Vegetative Filter Strips

for Improved Surface Water Quality

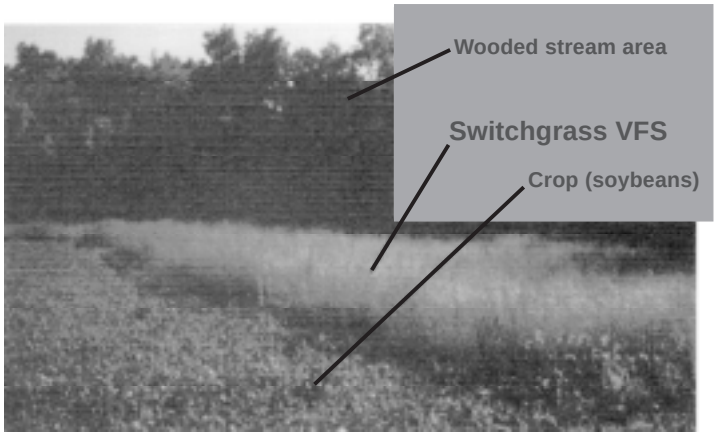
What are vegetative filter strips?

Vegetative filter strips (VFS) are areas next to cropland that are seeded to close-growing plants. They are designed to remove sediment, organic material, nutrients, and chemicals carried in runoff or waste water. Vegetative filter strips are planted along streams, ponds, and lakes, and are important management tools around sinkholes and agricultural drainage wells. In a properly designed VFS, water flows evenly through the strip, slowing the runoff velocity and allowing contaminants to settle from the water. In addition, where VFSs are seeded, fertilizers and herbicides no longer need to be applied right next to susceptible water sources. Vegetative filter strips also increase wildlife habitat.

What can be filtered?

Soil particles (sediment) settle from runoff water when flow is slowed by passing through a vegetative filter strip. The largest particles (sand and silt) settle within the shortest distance. Finer particles (clay) are carried the farthest before settling from runoff water, and may remain suspended when runoff velocity is high. Farming practices above vegetative filter strips affect the ability of strips to filter sediment. Fields with steep slopes or little crop residue will deliver more sediment to filter strips than more gently sloping fields and those with good residue cover. Large amounts of sediment entering the filter strip may overload the filtering capacity of the vegetation and some may pass on through.

Total nitrogen (N) and phosphorus (P) removal is closely related to sediment removal. In a Virginia experiment, vegetative filter strips 15 feet wide removed 55 percent of the N and 60 percent of the P from runoff water. Even so, there was enough dissolved N and P in the water that did pass through the strips to support algae and plant growth in streams or lakes. Other researchers have reported similar removals of P, but lower rates of N removal. Nitrogen and phosphorus that are dissolved in runoff water that reaches the VFS are



A three-year-old 66-foot wide filter strip bordering a small stream in Boone County, Iowa.

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PM1507 September 1992
Electronic version April 2000

less likely to be removed than N and P bound to sediment.

Very little information exists about herbicide removal by vegetative filter strips. One study evaluated the filtering of 2,4-D from a 75-foot long waterway, functioning as a filter strip. Approximately 70 percent of the 2,4-D that entered the waterway did not pass through. In Iowa, research is continuing to evaluate the effect of filter strips on herbicide movement from crop fields to water sources.

Effectiveness of filtration

Filter strip effectiveness depends on five factors:

1. **The amount of sediment reaching the VFS. This is influenced by:**

- *type and frequency of tillage in cropland above the VFS*
  The more aggressive and frequent tillage is above filter strips, the more likely soil is to erode.
- *time between tillage and a rain*
  The sooner it rains after a tillage operation, the more likely soil is to erode.
- *rain intensity and duration*
  The longer it rains and thus the more sediment deposited, the less effective filter strips become as they fill with soil. In Iowa, the most intense rainfall occurs during planting season — April, May, and June.
- *steepness and length of slope above the VFS*
  Water flows faster down steeper slopes. Filter strips below steep slopes need to be wider in relation to the cropland drained above to adequately slow water and sediment movement (**Table 1**). Longer slopes increase erosion potential and result in more water delivered to a VFS. If the length of a slope is doubled, the erosion hazard increases one and one-half times.

Table 1. Minimum guidelines for width of filter strips related to soil topic.

Field slope	**Minimum** width of filter strip
%	feet
0-10	15
10-20	20
20-30	25

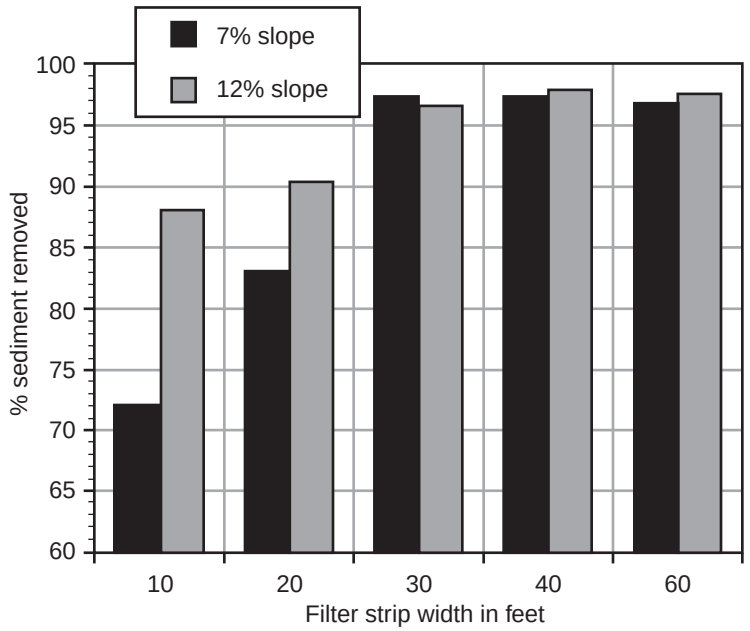
Soil Conservation Service Field Office Technical Guide, 1988.

2. **The amount of time that water is retained in the VFS. This is influenced by:**

- *width of the filter area*
  Vegetative filter strips will vary in width depending on the percent slope (**Table 1**), length of slope, and total drainage area above the strip. One demonstration in northeast Iowa, on both 7 and 12 percent slopes, measured more than 70 percent of sediment from fields removed within the first 10 feet of a vegetative filter strip and more than 95 percent removed within 30 feet (**Figure 1**). In Virginia, 30 foot wide strips filtered an additional 20 percent of total N and P compared to 15 foot wide strips.
- *type of vegetation and quality of the stand*
  Erect, tall grass can trap more sediment than can short, flexible grass. For that reason, Kentucky bluegrass is not a good choice for vegetative filter strips. Best species for filter strips are tall perennial grasses. Sod-forming species such as smooth bromegrass and reed canarygrass may provide a better filter than bunchgrasses like orchardgrass. The native prairie grasses; switchgrass, big bluestem, or Indiangrass also may be used. Annual grasses such as sudangrass may be used, but will only provide a temporary filter. Guidelines for grass seeding rates are provided in **Table 2**. Filter strips may include more than one type of plant, and may include parallel strips of trees (such as poplar, ash, maple, and walnut) and shrubs (such as red osier dogwood and ninebark), as well as perennial grasses. In addition to potential for improving water quality, these strips increase diversity of wildlife habitat. Research is ongoing in Iowa to determine the effectiveness of these mixed-species strips.

3. **Infiltration rate of the soil**
Soils with higher infiltration rates will absorb water and the accompanying dissolved nutrients and pesticides faster than soils with low infiltration rates. County soil survey reports include a table listing the infiltration rate group for the soils identified in each county.

Figure 1. Sediment % deposited in vegetative filter strips. 1991 demonstration, Allamakee County, IA.



Measured soil erosion rates from 60-foot wide fallow strips above vegetative filter strips were 13 tons per acre for the 7% and 29 tons per acre for the 12% slope.
Source: Schultz, et. al., 1992.

4. Uniformity of water flow through the VFS

Shallow depressions or rills need to be graded to allow uniform flow of water into the filter strip along its length. Water concentrated in low points or rills will flow at high volume, so that little filtering will take place.

5. Maintenance of the VFS

When heavy sediment loads are deposited, soil tends to build up across the strip forming a miniature terrace. If this becomes large enough to impound water, water will eventually break over the top and flow will become concentrated in that area. Strips should be inspected regularly for damage. Maintenance may include minor grading, reseeding, or interseeding to keep filter strips effective.

Summary

- Vegetative filter strips can effectively remove sediment if water flow is even and shallow.
- Filter strips must be properly designed and constructed to be effective.
- Vegetative filter strips become less effective as sediment accumulates. With slow accumulation, grass regrowth between rains often restores the filtering capacity.
- Filter strips remove larger sediment particles of sand and silt first. Smaller clay-sized particles settle most slowly and may be only partially removed depending on the strip width and water flow rate.
- Because soil-bound nutrients and pesticides are largely bound to clay particles, filter strips may be only partially effective in removing them.

Table 2. Suggested grass seeding rates for vegetative filter strips.

Type of Seeding	Grass Species	Pure live seed (PLS) lb/a
Permanent	Reed canarygrass	10
"	Reed canarygrass	6
"	Tall fescue	6
"	Smooth bromegrass	20
"	Switchgrass*	10
Temporary	Oats	64
"	Sudangrass	10-20
"	Wheat or rye	90

* Switchgrass is tolerant of the herbicides atrazine and simazine.

Adapted from Soil Conservation Service Field Office Technical Guide, 1988.

- Fewer dissolved nutrients and pesticides will be removed than those bound to soil particles.
- Vegetative filter strips are a complementary conservation practice that should be used with in-field conservation practices such as conservation tillage, contour buffer strips, strip cropping, and waterways.

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Related conservation practices

Buffer Zones

Similar to vegetative filter strips, buffer zones provide a physical separation between different areas. There may be buffer zones between a city and nature preserve or between cropland and a river. Buffer zones are not necessarily designed to filter water that may flow through them. Where topography allows and when designed properly, buffer strips can also function as vegetative filter strips.

Contour Buffer Strips

Contour buffers are strips of perennial vegetation alternated with wider crop strips, farmed on the contour. These strips of permanent vegetation, similar to filter strips, slow runoff and trap sediment but do not border bodies of water. Because they are an upland treatment, their primary purpose is to slow overland runoff and reduce potential soil erosion. They are an excellent practice to use with vegetative filter strips.

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MSEA — Management Systems Evaluation Areas — a federally funded project to evaluate the impact of current and emerging farming systems on water quality.

This project has been funded by the Iowa Department of Agriculture and Land Stewardship through a grant from the U.S. Environmental Protection Agency.

File: Environmental Quality 2-4 12/99

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Stanley R. Johnson, director, Cooperative Extension Service, Iowa State University of Science and Technology, Ames, Iowa.