University of Nebraska - Lincoln
DigitalCommons@University of Nebraska - Lincoln

Agroforestry Notes (USDA-NAC)

USDA Forest Service -- National Agroforestry Center

1-1-1997

How to Design a Riparian Buffer for Agricultural Land

Michael dosskey
University of Nebraska - Lincoln, mdosskey2@unl.edu

Dick Schultz
Iowa State University

Tom Isenhart
Iowa State University

Follow this and additional works at: http://digitalcommons.unl.edu/agroforestnotes

Part of the Forest Sciences Commons

dosskey, Michael; Schultz, Dick; and Isenhart, Tom, "How to Design a Riparian Buffer for Agricultural Land" (1997). *Agroforestry Notes (USDA-NAC)*. Paper 3.
http://digitalcommons.unl.edu/agroforestnotes/3

This Article is brought to you for free and open access by the USDA Forest Service -- National Agroforestry Center at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Agroforestry Notes (USDA-NAC) by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

AF Note — 4

Agroforestry Notes

USDA Forest Service, Rocky Mountain Station • USDA Natural Resources Conservation Service

January, 1997

How to Design a Riparian Buffer for Agricultural Land

Mike Dosskey, National Agroforestry Center; Dick Schultz and Tom Isenhart, Iowa State University, Department of Forestry

Purpose

Identify four basic steps to follow when designing a riparian buffer

Design Steps

1) Determine what benefits are needed
2) Identify the best types of vegetation to provide the needed benefits
3) Determine the minimum acceptable buffer width
4) Develop an installation and maintenance plan

Step #1

Determine what benefits are needed

Determine what problems are present at the site that a buffer can help solve. If you are assisting a landowner, use this information to help the landowner become aware of all the possible benefits a buffer can provide. For example, you might see:

- unacceptable bank erosion
- cultivated crops, livestock enclosures, or grazing along a waterway
- algae blooms or excessively turbid water
- lack of shade and larger debris for fish habitat
- sparse wildlife habitat
- low diversity of vegetation in the surrounding landscape
- cultivated cropland on a low floodplain.

Next, determine what the landowner wants to achieve with the site. This information may be in the form of problems the landowner wants solved (e.g., “I want that bank erosion stopped”) or conditions the landowner wants to see (e.g., “I want more wildlife”).

Then, prioritize the landowner’s needs. For example, a high priority — “I **must** stop bank erosion”, and a lower priority — “getting wildlife, too, would be nice”. Be aware that there may be site problems a buffer can solve which the landowner has no interest in addressing. There may be other problems, such as severe streambank erosion, which a buffer cannot solve.

Step #2

Identify the best types of vegetation for providing the needed benefits

There are three basic types of vegetation: grasses (including forbs), shrubs, and trees. Each type can provide certain benefits better than the others. Table 1 compares grass, shrubs, and trees for the relative level of specific benefits they can provide in an agricultural riparian buffer.

Table 1: Relative effectiveness of different vegetation types for providing specific benefits

Benefit	Vegetation Type		
	Grass	Shrub	Tree
Stabilize bank erosion	low	high	high
Filter sediment	high	low	low
Filter nutrients, pesticides, microbes			
sediment-bound	high	low	low
soluble	medium	low	medium
Aquatic habitat	low	medium	high
Wildlife habitat			
range/pasture/prairie wildlife	high	medium	low
forest wildlife	low	medium	high
Economic products	medium	low	medium
Visual diversity	low	medium	high
Flood protection	low	medium	high

Step #3

Determine the minimum acceptable buffer width

The minimum acceptable width is one that provides acceptable levels of all needed benefits at an acceptable cost. Minimum acceptable width is determined by the specific benefit needed that requires the greatest width.

Figure 1 presents a general comparison of buffer widths required for a good level of each benefit. For most benefits, research information is limited, so the widths indicated in the figure represent our best estimates. The required width may vary a great deal depending on site conditions, vegetation type, and landowner objectives, as explained below.

- **Stabilize eroding banks**
  On smaller streams and lakes, good erosion control may require only the width of the bank to be covered with shrubs and trees. Extending buffer vegetation beyond the bank is necessary where more active bank erosion is occurring. Severe bank erosion on larger streams will require special engineering practices to stabilize and protect the bank.
- **Filter sediment and sediment-attached contaminants from agricultural runoff**
  For slopes less than 15%, most sediment settling occurs within a 25 to 30 feet wide buffer of grass. Greater width may be required for shrub and tree vegetation, on steeper slopes, or where sediment loads are particularly high.
- **Filter soluble nutrients and pesticides from agricultural runoff**
  Width up to 100 feet or more may be necessary on steeper slopes and less-permeable soils to obtain sufficient capacity for infiltration of runoff, and vegetation and microbial uptake of nutrients and pesticides. Dilution of contaminant-rich runoff by rain falling on the buffer is directly related to buffer width.
- **Provide shade, shelter, and food for aquatic organisms**
  Warm water fisheries may require only very narrow buffers, except where shade and temperature control is needed to discourage algae blooms. Width up to 100 feet in trees may be needed for adequate shade and water temperature control for cold water fisheries in warmer climates.
- **Wildlife habitat**
  Width required is highly dependent upon desired species. For example, Nebraska NRCS Standards call for a minimum of 45 ft of grass to promote upland game birds. Generally, larger animals have greater minimum width requirements, particularly interior forest species. Narrower width may be acceptable where a travel corridor is desired for connecting larger areas of habitat.

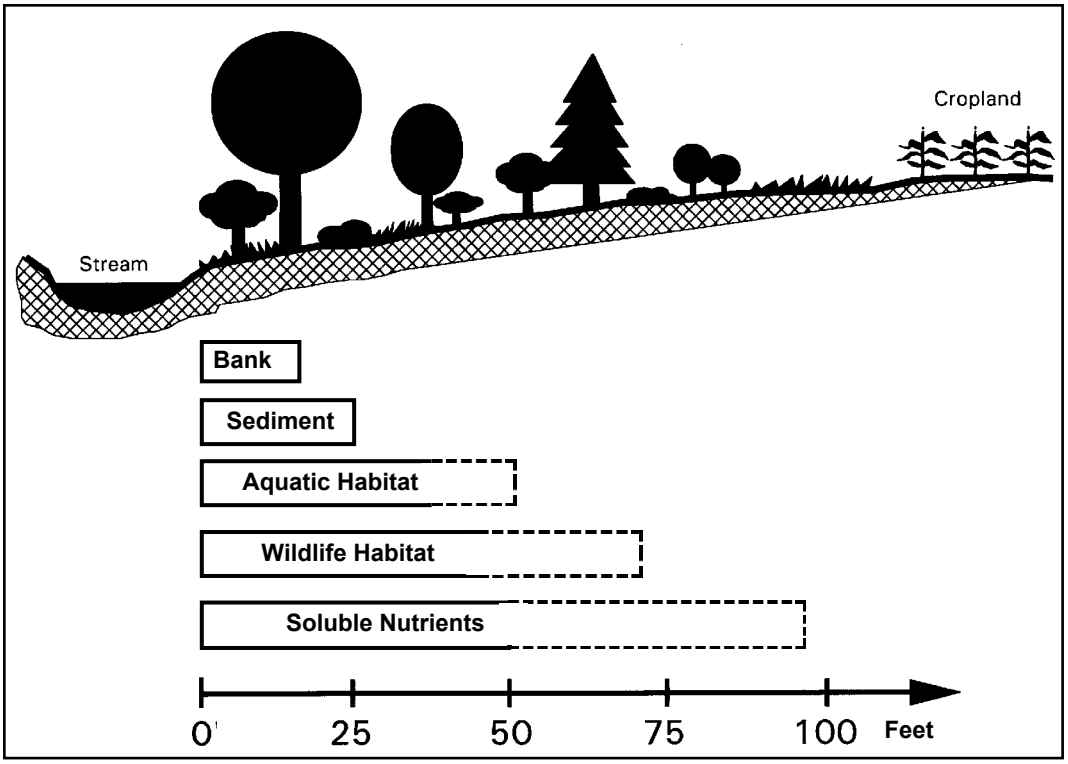

Figure 1 — Estimated buffer width required for providing a good level of each specific benefit

- **Economic products**
  Minimum width requirement is highly dependent upon the desired crop and its management. Tax incentives and cost-share program requirements must also be considered in determining buffer width from an economic standpoint.
- **Visually diversify a cropland landscape**
  Width required to obtain acceptable visual diversity depends entirely on the landowner's opinion.
- **Protect cropland from flood damage**
  Smaller streams may require only a narrow width of trees or shrubs to adequately protect cropland from flood damage. A larger stream or river may require a buffer that covers a substantial portion of its floodplain.

Step #4

Develop an installation and maintenance plan

Once vegetation types and width are determined, an installation and maintenance plan is necessary to obtain successful buffer establishment and long-term benefits. A few general considerations are listed below.

Installation:

- Use local knowledge to select the best plant species for each situation. Emphasize easily obtainable species yielding quick establishment and good growth on the site.
- Width may be varied to straighten tillage boundaries along meandering streams.
- Incorporate existing perennial vegetation into the buffer design, if possible, since some benefits, such as shade and bank stabilization from trees, are maximized only after vegetation matures. Using existing vegetation also reduces installation costs and risk of total planting failure.
- The site may require tillage or herbicide application prior to planting.
- Bare soil in areas where trees and shrubs are to be planted may also need to be planted with less-competitive grasses and forbs to hold soil in place and discourage weeds until trees and shrubs become established.

- Some replanting may be needed to get adequate vegetation established.

Maintenance:

- Weed control is often necessary until trees and shrubs are large enough to compete on their own. Mowing and mulches are good methods. Tillage is not. Herbicides may be useful for spot weed control provided their labels do not prohibit use near waterways.
- Mulches may be necessary for initial tree and shrub survival in drought-prone regions.
- Protecting tree and shrub plantings from wildlife, such as deer, rabbits, and beaver, may be necessary in some locations.
- Periodic soil removal may be needed at the cropland edge of a runoff filtering buffer, where sediment trapping or tillage has formed a dike which prevents evenly-spread, shallow flow through the buffer.
- Periodic harvesting of buffer vegetation may be necessary to maintain vigorous plant growth for filtering and nutrient uptake; and provide marketable products.
- The maintenance schedule should be flexible and fit into the landowner's schedule.

Additional Information

"Stewards of Our Streams: Riparian Buffer Systems." Iowa State University Extension Bulletin Pm-1626a/January 1996.

Authors

Michael G. Dosskey, Riparian Ecologist/Soil Scientist, National Agroforestry Center and University of Nebraska, Department of Forestry, Fisheries, and Wildlife, 101 Plant Industry Bldg., Lincoln, Nebraska 68583-0814. Phone 402-472-8472; fax 402-472-2964; e-mail mdosskey@unlinfo.unl.edu

Richard C. Schultz, Forest Ecologist/Hydrologist, Iowa State University, Department of Forestry, 251 Bessey Hall, Ames, Iowa 50011-1021. Phone 515-294-7602; fax 515-294-2995; e-mail rschultz@iastate.edu

Thomas M. Isenhart, Aquatic Ecologist, Iowa State University, Department of Forestry, 251 Bessey Hall, Ames, Iowa 50011-1021. Phone 515-294-8056; fax 515-294-2995; e-mail isenhart@iastate.edu

Acknowledgments

The authors thank the following agencies and programs for their support: • US Environmental Protection Agency (EPA) under the Federal Nonpoint Source Management Program • Agriculture in Concert with the Environment program, jointly funded by the USDA Cooperative State Research, Education and Extension Service, and the EPA • USDA Forest Service - Northeast Area State & Private Forestry • Iowa Department of Natural Resources • Nebraska Department of Environmental Quality • Leopold Center for Sustainable Agriculture, Iowa State University

For more information contact: National Agroforestry Center, USDA Forest Service, Rocky Mountain Station\ USDA Natual Resources Conservation Service, East Campus-UNL, Lincoln, Nebraska 68583-0822. Phone: 402-437-5178; fax: 402-437-5712.

The National Agroforestry Center is a partnership of the USDA Forest Service and the USDA Natural Resources Conservation Service. The Center's purpose is to accelerate the development and application of agroforestry technologies to attain more economically, environmentally, and socially sustainable land-use systems. To accomplish its mission, the Center interacts with a national network of cooperators to conduct research, develop technologies and tools, establish demonstrations, and provide useful information to natural resource professionals.

The United States Department of Agriculture (USDA) prohibits discrimination in its programs on the basis of race, color, national origin, sex, religion, age, disability, political beliefs and marital or familial status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (braille, large print, audiotape, etc.) should contact the USDA office of Communications at 202-720-5881 (voice) or 202-720-7808 (TDD).

To file a complaint, write the Secretary of Agriculture, U.S. Department of Agriculture, Washington, D.C. 20250, or call 202-720-7327 (voice) or 202-720-1127 (TDD). USDA is an Equal Employment Opportunity employer.