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How to Design a Riparian Buffer for Agricultural Land

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How to Design a Riparian Buffer for Agricultural Land

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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.

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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.

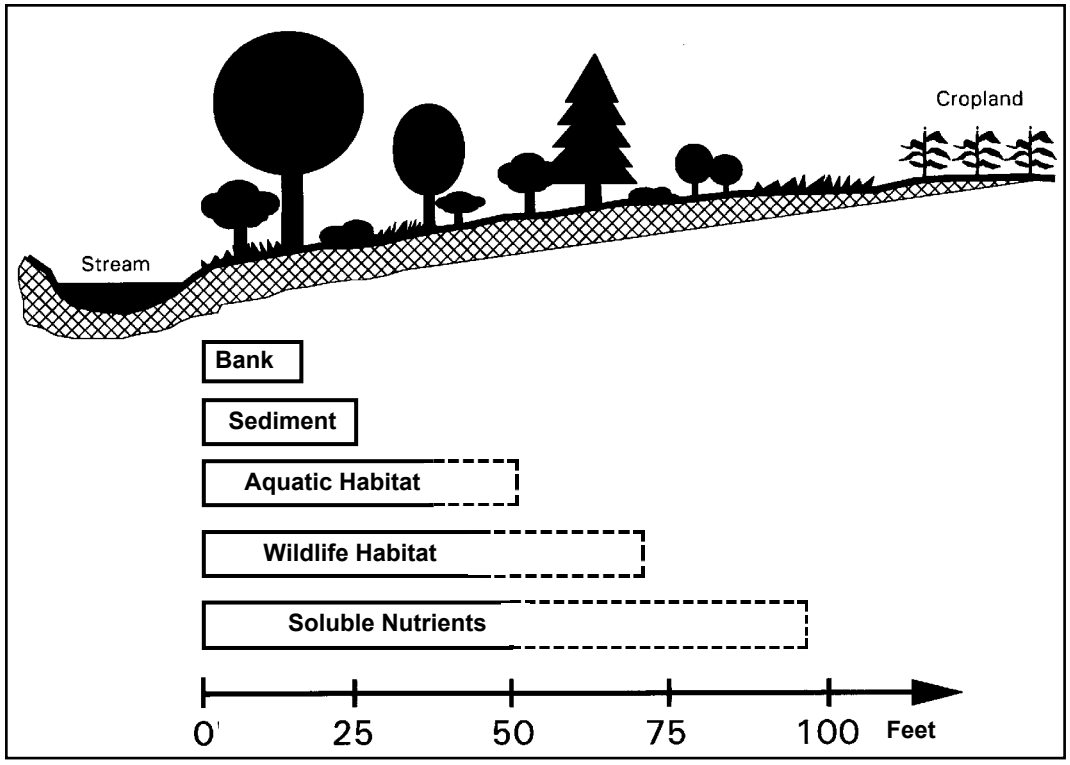

Figure 1 — Estimated buffer width required for providing a good level of each specific benefit

- **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.

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