Phosphorus Best Management Practices

Protecting Water Quality

Filter Strips

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Definition:

Filter strips are vegetated areas that are situated between surface water bodies (i.e., wetlands, streams and lakes) and cropland, grazing land, forestland or disturbed land. They are generally in locations where runoff water leaves a field, with the intention that sediment, organic material, nutrients and chemicals can be filtered from the runoff water. Filter strips are also known as vegetative filter strips or buffer strips.

Purpose:

This best management practice reduces sedimentation of surface water bodies and may reduce runoff pollutants such as phosphorus, nitrogen and pesticides. Filter strips can also lessen sheet and rill erosion. Strips slow runoff water leaving a field so that larger particles, including soil and organic material, can settle out. Filter strip vegetation can improve soil aeration, lessen water quality degradation by nutrient removal in the root zone by plant uptake and sorption to soil, and provide wildlife habitat. Filter strips allow the pollutants to infiltrate when overland flow is shallow and is dispersed across the width of the filter strip. Filter strips also allow the entrapment of sediment.

How Does This Practice Work?

Due to the entrapment of sediment and the establishment of vegetation, phosphorus can be sorbed to the sediment that is deposited and remain on the field landscape, enabling plant uptake. Conservation buffers improve infiltration and percolation, thus reducing runoff amounts. Vegetation in conservation buffers recycles entrapped nutrients in the harvested material and provides permanent habitat for many types of fauna.

Where This Practice Applies and Its Limitations:

Filter strips are useful in agricultural areas where both point and nonpoint source pollution occur; for residential and industrial uses such as residential areas (parks, businesses, schools, urban developments) and water treatment facilities; and in areas with potential sediment erosion, leaching and runoff. Basically, they can be applied anywhere land areas contribute contaminants to a water body. Advantages of filter strips include flood damage prevention, erosion control, aesthetic value, water quality improvement

Buffer Strip and Grassed Waterway System. Photo by USDA, Tim McCabe.

and soluble contaminant flow retardation. In addition, farm machinery is generally permitted to cross the filter strips, and federal, state and local programs may be available for assistance.

Limitations of these practices include the cost of installation (e.g., grading slopes and vegetation establishment), weed control, cost of maintenance, loss of acreage for pasture or crops and the variability of effectiveness due to the uncertainty of runoff rate and frequency. Filter strips are most effective at slopes between 2 and 6 percent because of the increased contact time between the runoff and the filter strip.

Vegetative Filter Strip. Photo by University of Illinois Extension.

Effectiveness:

In general, the filters strips are as effective as their trapping efficiency and filtration capability. These components are impacted by

- the amount of incoming cropland sediment,
- the time between cropland tillage and rainfall events,
- the intensity and duration of the rainfall events and its associated runoff velocity,
- the steepness and length of the slope surrounding and including the filter strip,
- soil characteristics,
- the type of vegetation used and its established density,
- the width of the strip, and
- correct installation and maintenance of filter strips to minimize sedimentation.

There is no definitive vegetative buffer width (direction of flow) that can be effectively used for all areas. They can be as small as 3 to 5 feet wide. Generally, 10 ft of buffer width is up to 90 percent effective at reducing sediment transport. Buffer widths greater than 50 feet have a diminishing effectiveness on the removal of soluble contaminates. Effectiveness of properly placed and maintained vegetative buffers can be expected to be greater than 70 percent for sediment removal and 50 percent for soluble pollutants (nitrates, phosphorus and pesticides).

Case studies vary depending on the location being researched. The purpose of one study was to determine the relationship of soluble phosphorus to sediment concentration during transport in surface runoff. Fifty pounds of phosphorus per acre were applied to a 4 percent slope. The soluble phosphorus concentration decreased with an increase in sediment concentration. A second case studied the effectiveness of vegetative filter strips to limit feedlot runoff pollution. The results demonstrated that the cropped buffer strips reduced runoff on a 4 percent slope by 67 percent and decreased total solids transport by 79 percent. Total phosphorus was reduced by 80 percent. A case study in the East stated that surface runoff nutrient concentrations are dependent on the number of rainfall events as compared to the amount of rainfall.

According to Nebraska Cooperative Extension, filter strips are known to be more effective in removing sediment than nutrients, are more effective when runoff is of a shallow depth, more effective with sod-forming vegetation, less effective when the cropland area drained is increased as compared to the filter strip area, less effective as more sediments and nutrients are kept in the filter strip and less effective when the filter strip is not appropriately maintained. According to Cooperative Extension experts, the contract life for grass (vegetative) filter strips is 10-15 years eligible for use under the continuous CRP sign-up.

The ecological benefits of using filter strips include

- the roots of plants stabilize the soil by increasing soil aggregation;
- the shoots of plants protect soil from absorbing forces of wind, water and raindrop impact;
- vegetation provides shade that impacts soil moisture content;
- strips act as a noise filter;
- nutrients are recycled, limiting stress to crops and animals caused by dry summer winds and cold winter winds that can cause reduced production.

Cost of Establishing and Putting the Practice in Place:

The cost of establishing a filter strip will vary according to the equipment, labor costs, grading, seed and fertilizer selected. Potential returns include revenue from harvesting and marketing filter-strip hay. The landowner/farmer may be eligible for CRP and EQIP programs and can receive both technical and financial assistance from federal, state and local levels.

The Ohio Department of Agriculture 1996 Annual Report states that revenue was generated from harvesting and marketing filter-strip hay, resulting in private benefits. The social benefit of filter strips is to increase the aesthetic value of an area. According to Iowa State University Extension, a summary of vegetative filter strip contaminant removal of total phosphorus was an average of 68.7 percent.

Following is an example of a cost:benefit comparison prepared by Ohio State University. For the corn-soybean rotation with conventional tillage and a medium production level ($117.50/acre), the cost of installing and establishing a filter strip on land that would normally be used for crop production must be considered. Land rental costs in Ohio are estimated to be $120 per acre. There is no cost for equipment and labor for a conventional tillage system of vegetative filter strips. The filter-strip hay will provide a 5 percent discount rate over a 10-year project life. The revenue generated will be $2,036.77, with land rental costs of $926.61. Including seed, fertilizer, lime, labor and equipment costs, an annual profit of $10.64 occurs with a 12 percent annual rate of return.

Additional factors to consider before installing filter strips include:

1) types and concentrations of pollutants for which they are being designed
2) soil characteristics, such as clay content, organic material and infiltration rate
3) size of contributing area
4) previous or existing vegetation
5) steepness of slope/irregularity of topography
6) dimensions of the watershed that will be draining into the filter strip
7) types of vegetation adaptable to the area
8) climatic conditions at planting times
9) possible combinations of conservation practices to reduce erosion and chemical loss
10) dominant wind direction

Operation and Maintenance:

The operation and maintenance of this best management practice is critical once the vegetation is established. After establishment, filter strip maintenance may include harvesting and marketing forage, repairing rills and removing accumulation of deposited sediment. Since adsorbed phosphorus is the main portion (75-90 percent) of the phosphorus transported from cultivated land, filter strips in tilled cropland are a vital component of the overall conservation plan of operation. The vegetation must continue to receive sufficient moisture and nutrients to increase its effectiveness.

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For Further Information:

Contact your local conservation district, USDA-NRCS or Cooperative Extension Service office.