Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

FILTER STRIP

Code 393

(Ac)

DEFINITION

A strip or area of herbaceous vegetation that removes contaminants from overland flow.

PURPOSE

- Reduce suspended solids and associated contaminants in runoff and excessive sediment in surface waters.
- Reduce dissolved contaminant loadings in runoff.
- Reduce suspended solids and associated contaminants in irrigation tailwater and excessive sediment in surface waters.

CONDITIONS WHERE PRACTICE APPLIES

Filter strips are established where environmentally sensitive areas need to be protected from sediment, other suspended solids, and dissolved contaminants in runoff. Filter strips augment but do not replace existing vegetation that provides environmental benefits. Sensitive areas include perennial and intermittent streams, lakes, and wetlands, wells, drainage ditches, grassed waterways, sinkholes, crevices, springs, surface tile inlets, surface water side inlets and other surface inlets which deliver surface runoff to ground water or surface water.

CRITERIA

General Criteria Applicable to All Purposes

Overland flow entering the filter strip will be uniform sheet flow.

Concentrated flow will be dispersed before it enters the filter strip or addressed by an additional practice. Any concentrated flows moving through the filter strip shall be shaped, graded and vegetated according to NRCS *Conservation Practice Standard: Critical Area Planting, Code 342, Grassed Waterway, Code 412, Water and Sediment Control Basin, Code 638 or any other vegetative/structural practice that meets the needs of the identified resource concern and purpose* or other means shall be used to convert concentrated flow to sheet flow.

Eroding streambanks and drainage ditches shall be stabilized if filter strips will be installed immediately adjacent to them. This includes use of side inlet controls to prevent headward cutting into the filter strip.

Filter strips shall be placed on the approximate contour. **The maximum gradient along the leading edge of filter strip will not exceed one-half of the up-and-down-hill slope percent, immediately upslope from the filter strip, up to a maximum of five percent.**

Filter strips will not be used as a travel lane for equipment or livestock.

Additional Criteria to Reduce Dissolved Contaminants, Suspended Solids and Associated Contaminants in Runoff and Excessive Sediment in Surface Waters.

The filter strip will be designed to have a 10-year life span, following the procedure in Agronomy Technical Note No. 2, “Using Revised Universal Soil Loss Equation, Version 2 (RUSLE2) for the Design

and Predicted Effectiveness of Vegetative Filter Strips (VFS) for Sediment," based on the amount of sediment delivery to the upper edge of the filter strip and ratio of filter strip flow length to length of flow path from the contributing area. The minimum flow length through the filter strip will be 30 feet for suspended solids and associated contaminants in runoff and 60 feet for dissolved contaminants and pathogens in runoff. See Table 1 for filter strip flow length.

The filter strip will be located immediately downslope from the source area of contaminants.

The drainage area immediately above the filter strip will have a slope of one percent or greater.

RUSLE2 estimated soils losses from the area contributing runoff to the filter strip shall be less than 8.1 tons/acre/year.

The area contributing "sheet flow" runoff to the filter strip shall be less than 60:1 of the filter strip; do not count acres that reach the VFS as concentrated flow. See table 1 footnotes for exceptions.

Widths (Flow lengths) and Sizing

When determining widths for sediment delivery the widths shall be based on RUSLE2 estimated soil loss on the contributing area and on the ratio of contributing area size to filter strip area size and the soil hydrologic group at the filter strip location is C or D. See table 1 footnotes for exceptions.

When determining widths for soluble nutrients, chemicals and pathogens the width shall be based on the slope of the contributing area and on the ratio of contributing area size to filter strip area size. Wider widths are appropriate when pathogen control is an objective and/or the soil hydrologic group at the filter strip location is C or D. See table 1 footnotes for exceptions.

Filter strip width (flow length measured perpendicular to the prevailing contour) shall be determined using table 1.

Filter strip width can vary across a site provided the narrowest spot meets width requirements.

Starting points for measuring filter strip widths when the strip is immediately adjacent to a sensitive area are: a) ordinary high water mark of lakes, b) top of bank of perennial and intermittent streams c) field side of drainage ditch spoil ridges (base of berm frontslope), d) top of side slopes of waterways, shallow surface drains, e) upland-wetland interface of wetlands, f) outside perimeter of sinkholes (depression and not the swallow hole), and g) design storage elevation of surface inlets.

Vegetation Establishment for seeding specifications and species recommendations see the Minnesota (MN) Agronomy Technical Note No. 31 Herbaceous Vegetation Establishment Guide.

The filter strip will be established to permanent herbaceous vegetation.

Species selected will be—

- Able to withstand partial burial from sediment deposition.
- Tolerant of herbicides used on the area that contributes runoff to the filter strip.
- Stiff stemmed and a high stem density near the ground surface.
- Suited to current site conditions and intended uses.
- Able to achieve adequate density and vigor within an appropriate period to stabilize the site sufficiently to permit suited uses with ordinary management activities.

Plant species, rates of seeding (lbs/ac), vegetative planting (plants/ac), minimum quality of planting stock (pure live seed [PLS] or stem caliper), and method of establishment shall be specified before application. Only viable, high quality seed or planting stock will be used.

Introduced grass/legume mixtures shall contain no more than one legume component not to exceed the maximum mixture composition in Table 12 of the MN Agronomy Technical Note No. 31.

Perform site preparation and seeding/planting at a time and in a manner that best ensures survival and growth of selected species. Successful establishment parameters, (e.g., minimum percent ground/ canopy cover, percent survival, stand density) will be specified before application.

Schedule planting dates during periods when soil moisture is adequate for germination and establishment. Seeding will be timed so that tillage for adjacent crop does not damage the seeded filter strip.

Where the purpose is to remove phosphorus, remove (or harvest) the filter strip aboveground biomass at least once each year.

The minimum seeding and stem density will be equivalent to the seeding rate for a high quality grass hay seeding rate for the climate area or the density of vegetation selected in current water erosion technology to determine trapping efficiency, whichever is the higher seeding rate.

Site conditions including water table depth and flooding frequency and duration must be conducive to establishing and maintaining perennial grasses.

State listed noxious weeds will not be established in the filter strip and will be controlled, if present. A list of noxious plants can be found on the Minn. Dept. of Agriculture web-site by clicking on A to Z; then N; and then noxious weeds list: http://www.mda.state.mn.us/

Where removal of nitrate nitrogen is a primary consideration, at least 50% of the cool season species shall be deep-rooted. Legumes shall all be deep-rooted. Recommended vegetation can be found within Table 12 and Table 13 of the MN Agronomy Technical Note No. 31.

Additional Criteria to Reduce Suspended Solids and Associated Contaminants in Irrigation Tailwater and Excessive Sediment in Surface Waters.

Filter strip vegetation will be a small grain or other suitable annual plant.

The seeding rate shall be sufficient to ensure that the plant spacing does not exceed 4 inches (about 16–18 plants per square foot).

Establish filter strips prior to the irrigation season so that the vegetation is mature enough to filter sediment from the first irrigation.

CONSIDERATIONS

General Considerations.

Filter strip width (flow length) can be increased as necessary to accommodate harvest and maintenance equipment.

Filters strips with the leading edge on the contour will function better than those with a gradient along the leading edge.

Seeding rates that establish a higher stem density than the normal density for a high quality grass hay crop will be more effective in trapping and treating contaminants.

Filter strips should be strategically located to reduce runoff, and increase infiltration and ground water recharge throughout the watershed and to enhance connectivity of corridors and non-cultivated patches of vegetation within a watershed.

Filter strips should be planned in conjunction with supporting upland treatment to ensure the life expectancy of the practice.

When needed, invasive plant species may be controlled through mowing, herbicides, and hand weeding.

Consideration for Reducing Suspended Solids and Associated Contaminants in Runoff.

Increasing the width of the filter strip beyond the minimum required will increase the potential for capturing more contaminants in runoff for both surface and subsurface.

Consideration for Subsurface Flow and Nutrient Up-take.
Filter strips that may be used in the future to address nutrients carried by subsurface drainage should provide for the width needed to meet that purpose. Subsurface flow treatment will be in accordance with 604 Saturated Buffer criteria. Vegetation selected should be able to remove nutrients at critical times of drainage flows from tile water.

When a Denitrifying Bioreactor (605) is placed in conjunction with a filter strip area, it is recommended to utilize shallow vegetation directly over the Denitrifying Bioreactor.

Considerations for Creating, Restoring or Enhancing Herbaceous Habitat for Wildlife and Beneficial Insects and Pollinators. Filter strips are often the only break in the monotony of intensively-cropped areas. The wildlife and pollinator benefits of this herbaceous cover can be enhanced by the following:

- When appropriate, use native grass species that fulfill the purpose(s) of the practice while also providing habitat for priority wildlife.
- Adding herbaceous plant species (including native forbs) to the seeding mix that are beneficial to wildlife and pollinators and are compatible for one of the listed purposes. Changing the seeding mix should not detract from the purpose for which the filter strip is established.
- Increasing the overall width beyond the minimum required. The additional area can increase food and cover for wildlife and pollinators.
- Management activities on filter strips (mowing, burning, or light disking), should not be done more often than every other year with frequency dependent on geographical location to maintain the purpose(s) of the practice.
- Management activities should be completed outside of the primary nesting, fawning, and calving seasons. Activities should be timed to allow for regrowth before the growing season ends.
- Organic producers should submit plans and specifications to their certifying agent for approval prior to installation, as part of the organic producer's organic system plan.
- Refer to National Agronomy Technical Note #9 for mitigation recommendations related to pesticide application and habitat development for pollinators.

Forbs can be added to any part of the filter strip. Reference the Minnesota Technical Note #31, Herbaceous Vegetation Establishment Guide, for seeding recommendations and Table 13 for recommendations of native forbs suitable to support higher volumes of water flow and sedimentation. Adding legumes to the seed mix also provides excellent pollinator habitat.

Livestock and vehicular traffic in the filter strip shall be excluded during the nesting season of the target species.

Considerations to Maintain or Enhance Watershed Functions and Values. Filter strips may be used to enhance connectivity of corridors and noncultivated patches of vegetation within the watershed, enhance the aesthetics of a watershed, and be strategically located to reduce runoff, and increase infiltration and groundwater recharge throughout the watershed.

Increase Carbon Storage. Increasing the width of the filter strip beyond the minimum required will increase potential for carbon sequestration.

PLANS AND SPECIFICATIONS

Specifications for establishment and operation of this practice will be prepared for each field or treatment unit. Record the specifications using the implementation requirements document. The specifications will identify at a minimum the following:

- Practice purpose(s).
- Length, width (width refers to flow length through the filter strip), and slope of the filter strip to accomplish the planned purpose(s).
- Plant species selection and seeding/planting/sprigging rates to accomplish the planned purpose.
- Planting dates and planting method(s).
- Specific care and handling requirements of the seed or plant material to ensure that planted materials

have an acceptable rate of survival.
- A statement that only viable, high quality, and adapted seed will be used.
- Site preparation instructions sufficient to establish and grow selected species.

OPERATION AND MAINTENANCE

For the purposes of filtering contaminants and nutrients, permanent filter strip vegetative plantings will be harvested and removed as appropriate to encourage dense growth, maintain an upright growth habit and remove nutrients and other contaminants that are contained in the plant tissue.

Control undesired weed species, especially State-listed noxious weeds.

If Conservation Practice Standard (CPS) Prescribed Burning (Code 338) is used to manage and maintain the filter strip, an approved burn plan must be developed.

Inspect the filter strip after storm events and repair any gullies that have formed, remove unevenly deposited sediment accumulation that will disrupt sheet flow, reseed disturbed areas and take other measures to prevent concentrated flow through the filter strip.

Apply supplemental nutrients as needed to maintain the desired species composition and stand density.

Periodically regrade and reestablish the filter strip area when sediment deposition at the filter strip-field interface jeopardizes its function. Reestablish the filter strip vegetation in regraded areas, if needed.

If grazing is used to harvest vegetation from the filter strip, the grazing plan must ensure that the integrity and function of the filter strip is not adversely affected.

REFERENCES

Dillaha, T.A., J.H. Sherrard, and D. Lee. 1986. Long-Term Effectiveness and Maintenance of Vegetative Filter Strips. VPI-VWRRC Bulletin 153.

Dillaha, T.A., and J.C. Hayes. 1991. A Procedure for the Design of Vegetative Filter Strips: Final Report Prepared for U.S. Soil Conservation Service.

Foster, G.R. Revised Universal Soil Loss Equation, Version 2 (RUSLE2) Science Documentation (In Draft). USDA-ARS, Washington, DC. 2005.

Renard, K.G., G.R. Foster, G.A. Weesies, D.K. McCool, and D.C. Yoder, coordinators. 1997. Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Universal Soil Loss Equation (RUSLE). U.S. Department of Agriculture. Agriculture Handbook 703.

Revised Universal Soil Loss Equation Version 2 (RUSLE2) Web site (checked May 2007): http://fargo.nserl.purdue.edu/rusle2_dataweb/RUSLE2_Index.htm.

M.G. Dosskey, M.J. Helmers, and D.E. Eisenhauer 2008. A Design Aid for Determining Width of Filter Strips. Journal of Soil and Water Conservation. July/Aug 2008—vol. 63, no. 4.

Johnson, A.W. and D.M. Ryba. 1992. A Literature Review of Recommended Buffer Widths to Maintain Various Functions of Stream Riparian Corridors. Prepared for King County Surface Water Management Division.

Mayer, P.M., S.K. Reynolds, M.D. McCutchen, and T.J. Canfield. 2006. Riparian buffer width, vegetative cover and nitrogen removal effectiveness: A Review of Current Science and Regulations. EPA/600/R-05/118. Cincinnati Ohio, US. Environmental Protection Agency

Rosen, B.H. 2001. Waterborne Pathogens: The Concept of Buffer Effectiveness, Microbial Source Tracking, and a Watershed Bacterial Model. PowerPoint presentation. Watershed Science Institute, USDA Natural Resources Conservation Service, Raleigh, North Carolina.

USDA, NRCS, 2000. Conservation Buffers to Reduce Pesticide Losses. Natural Resources Conservation Service. Fort Worth, Texas

Wenger, Seth. 1999. A Review of the Scientific Literature on Riparian Buffer Width, Extent and Vegetation.

Institute of Ecology, University of Georgia. Athens, Georgia.

TABLE 1. FILTER STRIP WIDTHS (FLOW LENGTHS)

Filter strip widths are for removal of pollutants from runoff. Widths for soluble materials and pathogens already include widths necessary for sediment.

Widths can be extended up to 350 feet if necessary to: 1. Create, enhance or restore wildlife and insect habitat (additional feet added to the overall width); 2. Ensure that a portion of the filter strip is above a floodplain's ordinary high water mark (2 yr. flooding return frequency); or 3. Accommodate harvest and maintenance and farmability requirements of the farming operation. This includes adding the width of a berm above a drainage ditch to the width required for filtering runoff before it reaches the berm.

Upper ends of the width ranges are appropriate when the Soil Hydrologic Group at the proposed filter strip site is C or D.

Sediment and sediment associated materials[5]

RUSLE2 Soil Loss	Upland Watershed Area to Filter Strip Area Ratio			
Tons/acre/year	**60:1[2]**	**40:1**	**20:1**	**10:1**
≤2	30 ft.	30 ft.[3]	30 ft.[3]	30 ft.[3]
2.1-4	60-100 ft.	60-100 ft.	30-60 ft.[3]	30 ft.[3]
4.1-6	Unsuitable[1]	60-100 ft.	60 ft.	30-60 ft.
6.1-8	Unsuitable[1]	90-120 ft.	90-120 ft.	60 ft.

Soluble nutrients, chemicals, and pathogens[6]

% Slope of Contributing Area	Upland Watershed Area to Filter Strip Area Ratio			
	60:1	**40:1**	**20:1**	**10:1**
1.1-3	120-160	90-160	90-120	60-120
3.1-5	160-200	120-200	120-160	90-160
5.1-12[4]	220	160-220	160-200	120-180

(1) An unsuitable site for sediment reduction is also unsuitable for soluble materials and pathogens.

(2) Table 1 and criteria in this standard insure a 10-year life span assuming moderate maintenance. Use the procedure in **National Agronomy Technical Note No. 2 -Using RUSLE2 for the Design and Predicted Effectiveness of Vegetative Filter Strips (VFS) for Sediment** and the note's companion spreadsheet to determine if a 10-year life span can be maintained when the contributing "sheet flow" watershed to filter strip area ratio is > 60:1; do not count acres that reach the VFS as concentrated flow.

(3) Width can be divided in half for installation of a filter strip along a grassed waterway or around a surface tile intake when either is located within a field.

(4) The >12 % slope limitation may be waived on a case-by-case basis by the Area Resource Conservationist. Runoff curve number on the contributing area must be ≤ 70 and the procedure listed in footnote 2 must be performed with results indicating ability to maintain a 10-year life span.

(5) To be used when filter strips are needed to reduce suspended solids to surface waters to meet planning objectives during the conservation planning process.

(6) To be used when filter strips are needed to reduce dissolved contaminant loadings in runoff to meet planning objectives during the conservation planning process. Upper ends of the width ranges are appropriate when pathogen control is an objective.

**Minnesota chapter 7020 rules require minimum widths of 100 feet for perennial streams and lakes and 50 feet for intermittent streams and protected wetlands when filter strips are to be established for manure management purposes.*