NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

VEGETATIVE BARRIER

(Feet)

CODE 601

DEFINITION

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

PURPOSE

This practice will be applied as part of conservation management systems to support one or more of the following purposes:

- 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: 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

Vegetative 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. The larger the VSI the better the barrier strength.

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

$*VSI = M \times (D)^4$
where M = stem number per square foot and D = large stem diameter in inches measured six inches above the ground (Count only stems equal to or greater in size than the D value used in this equation)

Example - $1000 \times (0.10)^4 = 0.10$ VSI

Density. The established barrier shall achieve the desired stem density required for its purpose by the end of the second growing season. Technical judgment will be made to reestablish or improve the vegetative stand if gaps between plants are greater than 3 inches at the end of the first growing season.

Species Selection. Species will be adapted to local soil and climate conditions, be easily

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

established, long-lived, and manageable. Species will be selected that exhibit the following characteristics:

- emergence vegetation through several inches of sediment or resuming growth from buried stem nodes,
- rhizomatous or stoloniferous growth habit
- stems that remain intact and erect year round.

Care will be taken when selecting plants to avoid invasive species.

All the grass species listed in **Table 2** can be used for either the VSI values of 0.05 and 0.10.

Establishment of Vegetative Barriers. Barriers may be established vegetatively or from seed. Barriers vegetatively propagated are not as subject to establishment failure from washouts or burial by sediment as are seedlings. Vegetative plantings are strongly recommended in areas where concentrated flow will washout or bury seed.

Seedings. 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. Seed planted in barriers will be placed to insure good seed-to-soil contact and packed after planting. Guidance from the Oklahoma NRCS Pasture and Hayland (512) and Range Planting (550) standards and specifications shall be used for establishment of grass plantings. The Oklahoma NRCS Cover Crop (340) standard and specification will be used as guidance in establishing cover for grass seedings.

Vegetative Plantings. Barriers established vegetatively will be planted in a single row at a dense enough spacing to insure a functional barrier in one growing season. Plantings in a continuous vegetative strip shall have spacings of no more than 6 inches apart down the row for sod chunks, plugs, rhizomes, transplants and plant divisions consisting of as many viable stems as possible. Herbaceous species established from 6-inch (gallon) potted material shall be established at a spacing of no more than 12 inches. Cover crops are not required for vegetative plantings

Vegetative plantings will be placed to insure good root-to-soil contact and packed after planting. Supplemental watering may be needed and should be considered for establishment purposes of vegetative plantings.

The Oklahoma NRCS Nutrient Management (590) standard and specification shall be used as guidance for determining fertility needs for establishment and maintenance.

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

Barrier Management. Management for the vegetative barrier is in the Operation and Maintenance section below.

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.

Additional Criteria for Reducing Sheet and Rill Erosion

Sheet and rill erosion reduction by barriers is achieved by diverting water flow. This reduces slope length (RUSLE “L”) and establishes the supporting practice factor (RUSLE “P”) for contouring and permanent buffer strips.

Vegetative barriers used for this purpose will be designed as close to the contour as possible. The barriers will be designed in continuous rows across the entire field or across that portion of the field needing erosion reduction.

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

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.

In order to redirect flow, and so reduce slope length, a berm must exist at the upslope edge of the barrier. This berm may be created through normal tillage operations along the edge of the grass barrier. However, it will not be formed in no-till situations. The berm can be constructed

with a minimum height of 3 inches. When berms are used to divert runoff, a stable conveyance system for the control of concentrated runoff must be present (ex. grassed waterway).

Spacing. Horizontal spacing between the vegetative barriers will be determined using the allowable "L" that achieves soil loss tolerance in RUSLE considering the planned practices in the conservation management system. In no circumstances will the vertical interval between barriers exceed 6 feet.

The spacing may be adjusted up to 10 percent between the barriers to allow for better alignment of tillage and farming equipment.

Vegetation. The barrier vegetation may be seeded or vegetatively propagated. When crossing ephemeral gullies, vegetative plantings will be more desirable than seedings. Barriers will be planted to a species which provides a vegetation stiffness index (VSI) of 0.05 or greater **(Refer to Table 2)**.

Additional Criteria for Reducing Ephemeral Gully Erosion

Many fields have too much undulation to allow alignment of barriers on the contour across concentrated flow areas 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 used to control ephemeral gully erosion will be designed to create sediment deposition along the barrier. Barriers will not need to extend to the ridge top where water does not flow into the barrier.

Width and Length. The length of the vegetative barrier will vary depending on the topography. At a minimum, each barrier 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)**.

Spacing. This practice functions by having backwaters 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.

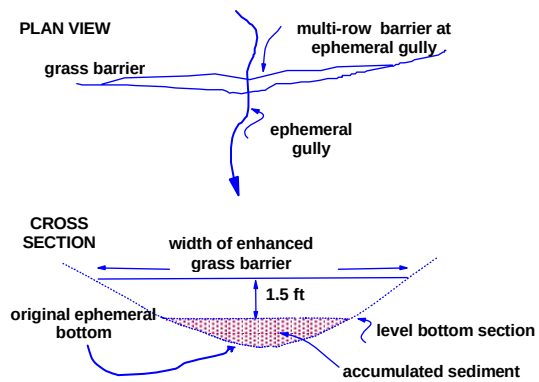

Figure 1. Two row barriers in concentrated flow areas must extend long enough to avoid bypass around the ends at high flow.

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 will be allowed for maintenance concerns and alignment of tillage equipment.

Minimum Level Bottom Section Width. The minimum level bottom section width (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 may 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. Barriers for this purpose will be vegetatively propagated and maintained 3 feet in width. Barriers will consist of a minimum of 2 rows planted 18 inches apart. To adequately treat headcuts along the ephemeral gully, place one row of a barrier at the bottom of the headcut and the other row at the top. The barrier

vegetation will be planted to a species which provides a vegetation stiffness index (VSI) of 0.10 **(Refer to Table 2)**.

Additional Criteria for Managing Water Flow

For this purpose, barriers are designed to slow runoff by increasing path length and for enhancing other buffer practices by retarding and spreading run-on water. This will increase the removal of contaminants by ponding, filtration, infiltration, and exposure to sunlight.

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.

In order to redirect flow, a berm must exist at the upslope edge of the barrier. Minimum berm height will be 3 inches. These berms may be created by normal tillage parallel to the vegetative barrier, but would need to be constructed in no-till situations

Length. Vegetative barrier length will vary depending on the topography and location of a stable outlet.

When used to retard and spread run-on water from concentrated flow areas for other buffer practices, 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 **(See Figure 1).**

Spacing. When two or more vegetative barriers are needed to redirect flow, the horizontal spacing between the vegetative barriers will be determined using the allowable "L" that achieves soil loss tolerance in RUSLE considering the planned practices in the conservation management system. In no circumstances will the vertical interval between barriers exceed 6 feet.

The spacing may be adjusted up to 10 percent between the barriers to allow for better alignment of tillage and farming equipment.

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

Maximum Watershed. The total watershed in a vegetative barrier system will be the smaller of either:

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 for a 2–year 24-hour storm as determined in **Chapter 7 in the Engineering Field Handbook**.

Using Vegetative Barriers With Other Buffer 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 provide additional 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.

Vegetation. Vegetative barriers may be seeded or vegetatively propagated. When crossing ephemeral gullies, vegetative plantings will be more desirable than seedings. The barrier vegetation will be planted to a species which provides a vegetation stiffness index (VSI) of 0.05 or greater for diverting runoff and VSI of 0.10 for areas retarding, spreading and/or ponding runoff **(Refer to Table 2)**.

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. If, however, concentrated flow occurs on the steep slope, mitigation practices, such as a terraces or diversions, must be installed to eliminate the concentrated flow.

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 vegetative barrier may be seeded or vegetatively propagated. The barrier vegetation will be planted to a species which provides a vegetation stiffness index (VSI) of 0.05 **(Refer to Table 2)**.

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

Barriers used for this purpose are intended only to trap sediment at the end of furrows or at the edge of fields. They effectively reduce sediment delivery to surface water downslope of the barrier and should only be used in fields with existing conservation management systems that already meet planned soil loss tolerances.

Alignment. Vegetative barriers may be used 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.

Vegetation. Vegetative barriers may be seeded or vegetatively propagated. The barrier vegetation will be planted to a species which provides a vegetation stiffness index (VSI) of 0.05 or greater **(Refer to Table 2)**.

CONSIDERATIONS

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 downslope 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.

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. Also consider land taken out of production and occupied by the vegetative barriers.

PLANS AND SPECIFICATIONS

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. 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 by the end of the next planting season, 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. 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 should be performed parallel with the vegetative barrier whenever possible.
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 by the end of the next planting season. 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.

TABLE 2

Species for Planting in Vegetative Barriers

Grass	Planting Rate (PLS lbs/ac)	Planting Dates	Area of Adaptation
Sand Bluestem			
Woodward	**12**	**Dec. 1 – May 31**	**NW, SW, P w/ Irrigation**
Big Bluestem			
Earl	**12**	**Dec. 1 – May 31**	**SW, SE ≥ 25" rainfall**
Kaw	**12**	**Dec. 1 – May 31**	**NW, NE, SW, SE P w/ irrigation**
Indiangrass			
Cheyenne	**9**	**Dec. 1 – May 31**	**NW, NE, SW, SE, P w/ irrigation**
Lometa	**9**	**Dec. 1 – May 31**	**NW, NE, SW, SE P w/ irrigation**
Osage	**9**	**Dec. 1 – May 31**	**NE, SE**
Switchgrass			
Alamo	**6**	**Dec. 1 – May 31**	**Statewide in areas with > 25" rainfall Statewide w/ irrigation**
Blackwell	**6**	**Dec. 1 – May 31**	**Statewide in areas with > 25" rainfall Statewide w/ irrigation**
Western Wheatgrass			
Common	**14**	**Sept. 1 - Oct. 31 Jan. 1 – Feb. 28**	**Bottomlands in the P, SW, NW**
Barton	**14**	**Sept. 1 - Oct. 31 Jan. 1 – Feb. 28**	**Bottomlands in the P, SW, NW**
Tall Wheatgrass			
Jose	**14**	**Sept. 1 - Oct. 15 Jan. 1 – Feb. 28**	**Statewide in saline, sub-irrigated areas, or wet areas, or slickspots NW, NE on deep medium texture soils**
Native Mixture			
Mixture will consist of any of the above native grass species	**Proportional to the seeding rates above**	**Dec. 1 – May 31**	**Species used must be adapted to the site**