives.

As the riparian forest buffer approaches 40 years of age, it will begin to produce large stable debris. Wherever possible, this stable debris should be conserved.

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 NRCS Practice Standard Forest Stand Improvement, Code 666 for more information. For more information on state guidelines for riparian forest buffer management refer to: *Sustaining Minnesota Forest Resources: Voluntary Site-Level Forest Management Guidelines for Landowners, Logger and Resource Managers*, in particular Appendix I: Silvicultural Examples for Riparian Areas.

Where debris dams must be removed, retain as much as possible useful stable portions which provide detritus storage. Remove unstable and smaller debris which will contribute to unwanted debris jams. Deposit removed material a sufficient distance from the stream so that it will not be refloated by high water.

Control or exclusion of livestock and harmful wildlife shall continue over the life of the practice.

Refer to the NRCS Conservation Practice Standards Prescribed Grazing, Code 528, and/or Use Exclusion, Code, 472, as applicable. Additional operation and maintenance requirements shall be developed on a site-specific basis to assure performance of the practice as intended.

Subcommittee of the Chesapeake Bay Program.
Annapolis, MD.

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TABLE 1: Woody Species Recommended for Establishing Forest Riparian Buffers*

| Common Name | Scientific Name | Flooding Tolerance | Large Debris | Shade Value | Wildlife Merit | Potential Mature Height (ft) |
|--------------------------|--------------------------------|--------------------|--------------|-------------|----------------|------------------------------|
| American cranberrybush | <i>Viburnum trilobum</i> | H-M | L | L | H | 16 |
| American plum | <i>Prunus americana</i> | L-M | L | L | H | 10 |
| Arrowwood | <i>Viburnum dentatum</i> | H | L | L | H | 8 |
| Ash, green | <i>Fraxinus pennsylvanica</i> | M | M | M | M | 60 |
| , white | <i>F. americana</i> | M | M | M | M | 80 |
| , black | <i>F. nigra</i> | H-M | M | M | M | 70 |
| Aspen, quaking | <i>Populus tremuloides</i> | L | M | M | H | 80 |
| Birch, white | <i>Betula papyrifera</i> | M-H | M | M | H | 70 |
| , river | <i>B. nigra</i> | M-H | M | M | M | 70 |
| , yellow | <i>B. alleghaniensis</i> | M-H | H | M | H | 60 |
| Basswood | <i>Tilia americana</i> | L-M | H | H | L | 100 |
| Black chokeberry | <i>Aronia melanocarpa</i> | M | L | L | H | 30 |
| Cedar, red | <i>Juniperus virginiana</i> | M | M | H | H | 40 |
| , white | <i>Thuja occidentalis</i> | H-M | M | H | H | 50 |
| Chokecherry | <i>Prunus virginiana</i> | L-M | L | L | H | 30 |
| Cottonwood, eastern | <i>Populus deltoides</i> | H-V | H | H-V | M | 100 |
| Dogwood, red osier | <i>Cornus sericea</i> | H | L | L | M | 10 |
| , silky | <i>C. amomum</i> | H | L | L | M | 10 |
| , gray | <i>C. racemosa</i> | M | L | L | M | 10 |
| False indigo | <i>Amorpha fruticosa</i> | H | L | L | L | 18 |
| Fir, balsam | <i>Abies balsamea</i> | M-H | M | M | H | 60 |
| Hackberry, common | <i>Celtis occidentalis</i> | M | M-H | H | H | 100 |
| Hawthorn, cockspur | <i>Crataegus crusgalli</i> | M | L | L | H | 25 |
| Hazelnut, american | <i>Corylus americana</i> | M | L | L | H | 25 |
| Maple, silver | <i>Acer saccharinum</i> | H | H | H | M | 95 |
| , red | <i>A. rubrum</i> | H | H | H | M-H | 70 |
| Nannyberry | <i>Viburnum lentago</i> | M | L | L | H | 14 |
| Ninebark, common | <i>Physocarpus opulifolius</i> | L | L | L | H-M | 10 |
| Oak, bur | <i>Quercus macrocarpa</i> | H-M | H | H | H | 80 |
| , northern pin | <i>Q. ellipsoidalis</i> | M-L | H | H | H | 75 |
| , red | <i>Q. rubrum</i> | L | H | H | H | 80 |
| , swamp white | <i>Q. bicolor</i> | H | M | H | H | 70 |
| Pine, jack | <i>Pinus banksiana</i> | L | L | M | L | 80 |
| , red | <i>P. resinosa</i> | M | H | M | M | 80 |
| , white | <i>P. strobus</i> | M | H | H | H | 100 |
| Spruce, black | <i>Picea mariana</i> | H-V | M | M | M-H | 70 |
| , white | <i>P. abies</i> | M-L | H | M-H | H | 80 |
| Serviceberry (Juneberry) | <i>Amelanchier alnifolia</i> | M-L | L | L | H | 12 |
| Tamarack (Larch) | <i>Larix laricina</i> | H-M | H | M | M | 75 |
| Walnut, black | <i>Juglans nigra</i> | L | M | M | H | 60 |
| , white | <i>J. cinerea</i> | L | M | M | H | 60 |
| Willow, black | <i>Salix nigra</i> | H | M | H | M | 60 |
| , sandbar | <i>S. exigua</i> | H-V | L | L | L | 8 |
| , peachleaf | <i>S. amygdaloides</i> | H | L | L | L | 25 |
| Winterberry | <i>Ilex verticillata</i> | H | L | L | H | 9 |

Relative ranking values: V = Very high; H = High; M = Medium; L = Low

*This is not an all inclusive list of species to plant or a list of only those species eligible for establishment with cost share. All native species which are locally adapted may be recommended for establishment. Additional references you may want to consult for species recommendations include:

"Trees and Large Shrubs: Species Native to Minnesota's Ecological Regions" by MN/DNR Division of Forestry and "Minnesota Tree Handbook" by MASWCD.

*Refer to Conservation Tree and Shrub Groups in Section 1 Plant Selection Tools in the eFOTG for additional information on suitability of trees and shrubs for specific soils.

Flooding Tolerance describes the relative capacity of the species to survive standing water or anaerobic soil conditions. Species shown with a "V" ranking have the ability to survive deep, prolonged flooding; "H" the ability to survive flooding for one growing season, with significant mortality occurring if flooding is repeated the following year; "M" the ability to survive flooding or saturated soils for 30 consecutive days during the growing season; "L" relatively unable to survive more than a few days of flooding during the growing season without significant mortality.

Large Debris describes the relative potential for the species to produce woody debris larger than ten inches in diameter before senescence. "H" indicates that large debris is likely within the species life span; "M" indicates that large debris is possible within the species life span; "L" indicates that large debris is unlikely.

Shade Value describes the density or degree of shade provided by the species' crown canopy in leaf out condition. "H" indicates that the species has a large crown canopy capable of providing full shade; "M" indicates that the species has a medium or narrower crown and/or an open grown canopy that provides partial shade; "L" indicates that the species is open grown, has a small canopy, or is too short to provide anything except minimal shade.

Wildlife Merit describes the relative potential for the species to be valuable for wildlife including providing useful cavity sites, quality nesting cover, or quality fruit and food production. "H" indicates excellent large cavity potential, nesting cover or fruit production; "M" indicates moderate cavity potential, nesting cover or fruit production; "L" indicates low cavity potential, nesting cover, or fruit production.

Potential Height indicates the species' potential height at maturity.