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

Physical Characteristics of Plants.

Stiffness Index. Vegetative barriers will be planted 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 in keeping 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.

	Concentrated Flow Areas	Other Purposes
Stem Diameter (Inch)	Stem Density Per Square Foot @VSI=0.1	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. Species must be adapted to local soil and climate conditions, be easily established, 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. Care will be taken when selecting plants to avoid invasive species.

Establishment of Vegetative Barriers. Barriers may be established vegetatively or from seed.

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service.

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

Barriers established vegetatively will be planted 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. Suckering shrubs or herbaceous species established from 6-inch (gallon) potted material will be established at a spacing of no more than 12 inches.

Site preparation must be done in a manner to ensure seed germination or vegetated material establishment.

Optimum planting dates for the species will be used. Plants will be placed to insure good root-to-soil contact and packed after planting.

Appropriate temporary measures, such as erosion control blankets, silt barriers or mulches, will be used, as appropriate, during the establishment period.

Barrier Alignment. Obstructions, such as trees and debris that interfere with vegetative growth and maintenance, will be removed to improve vegetation establishment and alignment.

Barrier Width. Barrier widths will be the larger of 3 feet wide or 0.75 times the design vertical interval. Broadcast or drilled seed will be sown in a strip at least 3 feet wide. Seed sown with a row planter will be seeded in a minimum of 2 rows.

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 so reduce slope length, a berm must exist at the upslope edge of the barrier and/or a channel must exist immediately upslope of the barrier. A berm or channel may develop at the upslope edge of the barrier that will redirect flow. This berm and/or channel can also be constructed. Minimum berm height/channel depth will be 3 inches or as high as required by local conditions. These berm/channels may be created by normal tillage operations along the edge of the grass, but will not form in no-till situations. Where berm/channels are used, a stable conveyance system for control of concentrated runoff must exist in flow areas that receive diverted runoff.

Spacing. Horizontal spacing between the vegetative barriers will be determined using the lesser of: a vertical interval of no more than 6 feet, or the allowable “L” that achieves soil loss tolerance in RUSLE considering the planned practices in the conservation management system.

Crop strip width will be planned in multiples of widths of planting, tillage, spraying and harvest equipment. This spacing may be adjusted up to 10 percent between the barriers.

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.

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, vegetative barriers may be installed 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 adequately treat pre-existing headcuts along the ephemeral, place one row of a barrier at the bottom of the headcut 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

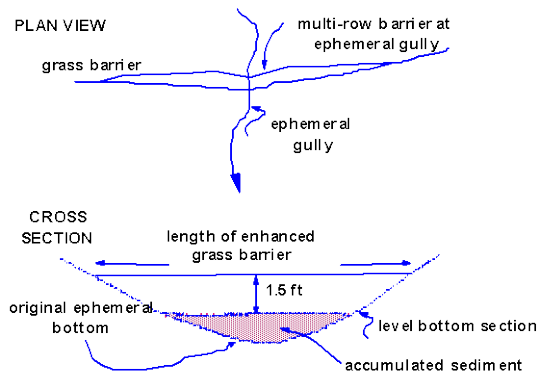

Figure 1. Two row barriers in concentrated flow areas must extend long enough to avoid bypass around the ends at high flow.

barrier up slope. This backwater dissipates energy and causes sediment deposition in the gully channel.

Spacing between the vegetative barriers will be based on the vertical interval of 1.5 feet for conditions where no tillage is performed between the barriers and 3 feet for all other conditions where sediment deposition and bench development is anticipated.

Adjustments of 10 percent in the width of the crop strip between the barriers will be allowed 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 minimum level bottom section length (in feet) shall be numerically equal to the peak discharge (in 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. Level bottom section is defined as the bottom width of a trapezoidal waterway. This will be shaped during construction or formed by sediment deposition. See Figure 1. Use methods in Chapter 2 Engineering Field Handbook 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, barriers are designed 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. These berm/channels may be created by normal tillage parallel to the vegetative barrier, but would need to be pre-formed in no-till situations.

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: a vertical interval of no more than 6 feet, or the allowable "L" that achieves soil loss tolerance in RUSLE 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.

Crop strip width will be planned in multiples of widths of planting, tillage, spraying and harvest equipment. This spacing may be adjusted up to 10 percent between the barriers.

Maximum Watershed. The total watershed in a vegetative barrier system will be the smaller of a) the size that will provide runoff to impound 1 foot of water upslope of the lowest barrier in the system, or b) 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.

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.

Additional Criteria for Stabilizing Steep Slopes

Vegetative barriers can be used to stabilize steep slopes if they are used in combination with other bioengineering principles. Concentrated flow channels are not acceptable on the slope face.

Alignment. The barrier will be installed on the contour. However, if overland water flow is expected down the slope face, the barrier alignment may deviate from the contour up to a grade of 2% 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 is expected down the slope face, the vertical interval of the barriers will be reduced 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. No maximum watershed size is given as criteria for this purpose. If, however, concentrated flow occurs on the steep slope, mitigation practices, such as a terrace or diversion, must be installed 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. Vegetative barriers may be used 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

During the planning process, consider the following:

General Considerations

Management practices such as conservation cropping rotation and residue management must be considered in designing the conservation management system on cropland.

Associated structural practices such as water and sediment control basins, subsurface drainage, and underground outlets must be considered to adequately 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 is moved down gradient by tillage. Soil upslope of barriers will gradually build up while soil will be removed down slope of the barrier. The effect of these should be considered with respect to soil depth, subsoil characteristics and response to amendments.

Soils in the area of the fields where barriers are being established will be evaluated 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 effects on erosion and the movement of sediment, pathogens and soluble and sediment-attached substances that would be carried by the 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.

Considerations to Enhance the Functioning of Other Practices

Field Stripcropping and Contour Buffer Strips. These strips are similar to vegetative barriers except they are wider, do not have as strict alignment criteria, and require sediment accumulations to be periodically removed and redistributed on the land. Vegetative barriers established with field strips where they cross concentrated flow areas could 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. Vegetative barriers could be used on the upslope edge of the

vegetation zones. Barriers used in association with riparian forest buffers will be located immediately upslope of zone two or zone three of the buffer. Shading effects on vegetative barrier growth should be considered in selecting species.

PLANS AND SPECIFICATIONS

1. Plans and specifications will include:
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.
6. Vegetation establishment date, seeding rate or vegetation spacing.
7. Guidance for operation and maintenance.

OPERATION AND MAINTENANCE

The following actions will be carried out 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. Mowing of herbaceous barriers may be used as a management practice to encourage the development of a dense stand and prevent shading of crops in adjacent fields. Mowing will not be closer than 15 inches or the recommended height for the species, whichever is taller. Mowing will be scheduled to coincide with access through crops in 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. Burning will be performed when the vegetation is dormant and with adequate supervision to prevent the fire from damaging surrounding areas. A controlled burn plan will be required.
4. Weed control will be accomplished by mowing or by spraying or wick application of labeled herbicides.
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. Pest control in adjacent fields will be performed with techniques and pesticides that will not damage the vegetative barrier.
8. Washouts or rills that develop will be filled and replanted immediately. Short gaps in established barriers will be reestablished with transplanted plant material.
9. Vegetative barriers will not be used as a field road or turn row. Vegetative barriers in concentrated flow areas will not be crossed with machinery.
10. Vegetative barriers will not be crossed with water furrow plows or similar implements to cut drainage ditches to allow the passage of surface and subsurface water. If necessary, water will be drained with underground outlets installed up gradient of the barrier.