

**Riparian Buffers in Forest Management:  
Establishment, Effectiveness and Recommendations**

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## Introduction

Properly established and managed forested riparian buffers, sometimes referred to as Streamside Management Zones (SMZ's) or Riparian Management Zones (RMZ's), are widely recognized as a preferred means to protect water quality. Buffers are commonly established during the planning and operational phases of forest management activities. Examples of these situations include timber harvesting operations, road construction, herbicide/fertilizer applications, practices related to reforestation, and aesthetics enhancement. Buffer effectiveness is a function of width, vegetative composition, and the degree of disturbance within the buffer area.

The North Carolina Division of Forest Resources supports the policy adopted by the National Association of State Foresters regarding forestry's role in managing watersheds. An excerpt states:

The protection and management of watersheds must consider that forests are dynamic. Wildfire, floods, insects and disease, hurricanes, and windstorms will alter forest conditions at the watershed scale....Management practices can also emulate (but not necessarily duplicate) disturbance events and thus be used to maintain forest and watershed health, while also providing an array of social, economic and environmental services. Increasing the ability....to manage, protect and enhance forests for water supply, water quality and watershed health will be needed to sustain the health of our forests and our watersheds in the future (NASF: October 2, 2002).

## Buffer Establishment

Determining the appropriate width of riparian buffers should be fact-based, and identified on the ground using site-specific criteria, such as:

- Purpose of the buffer
- Type and/or size of water body being protected
- Soil type and erodibility potential
- Slope and land-use of adjoining uplands
- Tree age and spatial distribution
- Ground cover type, amount and distribution

The concepts of appropriate buffer establishment are described below by Verry, et al. (pp277-280):

- *Some will argue that the wider the RMZ, the greater the protection given to riparian functions. At some point, increasing the width of the RMZ and imposing more restrictions on management will conflict with economic considerations, the landowner's management objectives, and issues of property rights...*
- *It could be difficult to convince nonindustrial private forest (NIPF) landowners to maintain a wide RMZ with many management restrictions where riparian edge is a significant portion of small tracts...*
- *The bulk of protection for water quality, aquatic habitat, and riparian functions occurs closest to the water body and diminishes with increasing distance from the water body...*
- *Ability to harvest riparian [tree] species with economic value is necessary to encourage continued landowner commitment to maintaining these areas.*

## Buffer Effectiveness: Sediment Capture

The USDA-Natural Resources Conservation Service (NRCS) states:

- Most sediment is trapped within the first 25% of a buffer's width (the area furthest out from the water)
- Twenty-five (25) feet is the minimum buffer width necessary to effectively protect water resources.

The National Council for Air and Stream Improvement (NCASI) provides this summary of research that examined the effectiveness of sediment capture by buffer filter strips (p41):

- *90% of sediment flows from roads are trapped within [26 feet] of entering a buffer on nearly level ground, but on 70% slopes sediment flows would require [167 feet] to be trapped.*
- *Buffer width would have to be doubled for domestic water supplies....*
- *Swift Jr. (1986) measured similar distances to trap sediment flows on level and steep slopes in the southern Appalachians.*

### **Buffer Effectiveness: Nutrient Capture**

Effectiveness of forest buffers to capture nitrate as outlined in NCASI (p35):

- *Hubbard and Lowrance (1996) found that most of the nitrate is removed after [23 to 40 feet] movement through a riparian forest...*
- *Peterjohn and Correll (1984) observed that the greatest reductions of [nitrate] occur in the first [56 feet] of a [164 feet] riparian forest buffer in an agricultural watershed in Maryland.*

The effectiveness of forest buffers to capture polluting forms of phosphorus is adequately handled in most cases, since “much of the [phosphorus] is filtered along with sediment in a particulate form” (NCASI, p37).

In addition, younger aged trees typically process and capture more nutrients than older aged trees, as a result of rapid tissue growth exhibited in the stages of new tree growth (Smith, et.al.; Wenger).

### **Buffer Effectiveness: Water Temperature**

Maintaining adequate shading to insure continuity of water temperature while undertaking forest management activities is important in order to achieve proper conditions for the aquatic habitat of the water resources being protected.

- *Clear-cutting effects on temperature of water in streams is variable, depending on volume of streamflow, elevation, shape of the channel, orientation of the watershed, and its latitude....*
- *As a rule of thumb, leaving enough vegetation to fully shade the stream channel at midday will hold water temperature close to levels in the uncut forest....*
- *There is no single width of shade strip that suits all conditions; rather, the watershed manager must adapt to local conditions and owner objectives, doing whatever is necessary to keep temperatures at appropriate levels....(Patric, p52).*

### **Buffer Effectiveness: Wildlife and Avian Considerations**

Riparian areas serve as important wildlife and avian habitat, especially in urban or agriculture settings where the only forest available in a localized area is whatever forest exists along riparian corridors.

- *Although complete protection has been commonly used to “manage” riparian habitats, many riparian areas are amenable to active management...*
- *In fact, optimizing wildlife habitat quality over time requires active vegetation management; more species will occupy managed rather than unmanaged riparian forests...*
- *The vegetation structure of riparian areas largely determines the wildlife habitat values for the avian community....(Verry et al., p139-143).*

### **Buffer Management Regimes**

Once a forested buffer is identified and established, it is essential to manage the buffer to maintain the ecological functions of the riparian area, including the need to harvest trees. Management of riparian buffer areas is especially critical to promote forest health, as it relates to insects, diseases, wildfires, infrequent storm events and control of exotic invasive plant species. As noted:

- *...No-cut buffers do not accommodate the natural range of variability in riparian forests, including differences in potential composition and productivity.*
- *These buffers ignore the fact that disturbance is a natural part of riparian systems*
- *...And they provide minimal flexibility for meeting diverse management objectives.*  
(Verry, et al. p235-236).

## Trends in Buffer Implementation and Management

Appendix I is a matrix summary from a variety of sources across the country describing buffer requirements or recommendations for forestry. There are two important observations to note from this summary:

- 1: The width recommendations, even for ‘special waters’, call for corridors of widths significantly less than 300 feet. The maximum widths noted typically fall in the range of 150 - 200 feet, even on sites of steep slope.**
- 2: There are very few cases in which a ‘no-cut’ buffer is required for forestry activities. More importantly, forestry or silvicultural practices are normally allowed, including timber removal, within the buffer.** However, in most cases, intensive activities within the buffer area are discouraged or not allowed, such as fertilizer application, herbicide use, and tractor-assisted site preparation or tree planting.

Some specific examples of riparian buffer implementation and management practices in other states:

**South Carolina’s** ‘Heritage Trust’ program allows for timber cutting in order to enhance the ecological integrity of the acquired forestland. Examples may include harvests to re-establish longleaf pine, or other species considered more appropriate for a particular site. Width of riparian buffers during harvesting activities on acquired lands would be considered on a case-by-case basis, though buffers somewhat wider than those recommended by that State’s BMP guidelines would likely be established.

**Georgia’s** ‘Community Greenspace’ land conservation program recognizes the economic, environmental and social benefits of land that is managed for sustainable forestry, and allows managed timberlands to qualify as acceptable ‘Greenspace.’ A management plan developed by a forester is required, and the timber must be managed in accordance to Georgia’s ‘Forest Stewardship’ guidelines. Implementing BMP’s is required when any operations are conducted on the property. Clearcut harvesting is allowed if appropriate aesthetic buffers are retained along all public highway corridors.

**In Virginia**, lands in the eastern “Tidewater” region fall under the jurisdiction of the Chesapeake Bay Act, which requires a minimum 100-foot wide ‘no-cut’ vegetative buffer along all perennial waters located within that region. However, ongoing silviculture activities are exempt from this Act, and limited timber harvesting is allowed within the buffer if forestry BMP’s are implemented, as outlined by the Virginia Department of Forestry. The Virginia Department of Forestry is required to inspect all operations that claim the exemption, to insure the operation is a justified silvicultural activity, and not related to a land-use change.

**In the City of New York watershed**, the Watershed Agricultural Council’s Watershed Forestry Program provides written management plans for cooperating private landowners whose holdings exist within the watershed for the City’s drinking water supply. Riparian buffers are delineated using a field key developed by the USDA-Forest Service, which takes into account the bank structure, floodplain characteristics and accompanying upland slope factors of the individual waterbody being protected. The management plans provide for timber harvesting and forestry activities that are consistent with protecting water quality.

**New York State’s** Division of Lands and Forests requires written management plans on all properties in which the State purchases a conservation easement, and promotes continued management of the property for sustainable forest resources. Riparian buffers are implemented on a “resource-based” approach, taking into account the water resource that is being protected and adjusting buffer recommendations accordingly.

## Recommendations

The North Carolina Division of Forest Resources ('DFR') proposes the following recommendations be considered regarding riparian buffer areas on tracts purchased by the North Carolina Clean Water Management Trust Fund ('CWMTF'):

- 1. Active forest silvicultural practices, including timber harvesting, should be an allowable practice within the riparian buffer area.** All forest silvicultural activities must comply with the N.C. Forest Practices Guidelines Related to Water Quality. North Carolina Forestry Best Management Practices (BMP's) must be implemented as described in the N.C. Forestry BMP Manual (the most recent edition at the time of the scheduled activity).
- 2. The tract must be managed according to a written forest management plan created and executed by a North Carolina Registered Forester.** This plan would specifically outline any work that is proposed to occur within a riparian area. The grant applicant would be responsible for having this plan written or developed, at the applicant's own expense. A copy of the plan would be provided to the CWMTF within six (6) months after a grant award.
- 3. Riparian buffer widths would be established to meet or exceed the minimum recommendations detailed in the N.C. Forestry BMP Manual** (the most recent edition at the time of the scheduled activity). Division of Forest Resources personnel would create a written pre-harvest plan prior to any timber harvesting activity, and monitor timber-harvesting operations while work is ongoing and document each visit. Any inconsistencies discovered during the visit would be handled via normal procedures that already exist within the DFR (*ie*: Policy & Procedure 4808). The appropriate CWMTF representative would be notified of any inconsistent practice, with follow up regarding the remedial and/or referral actions undertaken.
- 4. Use of the DFR's Self-Audit Program by the responsible party (in lieu of obtaining a site-closure visit by a DFR Forester) would be required** while any forestry operations are undertaken on the tract.
- 5. The DFR would assist the CWMTF staff with cooperative on-site inspections of tracts** of land in which any grant application is pending with the CWMTF for either acquisition or conservation easement. The DFR's representative would meet with the CWMTF's representative on a tract to evaluate any site-specific issues relating to the management of forested riparian buffers on the tract, only as it relates to potential future forest management activities, including timber harvesting. Final determination and buffer recommendations would be outlined in the written forest management plan, as described above in Paragraph 2. Dispute resolution regarding the final implementation and activity allowed within the riparian buffers would be resolved by establishing and managing the riparian buffer area of question in accordance to the technical specifications outlined in USDA-Forest Service publication number NA-PR-07-91, *Riparian Forest Buffers: Function and Design for Protection and Enhancement of Water Resources* (1992).

## DFR Position Statement

The North Carolina Division of Forest Resources ('DFR') respectfully requests that the North Carolina Clean Water Management Trust Fund (CWMTF) amend its current policy of requiring the establishment of minimum 300-foot preservation riparian buffers upon lands that are acquired by CWMTF grant awards. Prevailing research and practical in-field applications indicate forested buffers of substantially less than 300 feet provide adequate protection of water quality, while achieving sustainable forestry goals, where proper BMP's are employed.

Implementation of mandated buffer widths by the CWMTF may encumber a significant amount of acreage, and limit the ability of natural resource professionals to sustainably manage riparian areas, and associated upland areas. Opportunities to conserve green space and help contribute to the Governor's *One North Carolina Naturally* million acre goal could be lost or compromised when cooperating landowners decide that a resulting loss in income stream outweighs the gains of preserving the land. As a reference note, for every one-quarter mile of horizontal buffer established at a total width of 600 feet (*300 feet on both sides of a waterbody*), eighteen acres are permanently encumbered, or nearly 80 acres per mile. In financial terms, this loss could amount to thousands of dollars per acre during a timber sale, which typically occur only once or twice during a private landowner's lifetime.

The DFR, as it continues to expand the Educational State Forest system across the State, must also contend with the CWMTF's requirements of extraordinarily wide, preserved riparian buffers on tracts of land that are purchased with CWMTF funding. Demonstrating sustainable forest management while protecting water quality, facilitating environmental educational programs, and providing recreational opportunities for the citizens of North Carolina are paramount to the management goals of the DFR's assigned forest properties. The DFR remains committed to its part in protecting and enhancing water quality in North Carolina's forests; this commitment dovetails with the CWMTF's strategic directive. However, placing unnecessarily stringent covenants upon property acquired by CWMTF grants can unduly restrict a landowner's options, or the DFR's ability to showcase good forest management practices that can be utilized to sustain properly functioning riparian areas.

## Appendix I: Summary of Selected Forested Buffer Recommendations

Agency / Source	Minimum Buffer Width (feet) <i>Normal Waters</i>	Buffer Width Range (feet) <i>Normal Waters</i>	Preferred Buffer Width (feet) <i>Special Waters*</i>	Allowable Activities
Alabama	35	Must maintain water quality standards	Must maintain water quality standards	Managed Forest, Selective harvesting
Arkansas	35	35 - 80	80+	Managed Forest, Selective harvesting
Catawba River (Mainstem temp. buffer rule)	50	50+	50+	Managed Forest, selective harvesting of high value trees
City of New York Water Supply watershed plans	Min. NY State BMP w/ Site-specific Adjustments <sup>1</sup>	Min. NY State BMP w/ Site-specific Adjustments <sup>1</sup>	Min. NY State BMP w/ Site-specific Adjustments <sup>1</sup>	Managed Forest captured by a written plan
Florida	35	35 - 200	200	Managed Forest, Selective harvesting
Georgia	20	20 - 100	100 minimum on trout waters	Managed Forest, Selective harvesting
Idaho	30	30 - 75	75+	Managed Forest, Selective harvesting
Kentucky	25	25 - 55	60+	Managed Forest, Selective harvesting
Mississippi	30	30 - 60		Managed Forest, Selective harvesting
N.C. Forestry BMP	50	50 - 100	125+	Managed Forest, Selective harvesting
N.C. Wildlife Resources Comm.	N.C. BMP's	N.C. BMP's	N.C. BMP's	Managed Forest, Selective harvesting
Neuse & Tar/Pamlico riverbasins buffer rule	50	50+	50+	Managed Forest, selective harvesting of high value trees
New York State	50	50 - 150	150+	Selective Harvesting
South Carolina	40	40 - 120	80+	Managed Forest, Selective harvesting
Tennessee	25	25 - 145	Min. 50	Managed Forest, Selective harvesting
USDA-Forest Service ( <i>unk</i> )	25	25 - 170	170+	Managed Forest, Selective harvesting
USDA-NRCS	25	50 - 100	200	Managed Forest, Selective harvesting
Virginia	50	50	60 – 200	Managed Forest, Selective harvesting

\**Special Waters include drinking water supplies, ONRW, Wild & Scenic, trout-quality waters, or other waterbodies that may warrant additional protection as determined by the governing Agency/Source.*

<sup>1</sup> *Riparian buffers are delineated according to a subjective field-key developed by the USDA-Forest Service as described in Figure 2.3 of Verry, et al.*

Additional tabular summaries are located in Verry, et al.:

Page 140, Table 8.1 "Guidance for riparian area widths and suggested management practices in northern New England"

Page 237, Table 14.1 "Best management practices for riparian forests in selected eastern states"

Page 275, Table 16.1 "Potential impacts to riparian areas from forest management activities"

Page 278, Table 16.2 "Examples of RMZ widths and harvest restrictions"

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