NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

VEGETATIVE BARRIER

(Ft.)

CODE 601

DEFINITION

Permanent strips of stiff, dense vegetation along the general contour of slopes or across concentrated flow areas

PURPOSE

- Reduce sheet and rill erosion.
- Reduce ephemeral gully erosion.
- Manage water flow.
- Stabilize steep slopes.
- Trap sediment.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all eroding areas including but not limited to cropland, pastureland, rangeland, forestland, farmsteads, mined land and construction sites.

This practice applies only when used in conjunction with other conservation practices as part of a conservation management system.

CRITERIA

General Criteria Applicable to All Purposes

Stiffness Index
Plant vegetative barriers to vegetation having the minimum Vegetation Stiffness Index (VSI) designated in Table 1, measured at a point 6 inches above the ground. VSI values reflect the importance of large stems to keep barriers upright during runoff events.

Table 1. Stem Diameter and Minimum Stem Density Values for Vegetation Stiffness Index (VSI) Values of 0.05 and 0.10.

Stem Diameter (Inch)	Concentrated Flow Areas Stem Density Per Square Foot @VSI=0.1	Other Purposes Stem Density Per Square Foot @VSI=0.05
0.10	1000	500
0.15	200	100
0.20	60	30
0.25	30	15
0.50	20	10
≥1.00	1.0	1.0

Density
Gaps between plants will be no greater than 3 inches at the end of the first growing season.

Species Selection
Select species adapted to local soil and climate conditions that establish easily, are long-lived and manageable. Species will be selected that exhibit characteristics that are required for adequate function such as: emergence though several inches of sediment or resuming growth from buried stem nodes, rhizomatous or stoloniferous growth habit, and stems that remain intact and erect year round. Do not establish invasive species in vegetative barriers.

Refer to Colorado Plant Materials Technical Note 59, Plant Suitability and Seeding Rates for Conservation Plantings in Colorado, or the USDA NRCS Plants Database, for information about species that are adapted to specific locations.

Establishment of Vegetative Barriers
Establish barriers vegetatively or from seed.

Seeding dates, depths and rates will be appropriate for the species selected and the conditions of the site. Place seeds to insure good seed-to-soil contact and pack after planting.

Plant vegetatively established Barriers in a single row at a dense enough spacing to insure a functional barrier in one growing season. For most herbaceous species, this will require a spacing of no more than 6 inches for bare-root seedlings, cuttings, sod chunks, plugs, rhizomes, or divisions consisting of no less than 5 viable stems. Establish suckering shrubs or herbaceous species established from 6-inch (gallon) potted material at a spacing of no more than 12 inches.

Complete site preparation in a manner to ensure seed germination or vegetated material establishment.

Use optimum planting dates for the species. Place plants to insure good root-to-soil contact and pack after planting.

Use appropriate temporary measures such as erosion control blankets, silt barriers or mulches, as appropriate, during the establishment period.

Barrier Alignment
Remove obstructions such as trees and debris that interfere with vegetative growth and maintenance to improve vegetation establishment and alignment.

Barrier Width
Barrier widths will be 3 feet wide or 0.75 times the design vertical interval, whichever is greater. Broadcast or drill seed in a strip at least 3 feet wide. Seed drilled with a row planter will be a minimum of two rows wide.

Additional Criteria for Reducing Sheet and Rill Erosion

Erosion reduction by barriers is achieved by diverting flow which reduces slope length (RUSLE “L”), and or through the supporting practice factor (RUSLE “P”) for contouring and permanent buffer strips.

Gradient
Gradients along the barrier will be no less than 0.2 percent and no greater than 1.0 percent except where the vegetative barrier crosses concentrated flow areas. Gradients entering a concentrated flow area may be up to 1.5 percent for 100 feet in order to get better row alignment.

All tillage and equipment operations in the interval between barriers will be parallel to the vegetative barrier.

In order to redirect flow and decrease slope length, install a berm and or channel at the upslope edge of the barrier or immediately upslope of the barrier. The minimum berm height or channel depth will be 3 inches, or as high as required by local conditions. The berm or channel may form by normal tillage operations along the edge of the grass, but will not form in no-till situations. Where berms or channels are used, a stable conveyance system for control of concentrated runoff must exist in flow areas that receive diverted runoff.

Spacing
The horizontal spacing between vegetative barriers shall be a vertical interval of no more than 6 feet, or the allowable “L” that achieves soil loss tolerance in Rusle 2, whichever is less, considering other planned practices in the conservation management system.

Plan crop strip widths in multiples of widths of planting, tillage, spraying and harvest equipment. Adjust this spacing up to 10 percent between the barriers.

Vegetation
Select vegetation to provide the designated minimum stem density with the designated stem diameter for a vegetation stiffness index (VSI) of 0.05.

Additional Criteria for Reducing Gully Erosion

Alignment
Many fields have too much undulation to allow alignment on the contour across a concentrated flow area at angles convenient for the operation of farm equipment. In such cases, install vegetative barriers across concentrated flow areas perpendicular to the direction of water flow. Vegetative barriers, when used to control ephemeral erosion, do not need to extend across the ridge top where water does not flow into the vegetative barrier.

Width and Length.
Vegetative barriers will consist of a minimum of 2 rows. Vegetative barrier length will vary depending on the topography. As a minimum, each strip will extend far enough to provide 1.5 feet of elevation from the center of the flow area to the end of the vegetative barrier (Figure 1). To treat pre-existing head cuts along the ephemeral, place one row of a barrier at the bottom of the head cut and the other row at the top.

Spacing.
This practice functions by having backwaters from one barrier extend up to the base of the next.

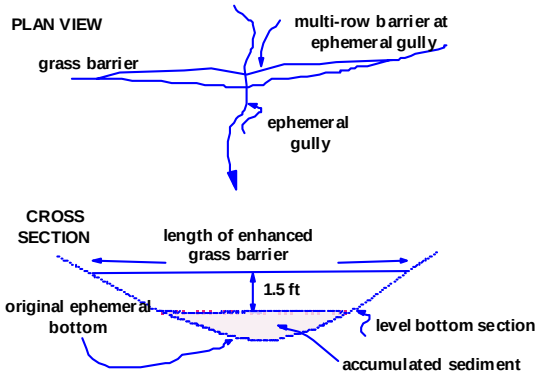

Figure 1. Two row barriers in concentrated flow areas must extend long enough to avoid bypass around the ends at high flow.

Barrier Up-Slope
This backwater dissipates energy and causes sediment deposition in the gully channel.

Base vegetative barrier spacing on a vertical interval of 1.5 feet for conditions where tillage is not performed between the barriers, and 3 feet for all other conditions where sediment deposition and bench development is anticipated.

A 10 percent adjustment in the width of the crop strip between the barriers is permissible for wildlife habitat or maintenance concerns. Crop strip width will be in multiples of widths of planting, tillage, spraying, and harvesting equipment.

Minimum Level Bottom Section Length
The definition of a Level bottom Section Length is the bottom width of a trapezoidal waterway.

The minimum Level Bottom Section Length (in feet) shall be numerically equal to the peak discharge (cfs) for a 2-year 24-hour design storm from the total watershed upslope of the lowest barrier. This equates to a specific discharge of 1 cfs/ft vegetative barrier. Shape the Level Bottom Section Length during construction or by sediment deposition. See Figure 1. Use methods in Chapter 2 Engineering Field Handbook, Technical Release 55, or other approved method, to estimate peak discharge for local soil, climate and management conditions.

If the channel does not have a level bottom section, the peak discharge for a 2-year 24-hour storm cannot create velocities through the barriers greater than allowable for the soil, vegetation, and slope conditions as determined using Chapter 7 of the Engineering Field Handbook.

Vegetation.
The vegetation will be of species to provide the designated minimum stem density with the designated stem diameter and have a vegetation stiffness index (VSI) of 0.10. See Table 1.

Additional Criteria for Managing Water Flow

For this purpose, design barriers to slow runoff by increasing path length and by retarding and spreading run-on water for subsequent treatment within filter strips and flow channels to remove contaminants by ponding, filtration, infiltration and exposure to sunlight.

Gradient
In order to divert flow, gradients along the barrier will be no less than 0.2 percent nor no greater than 1.0 percent except where the vegetative barrier crosses a draw (a concentrated flow area). Gradients entering a concentrated flow area may be up to 1.5 percent for 100 feet in order to get better row alignment.

In order to redirect flow, a berm must exist at the upslope edge of the barrier and/or a channel must exist immediately upslope of the barrier. Minimum berm height/channel depth will be 3 inches or as high as required by local conditions. Create berm/channels by normal tillage parallel to the vegetative barrier. Pre-form berm/channels in no-till situations.

Vegetation
The vegetation will be of species to provide the designated minimum stem density with the designated stem diameter and have a vegetation stiffness index (VSI) of 0.05 for areas diverting runoff and VSI of 0.1 for areas retarding and ponding runoff. See Table 1.

Width and Length
Vegetative barriers may consist of 1 or 2 rows. Vegetative barriers may be wider to adjust for planter and/or sprayer width, or for improved contour alignment. Vegetative barrier length will vary depending on the topography. At a minimum, each strip will extend far enough from concentrated flow areas to provide 1.5 feet of elevation from the center of the flow area to the end of the vegetative barrier (Figure 1).

Spacing
Horizontal spacing between the vegetative barriers intended to redirect runoff will be determined using the lesser of 1) a vertical interval of no more than 6 feet or 2) the allowable "L" that achieves soil loss tolerance in Rusle 2 considering the planned practices in the conservation management system.

For barriers intended to retard and spread run-on, the maximum vertical interval will be 1 foot.

Plan crop strip width in multiples of widths of planting, tillage, spraying and harvest equipment. Spacing adjustment up to 10 percent is permissible between the barriers.

Maximum Watershed
The maximum watershed in a vegetative barrier system will be the smaller of the following:

1. the size that will provide 2 yr-24 hr runoff volume to impound 1 foot of water upslope of the lowest barrier in the system, or;
2. the size that will generate velocities greater than allowable on bare soil for the soil texture in the concentrated flow area, as determined in Chapter 7 in the Engineering Field Handbook.

Additional Criteria for Stabilizing Steep Slopes

Use vegetative barriers to stabilize steep slopes in combination with other bioengineering principles. Concentrated flow channels are not acceptable on the slope face.

Alignment
Install barriers on the contour. However, if overland water flow can occur down the slope face, barrier alignment may deviate from the contour up to a grade of 1% to divert water.

Spacing.
Horizontal spacing between the vegetative barriers will be the spacing that results in a vertical interval of no more than 6 feet. However, if overland water flow can occur down the slope face, decrease the vertical interval of the barriers to no greater than 4 feet.

Vegetation
The vegetation will be a deeply rooted species that establishes easily and grows rapidly.

The vegetation stiffness shall provide the designated minimum stem density with the designated stem diameter and have a vegetative stiffness index (VSI) of 0.05 based on Table 1.

Maximum Watershed
Maximum watershed size is not criteria for this purpose. If, however, concentrated flow occurs on the steep slope, install mitigation practices such as a terraces or diversions to eliminate the concentrated flow.

Additional Criteria for Trapping Sediment at the Bottom of Fields and/or the Ends of Furrows

Barriers intended only to trap sediment at the end of fields will not be credited with additional in-field erosion reduction credit and should therefore be used at the edge of the field or end of furrows already within soil loss tolerance. They will effectively reduce sediment delivery to surface water down slope of the barrier and are desirable additions to conservation management systems.

Alignment
Use vegetative barriers as field buffers at the bottom of fields and/or the ends of furrows whether the furrows are aligned up and down the slope, across the slope or on the contour.

Width
Vegetative barriers used as field buffers will be a minimum of 3 feet wide. There is no maximum crop strip width or slope length.

CONSIDERATIONS

Consider the following during the planning process.

General
Consider management practices such as conservation crop rotation and residue management when designing the conservation management system on cropland.

Consider associated structural practices such as water and sediment control basins, subsurface drainage, and underground outlets to handle surface and subsurface water.

This practice may improve the efficiency of other practices such as stripcropping, filter strips, riparian forest buffers, grassed waterways, diversions and terraces.

On tilled fields, consider soil profiles that have sufficient depth to retain productivity where benches will develop as soil moves down gradient by tillage. Soil upslope of barriers will gradually build up while soil down slope of the barrier erodes. Consider these effects with respect to soil depth, subsoil characteristics and response to amendments.

Evaluate soils in barrier areas for their potential to create field access problems by ponding water behind the barriers. Subsurface drains perpendicular to or along the length of the barrier may improve drainage of the area upslope of the barrier.

Consider the effects on the water budget, especially on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation and ground water discharge.

Consider the effects of erosion and sediment, pathogens and soluble and sediment-attached substances that can move with runoff.

Consider the potential for development of saline seeps or other salinity problems resulting from increased infiltration in soils that have restrictive layers.

Consider the potential for uncovering or redistributing toxic materials such as saline soils.

Consider increasing the minimum width of the barrier to increase potential for carbon sequestration.

Wildlife Habitat
Consider the effects on wetlands and water related wildlife habitats.

Consider the effects on the availability of food and nesting and escape cover.

Economics
Consider the effects on the production of crops in adjacent fields from shading, and competition for water and nutrients.

Consider the impact of land taken out of production and occupied by the vegetative barriers.

Field Stripcropping and Contour Buffers
These strips are similar to vegetative barriers except they are wider, do not have as strict alignment criteria and require removal and redistribution of sediments deposited on the up slope strip edges. Vegetative barriers established with field strips in concentrated flow areas can reduce the failure of field strips caused by concentrated flow. Barriers used in association with field strips and contour buffer strips will be located immediately upslope of these practices.

Filter Strips
Vegetative barriers incorporated into the upslope portion of filter strips will increase filter strip longevity by promoting sediment deposition above the filter strip. Barriers used in association with filter strips will be located immediately upslope of and/or periodically within the filter strip.

Field Borders
Vegetative barriers incorporated into the upslope portion of field borders at the bottom of slopes will increase field border longevity by promoting sediment deposition above the field border. Vegetative barriers will also additional provide wildlife cover in borders of predominantly sod-forming grasses. Barriers used in association with field borders will be located immediately upslope of the field border.

Riparian Forest Buffers
Use vegetative barriers on the upslope edge of the vegetation zones. Locate barriers used in association with riparian forest buffers immediately upslope of zone two or zone three of the buffer. Consider shading effects on vegetative barrier growth when selecting species.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for each field or treatment unit according to the Criteria and Operation and Maintenance sections of this standard. Specifications shall describe the requirements for applying this practice to meet the intended purpose.

Record practice specifications on the Colorado Vegetative Barrier, 601 Conservation Practice Job Sheet.

Plans and specifications will include the following information.

1. Field map with location of vegetative barriers
2. Width of crop strip
3. Vegetative barrier and crop strip orientation
4. Width of barrier
5. Vegetative species and cultivar, attach a completed CO-ECS-5 for each mix
6. Vegetation establishment date, seeding rate or vegetation spacing
7. Guidance for operation and maintenance

OPERATION AND MAINTENANCE

Carry out the following actions to insure that this practice functions as intended. These actions include normal activities in the application and use of the practice and repair and maintenance of the practice.

1. Establishment failures will be replanted or reseeded immediately, short gaps in seeded barriers may be reestablished more effectively and immediately with transplanted plant material.
2. Mow vegetative barriers as a management practice to encourage the development of a dense stand and prevent shading of crops in adjacent fields. Do not mow closer than 15 inches or the recommended height for the species, whichever is taller. Complete mowing operations when access is available through adjacent fields. Mowing in concentrated flow areas is discouraged because it will lower the vegetative stiffness index (VSI) by reducing average stem diameter.
3. Burning of herbaceous barriers may be used as a management practice, based on a case by case analysis to encourage the development of a dense stand and prevent the accumulation of residue in the barrier. Apply burning when the vegetation is dormant. Plan and implement the Colorado Prescribed Burning, 338 Conservation Practice Standard before burning Vegetative Barriers.
4. Accomplish weed control by mowing or spraying or by wick application of labeled herbicides. Planning and implementation of the Colorado Pest Management, 595 Conservation Practice Standard is required.
5. Vegetation in the barrier will be tolerant to or protected from herbicide used in the cropped field.
6. Crop tillage and planting operations will be parallel with the vegetative barrier.
7. Perform pest control methods in adjacent fields with techniques and pesticides that will not damage the vegetative barrier.
8. Fill and replant washouts or rills that develop immediately after storm events. Reestablish short gaps in established barriers with transplanted plant material.
9. Do not use vegetative barriers as field roads or turn rows. Do not cross machinery over vegetative barriers located in concentrated flow areas.
10. Do not cross Vegetative Barriers with water furrow plows or similar implements to cut drainage ditches to allow the passage of surface and subsurface water. If necessary, drain water with underground outlets installed up gradient from the barrier.

REFERENCES

Colorado Field Office Technical Guide, Section I. Plant suitability and seeding rates for conservation plantings in Colorado. 2002. USDA, NRCS. Lakewood, CO.

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