NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

FILTER STRIP

(ACRES)

CODE 393

DEFINITION

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

PURPOSE

- To reduce suspended solids and associated materials in runoff.
- To reduce dissolved materials and pathogens in runoff.

CONDITIONS WHERE PRACTICE APPLIES

Filter strips are established on sites where existing vegetation does not adequately protect environmentally sensitive areas from sediment, other suspended solids; dissolved contaminants and pathogens 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

Filter strips shall be permanently designated plantings and are not part of the adjacent cropland rotation.

Filter strips shall be designed to have no less than a 10 year life span.

The slope of the area contributing runoff to the filter strip shall be between 1% and 12%. See table 1 footnotes for exceptions

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 runoff to the filter strip shall be less than 60 times the area of the filter strip. See table 1 footnotes for exceptions.

Filter strips shall be placed on the approximate contour. Variation in placement on the contour shall not exceed one-half of the up-and-down hill slope percent, immediately upslope from the filter strip, up to a maximum of 5%.

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

A minimum of 50% of overland flow entering the filter strip from the contributing watershed shall or shall be converted to uniform sheet flow.

Level spreaders, grading and shaping, vegetative barriers upslope from the filter strip, contour furrows, contour buffers, or other means shall be used to convert concentrated flow to sheet flow to achieve the minimum 50% uniform flow criteria.

Any remaining concentrated flows moving through the filter strip shall be shaped and graded and vegetated according to NRCS

Conservation Practice Standard Critical Area Planting, Code 342. These concentrated flows shall also have vegetative barriers established at the up-slope and down-slope edges of the filter strip (See Appendix).

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.

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/

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

Location

Filter strips should be located adjacent to and downslope from the source area of contaminants and upslope from the sensitive area being protected. This can be the downslope edge of a field or within the field itself.

Filter Strip Vegetative Cover

The filter strip shall be established to permanent herbaceous vegetation consisting of a single species or a mixture of grasses, legumes and/or other forbs. Acceptable plant species and seeding rates are found in Table 2. Species and mixtures selected should:

- Emphasize tall, erect, stiff stemmed perennial, long-lived sod forming rhizomatous grasses. Natives are preferred
- Be adapted to the soil, climate, nutrients, herbicides and other practices used in the current or planned management system.
- Have capacity to achieve adequate density and vigor with ordinary management activities.
- Be able to withstand partial burial from sediment deposition
- Have a high established stem density near the ground surface. Rates and resultant stem densities should approximate those for a high quality grass or grass legume hay seeding for the climate area.
- Remain upright during the expected run-on periods

Introduced grass/legume mixtures shall contain no more than one legume component not to exceed the maximum mixture composition in table 2.

Filter Strip Vegetation Establishment

Only viable, high quality seed or planting stock will be used.

Site preparation and seeding or planting shall be done at a time and in a manner that best ensures survival and growth of the selected species.

Planting dates shall be scheduled during periods when soil moisture is adequate for germination and/or establishment.

Filter Strip Widths (Flow lengths) and Sizing

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.

Additional Criteria to Reduce Suspended Solids and Associated Contaminants in Runoff

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.

Additional Criteria to Reduce Dissolved Contaminants and/or pathogens in Runoff

Widths 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.

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 (≥ 3 feet).

CONSIDERATIONS

Filter strip width can be increased as necessary to accommodate harvest and maintenance equipment.

Increasing filter strip widths beyond listed widths may increase the potential for carbon sequestration.

Filter 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 may 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.

Enhancing herbaceous habitat for wildlife and beneficial insects

If this also an intended purpose then the width for pollutant reduction must first be met with an additional filter strip width (flow length) for wildlife purposes added as necessary to the downhill edge of the filter strip.

Native grasses listed in table 2 shall be planted in the entire filter strip. Forbs can be added to any part of the filter strip. Consult *Minnesota Conservation Practice Standard Upland Wildlife Habitat Management, Code 645* for recommended forbs and seeding rates.

The filter strip shall not be mowed during the nesting season of the target wildlife.

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

PLANS AND SPECIFICATIONS

Plans and specifications shall be prepared for each specific field site where a filter strip will be installed. A plan includes information about the location, construction sequence, vegetation establishment, and management and maintenance requirements.
Minnesota Job Sheet 393 can be used as a plan template.

Specifications will include:

a) Length, width, and slope of the filter strip to accomplish the planned purpose (width refers to flow length across the filter strip).

b) Species selection and seeding or sprigging rates (PLS or stem caliper) to obtain the required stand density and accomplish the planned purpose

c) Method of establishment to include planting dates, care, and handling of the seed to ensure that planted materials have an acceptable rate of survival

d) Plans for practices used to induce sheet flow across the filter strip and to stabilize channels passing through the filter strip.

e) A statement that only viable, high quality, and regionally adapted seed will be used

f) Site preparation sufficient to establish and grow selected species

OPERATION AND MAINTENANCE

Permanent filter strip vegetative plantings shall be harvested as appropriate to encourage dense growth, maintain an upright growth habit and remove nutrients and other contaminants that are contained in the plant tissue.

An approved burn plan must be developed if prescribed burning is used to manage and maintain the filter strip.

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

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

Control undesired weed species.

Inspect the filter strip after storm events and repair any gullies that have formed. Remove unevenly deposited sediment accumulation that disrupts sheet flow. Reseed disturbed areas and take other measures to prevent concentrated flow through the filter strip.

Periodically re-grade and re-establish the filter strip area when sediment deposition at the filter strip-field interface jeopardizes its function. Re-establish the filter strip vegetation in the regraded areas, if needed.
Consult *Minnesota Job Sheet 393.*

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.

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. Ppt 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)[1]				
Sediment and sediment associated materials				
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 materials and pathogens[4]				
% 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[5]	220	160-220	160-200	120-180

[1] Widths are for removal of pollutants from runoff. Widths for soluble materials and pathogens already include widths necessary for sediment. An unsuitable site for sediment reduction is also unsuitable for soluble materials and pathogens.

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 downhill edge); 2. Insure 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.

[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 watershed to filter strip area ratio is > 60:1. http://www.nrcs.usda.gov/technical/agronomy.html

[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] Upper ends of the width ranges are appropriate when pathogen control is an objective and/or when the Soil Hydrologic Group at the proposed filter strip site is C or D.

[5] 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.

**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.*

Table 2. Species Components for Designing Filter Strip Seed Mixtures									
Species **C = Cool season** **W = Warm season** **R = Rhizomatous**		**% allowed in Mix**	**Pure Stand (full) seeding rate (Lbs./ac PLS)[1]**	**Drought**	**Flooding**	**Salts**	**Wet Soil**	**Min pH**	**Longevity**
Introduced Grasses and Legumes[2]									
Creeping Foxtail*	C/R	0-100	5	Poor	Excel	Fair	Yes	5.5	Long
Smooth Bromegrass	C/R	0-100	16	Good	Fair	Good	No	5.5	Long
Redtop[3]	C/R	0-100	3	Fair	Good	Fair	Yes	4.0	Moderate
Meadow Brome	C	0-100	22	Fa-Good	Poor	Pr-fair	No	5.7	Moderate
Intermed. Wheatgrass*	C/R	0-50	15	Good	Fair	Fa-Gd	No	6.5	Moderate
Birdsfoot Trefoil*[3]	C	0-50	8	Good	Good	Excel	Yes	5.5	Moderate
Tall Wheatgrass*	C	0-50	15	Good	Good	Excel	Yes	6.5	Moderate
Alfalfa*	C	0-50	13	Good	Poor	Fair	No	6.2	Moderate
Red Clover*	C	0-33	9	Fair	Fair	Pr-fair	No	5.5	Short
Alsike Clover	C	0-25	3	Poor	Good	Pr-fair	Yes	4.0	Short
Timothy*	C	0-25	3	Poor	Good	Fair	Yes	5.5	Short
Native Grasses									
Canada Wildrye	C	0-25	10	Fair	Good	Fair	No	5.5	Short
Slender Wheatgrass*	C	0-25	11	Good	Good	Excel	No	6.5	Short
Virginia Wildrye	C	0-25	12	Fa-Good	Good	Poor	S	5.5	Short
Green Needlegrass	C	0-25	8	Good	Fair	Fa-Gd	No	6.6	Moderate
Western Wheatgrass*	C/R	0-50	15	Good	Excel	Excel	Yes	6.5	Long
Reed Canarygrass*[4]	C/R	0-100	7	Good	Excel	Good	Yes	5.5	Long
Switchgrass*	W/R	0-100	6	Good	Good	Fair	Yes	5.5	Long
Prairie Cordgrass[5]	W/R	0-100	10	Poor	Excel	Fair	Yes	6.0	Long
Big Bluestem*	W/R	0-50	10	Fair	Poor	Poor	No	5.5	Long
Indiangrass*	W/R	0-25	10	Fair	Poor	Poor	No	5.5	Long
Sideoats Grama*	W/R	0-25	10	Good-Ex.	None	Poor	No	5.0	Long
Little Bluestem*	W	0-25	7	Good-Ex.	Poor	Poor	No	5.0	Long

*Varietal selection important. See table 3 and/or current edition of Minnesota Varietal Trails for Select Crops at: http://www.maes.umn.edu/09varietaltrials/

[1] PLS is Pure Live Seed. [2] Do not mix introduced grass species with native grass species.

[3] Only use Birdsfoot Trefoil or Redtop on sites where other species will not work and do not recommend these species adjacent to native seed production fields.

[4] Use of Reed Canarygrass is restricted to very poorly drained sites and must be approved by the SRC.

[5] Prairie Cordgrass should not exceed 20% of the mixture when combined with Big Bluestem, Indiangrass or Switchgrass.

Flooding ratings: **None**<1 week; **Poor** 1-2 weeks; **Fair** 2-4 weeks; **Good** 4-6 Weeks; **Excellent** >6 weeks

Soluble salts ratings: **Poor** 0-2 mmhos; **Fair** 3-4 mmhos; **Good** 5-7 mmhos; **Excellent** 8-16 mmhos

Longevity: **Short** 1-4 Years; **Moderate** 5-10 Years; **Long** > 10 Years

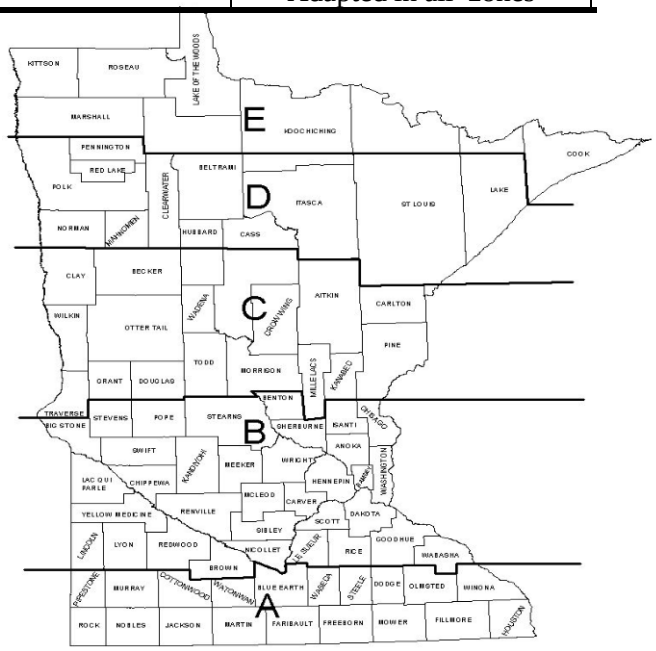
Wet soils: **Yes**-tolerates poorly or very poorly drained. **S**-Tolerates somewhat poorly drained sites

TABLE 3: RECOMMENDED VARIETIES FOR SELECT GRASSES						
		ADAPTABILITY ZONE				
SPECIES	VARIETY	A	B	C	D	E
Switchgrass	Forestburg, Sunburst	1	1	1	2	3
	Nebraska 28	1	1	2	3	4
	Pathfinder, Summer, Trailblazer	1	2	3	4	4
	Dacotah	3	2	1	1	1
Big Bluestem	Bonilla, Sunnyview	1	1	1	2	3
	Champ	1	1	2	3	4
	Rountree	1	2	3	4	4
	Bonanza, Pawnee	1	2	3	3	4
	Bison	3	2	1	1	1
Indiangrass	Holt	1	1	2	3	4
	Oto	2	3	4	4	4
	Tomahawk	2	1	1	1	1
Sideoats Grama	Pierre	1	1	1	2	3
	Butte	1	1	2	3	4
	Trailway	1	2	3	4	4
	Killdeer	3	2	1	1	1
Little Bluestem	Itasca	1	1	1	1	1
	Badlands	2	1	1	1	1
	Camper	2	3	3	4	4
	Blaze	2	3	4	4	4
Prairie Cordgrass	Red River	Adapted in all zones				
Green Needlegrass	Lodorm, AC Mallard	Adapted in all zones				
Pubescent/Intermediate Wheatgrass	Beefmaker, Chief, Clarke, Haymaker, Manifest Manska, Oahe, Reliant, Slate, Tegmar	Adapted in all zones				
Slender Wheatgrass	Adanac, Primar, Pryor, Revenue,	Adapted in all zones				
Tall Wheatgrass	Alkar, Jose, Orbit, Platte	Adapted in all zones				
Western Wheatgrass	Flintlock, Rodan, Rosana	Adapted in all zones				
Canada Wildrye	Mandan	Adapted in all zones				

RATINGS: 1= Adapted with optimum performance
2= Moderately adapted
3= Poorly Adapted
4= Not Adapted

Local seed sources of the above species may be used within 200 miles north or 150 miles south of the seed origin if tested for germination and purity.

ZONES



APPENDIX

Guidelines for Managing Concentrated Flows Through Filter Strips

Concentrated flows moving through a filter strip must be shaped, graded and vegetated to resist erosion. Vegetated barriers should be installed across the flow areas to induce sediment deposition and the creation of a level bench. The barriers must be at least 3 feet in width (flow length) and must extend across the channel to a minimum of 1.5 feet above the low point of the channel (See Figure 1). As a minimum, one barrier will be installed at the upslope edge of the filter strip where the concentrated flow enters and at the outlet of the concentrated flow channel (See Figure 2).

Barriers shall not be mowed shorter than 12 inches. As vegetative barriers mature, the amount of ponding at the upslope edge can increase. The wetness created may eventually impede timely field operations in the adjacent agricultural land. Approved species for vegetative barriers is **Switchgrass seeded at 10 lbs. PLS per acre.** Consult Conservation Practice Standard Vegetative Barrier, Code 601, if additional information is required.

Figure 1. **Vegetative barrier installed across the channel to an elevation of 1.5 feet above the low point**

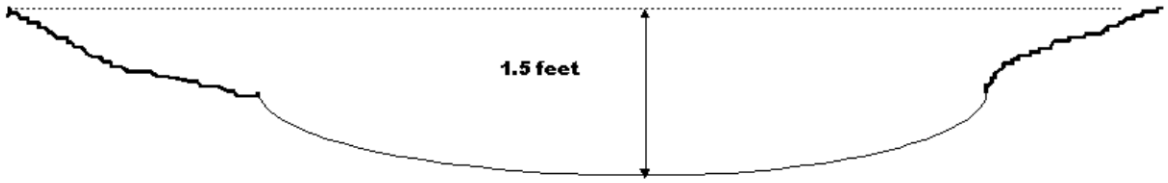


Figure 2. **Filter strip with vegetative barriers**