NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD AND SPECIFICATIONS

VEGETATIVE BARRIER

(Feet)
CODE 601

DEFINITION

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

PURPOSES

This practice may be applied as part of a conservation system to support one or more of the following:

* 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 where erosion control is needed.

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

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 – Species must adapt to local soil and climate conditions, be easily established, long-lived, and manageable. Species will be selected that exhibit characteristics required for adequate function such as emergence through several inches of sediment, resuming growth from buried stem nodes, rhizomatous or stoloniferous growth habit, and stems that remain intact and erect year around. Care will be taken when selecting plant species to avoid invasive species.

Establishment of Vegetative Barriers
Barriers may be established vegetatively or from

seed. Select the method best suited for successful establishment of the barriers.

Planting dates from the CRITICAL AREA PLANTING (342) conservation practice standard will be used for the species to be established. Plants and seeds will be placed to insure good root to soil contact. Seed will be planted with a drill or "Brillion-type" seeder to meter and place seed properly.

Establish seedings of perennial grasses according to the conservation practice standard CRITICAL AREA PLANTING (342). Mulching will be used according to the MULCHING (484) conservation practice standard. Establish plantings of woody vegetation according to the conservation practice standard TREE/SHRUB ESTABLISHMENT (612).

Barriers established vegetatively will be planted at a spacing sufficiently dense to ensure a functional barrier in one growing season. While planting a continuous sod strip is best, bareroot seedlings, cuttings, sod chunks, plugs, rhizomes, slips, sprigs or divisions consisting of no less than 5 viable stems may be planted at a 6-inch spacing. Suckering shrubs or herbaceous plants established with 6-inch (gallon) potted material will be established at a spacing of no more than 12 inches. Establish two parallel rows of vegetative material not more than 2 feet apart.

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

Establishment by plants or by seed may be enhanced by properly installing straw bales, woven silt fences, or fiber rolls immediately upslope of the barrier location. Remove these temporary structures as soon as the vegetative barrier is established.

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

Barrier Width – Barrier widths will be the larger of 3 feet wide or 0.75 times the design vertical interval. 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 to Reduce Rill and Interrill Erosion

Erosion reduction by vegetative barriers is achieved by diverting overland flow (reduces slope length) and/or improvements in support practices such as 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 only to achieve better row alignment.

Vegetative barriers are to be arranged as parallel as possible to each other on or near the contour but cross concentrated flow areas at angles convenient for farming. All tillage and planting is to be performed parallel to the vegetative barriers.

In order to redirect flow and 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. The berm or channel will develop over time or these may be constructed prior to establishing the vegetative barrier. Minimum berm height or channel depth will be 3 inches. The berm or channel may be created by normal tillage operations along the edge of the barrier. No till situations will not create an acceptable berm or channel. Where a berm or channel system is used, a stable conveyance system for control of concentrated runoff must exist in flow areas that receive diverted runoff.

Spacing - The spacing between barriers will be determined using the lessor of a vertical interval of no more than six (6) feet or the allowable slope length that achieves soil loss tolerance using current acceptable erosion prediction technology.

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

Vegetation – The vegetation in the barrier will be of a species to provide the designated minimum stem density with the designated stem diameter and have a VSI of 0.05.

Select only species that will remain erect during a runoff event.

Additional Criteria to Reduce Ephemeral 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. Separate and discrete barrier sections may be installed across concentrated flow areas perpendicular to the direction of water flow. When used in this fashion alone, barriers do not need to extend across the ridge tops but only long enough to prevent bypass flow around the ends.

Width and Length – Vegetative barriers will consist of a minimum of two rows. Barrier lengths will vary depending on the topography, As a minimum, each strip must extend far enough to provide 1.5 feet of elevation from the center of the flow area above the estimated sedimentation area to the end of the vegetative barrier (Figure 1). To adequately treat pre-existing headcuts along the ephemeral gully, place one row of the barrier at the bottom of the headcut and the other row at the top.

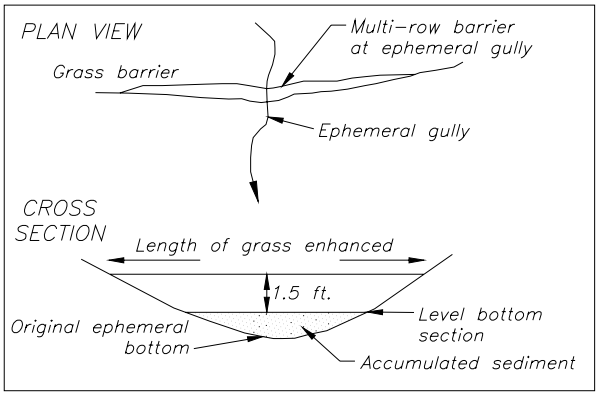

Figure 1 – Two row barriers in concentrated flow areas must extend long enough to avoid bypass flows around the ends at high flow.

Spacing – This practice functions by having backwater from one barrier extending up to the base of the next barrier up slope. This backwater dissipates energy and causes sediment deposition in the gully channel.

Spacing between vegetative barriers will be based on a 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 up to 10 percent in the width of the crop strip between the barriers will be allowed for maintenance concerns. Crop strip width will be in multiples of planting, tillage, spraying, and harvest equipment.

Minimum Level Bottom Section Length – The minimum level bottom section length in feet shall be numerically equal to the peak discharge in cubic feet per second (cfs) for a 2-year 24-hour design storm event from the total watershed up slope of the lowest barrier. This equates to a specific discharge of 1 cfs per foot of vegetative barrier. The level bottom section is defined as the bottom width of a trapezoidal waterway. The waterway will be shaped during construction or formed by sediment deposition (Figure 1). Use methods in Chapter 2, Engineering Field Handbook to estimate the 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, 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 VSI of 0.10.

The barrier should be at least three (3) feet wide. Establishing the barrier with sod instead of seeds will improve establishment success.

Vegetation shall be selected and managed to maintain a height of at least 15 inches throughout the entire year.

Additional Criteria to Manage 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, the gradient 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 concentrated flow area. Gradients entering a concentrated flow area may be up to 1.5 percent for 100 feet only to achieve better row alignment.

In order to redirect flow a berm must exist at the upslope edge of the vegetative barrier and/or a channel must exist immediately upslope of the barrier. Minimum berm height or channel depth will be 3 inches or as high as required by local conditions. This berm or channel may be created by normal tillage parallel to the vegetative barrier. In no till situations the berm or channel will need to be constructed prior to establishing the vegetative barrier.

Width and Length – Vegetative barriers may consist of 1 or 2 rows. Barriers may be wider to adjust for planter and/or sprayer width or for improved contour alignment. Barrier length will vary depending on the topography. At a minimum, each barrier 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 - The horizontal spacing between vegetative barriers will not exceed a vertical interval of six (6) feet.

For barriers intended to retard and spread run-on water, the maximum vertical interval will be one (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.

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

Maximum Watershed – The total watershed in a vegetative barrier system will be the smaller of :
a) the size that will provide runoff to a depth of 1 foot of water at the lowest barrier in the system, or
b) the size that will generate runoff velocities greater than allowable on bare soil for the soil texture in the concentrated flow area as determined by procedures in Chapter 7, Engineering Field Handbook.

Vegetation – The vegetation will be a species that provides the designated minimum stem density with the designated stem diameter. The vegetation will have a VSI of 0.05 for areas diverting runoff and a VSI of 0.1 for areas retarding and ponding runoff (Table 1).

Additional Criteria to Stabilize Steep Slopes

Vegetative barriers may be used to stablize steep slopes if they are used in combination with other bioengineering principles. Concentrated flow channels on the slope face are not acceptable for the application of this practice and this purpose.

Alignment - Barriers will be installed on the contour with a maximum grade of two (2) percent to divert water from the slope face.

Spacing - The horizontal spacing between the vegetative barriers will be based on a maximum vertical interval not to exceed 6 feet. If overland water flow is expected down the slope face, the vertical interval between 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 to have a VSI of 0.05 based on Table 1.

Maximum Watershed – No maximum watershed size is established for this criteria. If concentrated flow occurs on the steep slope, mitigation practices such as a terrace or diversion system must be installed to eliminate the concentrated flow.

Additional Criteria to Trap Sediment

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

Alignment – Vegetative barriers may be used as field buffers at the bottom of fields and/or end 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 three (3) feet wide. There is no maximum crop strip width or slope length for this purpose.

CONSIDERATIONS

During the planning process consider the following:

General Considerations

Management practices such as conservation crop rotation and residue management must be considered in designing the conservation 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 benched will develop as soil is moved down gradient by tillage. Soil upslope of barriers will gradually build up while soil will be removed downslope of the barrier. These effects 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 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.

Considerations to Enhance Wildlife Habitat

Consider the effects on wetlands and water related wildlife habitats.

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

Native species should be used when feasible. Wildlife enhancement and other benefits of native plants should be discussed during the planning process.

Economic Considerations

Consider the effects on the production of crops in adjacent fields from shading and competition for water and nutrients. Also consider 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 the 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 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 additionally provide wildlife cover in borders on 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

Site specifications for establishment and maintenance of this practice shall be prepared for each field or treatment unit according to the Criteria, Considerations, and Operation and Maintenance described in this standard.

Site specifications shall be recorded using approved specification sheets, job sheets, narrative statements in the conservation plan, or other acceptable documentation.

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. Mow no 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 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 according to a prescribed burn plan to prevent damage to surrounding areas.

4. Weed control will be accomplished by mowing or by spraying or wick application of labeled herbicides. Use spot treatments when practical to control weeds.

5. Vegetation in the barrier will be tolerant to or protected from the herbicides 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. Vegetative barriers should be inspected after every major storm event. Washouts or rills that develop through the barriers 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 upgradient of the barrier.