Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

GRASSED WATERWAY

CODE 412

(ac)

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DEFINITION

A shaped or graded channel that is established with suitable vegetation to convey surface water at a nonerosive velocity using a broad and shallow cross section to a stable outlet.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- To convey runoff from terraces, diversions, or other water concentrations without causing erosion or flooding
- To prevent gully formation
- To protect/improve water quality

CONDITIONS WHERE PRACTICE APPLIES

This practice is applied in areas where added water conveyance capacity and vegetative protection are needed to prevent erosion and improve runoff water quality resulting from concentrated surface flow.

CRITERIA

General Criteria Applicable to All Purposes

Plan, design, and construct grassed waterways to comply with all Federal, State, and local laws and regulations.

Capacity

Design the waterway to convey the peak runoff expected from the 10-year frequency, 24-hour duration storm. Increase capacity as needed to account for potential volume of sediment expected to accumulate in the waterway between planned maintenance activities. When the waterway slope is less than 1 percent, out-of-bank flow may be permitted if such flow will not cause excessive erosion. Ensure that the design capacity, at a minimum, will remove the water before crops are damaged.

Runoff from graded terraces and graded diversion shall be computed as 100 percent of the peak discharge for the drainage area. Runoff from level terraces and level diversion (closed or open-end) may be computed as 50 percent of the peak discharge of the drainage area.

Stability

Determine the minimum depth and width requirements for stability of the grassed waterway using the procedures in the NRCS National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 7, Grassed Waterways, or Agricultural Research Service (ARS) Agriculture Handbook 667, Stability Design of Grass-Lined Open Channels.

NRCS reviews and periodically updates conservation practice standards. To obtain the current version of this standard, contact your Natural Resources Conservation Service State office or visit the Field Office Technical Guide online by going to the NRCS website at https://www.nrcs.usda.gov/ and type FOTG in the search field.

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The erodibility of the soil material may be estimated to fall into one of the following categories:

- Easily Eroded (very coarse sand, coarse sand, sand, fine sand, very fine sand, loamy coarse sand, loamy sand, loamy fine sand, loamy very fine sand, coarse sandy loam, sandy loam, fine sandy loam, and very fine sandy loam)
- Erodible (loam, silt loam, silt, silty clay loam, and sandy clay loam)
- Erosion Resistant (clay, silty clay, sandy clay, and clay loam)
- Very Erosion Resistant (based on the soil properties only - no soil texture defined)

Allowable effective stress is implied from the categories above. Soil allowable effective stress may also be determined directly from soil properties. The allowable effective stress is the maximum hydraulic stress that may be applied directly to the soil without the occurrence of unacceptable erosion.

Grassed waterway construction areas where dispersive clays are present shall be avoided when possible. If dispersive clays are used in constructing a grassed waterway, internal erosion shall be controlled by treating the soil with 1.5 lbs of gypsum per square foot and incorporating the gypsum a minimum of 3 inches into the soil.

Ensure that the vegetation species selected are suited to the current site conditions and intended uses. Select species that have the capacity to achieve adequate density, height, and vigor within an appropriate time frame to stabilize the waterway.

Width
Keep the bottom width of trapezoidal waterways less than 100 feet unless multiple or divided waterways or other means are provided to control meandering of low flows.

Side Slopes
Keep the side slopes flatter than a ratio of two horizontal to one vertical. Reduce the side slopes as needed to accommodate the equipment anticipated to be used for maintenance and tillage/harvesting equipment so that damage to the waterway is minimized.

Depth
The capacity of the waterway must be large enough so that the water surface of the waterway is below the water surface of the tributary channel, terrace, or diversion that flows into the waterway, at their junction, when both are flowing at design depth.

Provide 0.5 foot freeboard above the designed depth when flow must be contained to prevent damage. Provide freeboard above the designed depth when the vegetation has the maximum expected retardance.

The depth shall be such that the terrace will drain properly and will enter the grassed waterway or outlet in a manner that will eliminate irregular and odd-shaped land patterns which are difficult to farm.

When embankments are constructed to confine the runoff, they shall have a minimum 4-foot top width at the designed height.

Drainage
When needed to establish or maintain vegetation on sites having prolonged flows, high water tables, or seepage problems, use Oklahoma NRCS Conservation Practice Standard (CPS), *Subsurface Drain (606), Underground Outlet (620)*, or other suitable measures in waterway designs.

Where drainage practices are not practicable or sufficient to solve these prolonged flow, high water table, or seepage problems, use conservation practice Lined Waterway or Outlet (468) in place of Grassed Waterway (412).

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Outlets
Provide a stable outlet with adequate capacity. The outlet can be another vegetated channel, an earthen ditch, a grade-stabilization structure, filter strip or other suitable outlet.

Vegetative Establishment
Establish vegetation as soon as possible using the criteria in the Oklahoma NRCS CPS, *Critical Area Planting (342)* and/or the *Oklahoma Plant Materials Technical Note 21*.

Apply soil amendments (e.g. lime, fertilizer, compost) at the rates necessary to insure grass stand establishment. Timing should be during seedbed preparation to be most effective. See the Oklahoma NRCS CPS, *Critical Area Planting (342)* and/or the *Oklahoma Plant Materials Technical Note 21* for further guidance.

Schedule construction of grassed waterways to coincide with the proper seeding/sprigging season. Start the construction of all grassed waterways no more than 30 days before the beginning of the proper seeding/sprigging season. Complete the construction of all grassed waterways at least 15 days before the end of the proper seeding/sprigging season.

If circumstances beyond the control of the producer/landowner (i.e. weather) prevent the construction of the grassed waterway to coincide with the proper seeding/sprigging season, as described previously, then protective action such as cover crop and/or mulch shall be implemented until the correct time for the next proper seeding/sprigging season. Refer to the Oklahoma NRCS CPS, *Mulching (484)* and/or *Cover Crop (340)* for further guidance.

Grassed waterways or outlets on gentle slopes, usually less than 2 percent with a velocity of 3 feet per second or less, may be established to alfalfa using the criteria in the Oklahoma NRCS CPS, *Critical Area Planting (342)* and/or the *Oklahoma Plant Materials Technical Note 21*.

Grassed waterways on slopes less than 1 percent and a velocity of 2 feet per second or less may be planted to a close spaced high residue crop.

Seedbed preparation, time of seeding, mixture rate, cover crop, mulching, or mechanical means of stabilizing, fertilizer, and lime requirements shall be specified for each applicable area.

The most critical time in successfully installing a grassed waterway is when the vegetation is being established. Establish vegetation as soon as conditions permit. Use mulch anchoring, cover crop, rock, straw or hay bale dikes, filter fences, or runoff diversion to protect the vegetation until it is established. Planting of a close growing crop, e.g. small grains or millet, on the contributing watershed prior to construction of the grassed waterway can also significantly reduce the flow through the grassed waterway during establishment.

Avoid areas where unsuitable subsurface, subsoil, substratum material that limits plant growth such as salts, acidity, root restrictions, etc., may be exposed during implementation of the practice. Where areas cannot be avoided, seek technical recommendations for improving the condition or, if not feasible over-cut the grassed waterway and add topsoil over the cut area to facilitate vegetative establishment.

When a grassed waterway is the stable outlet for an existing terrace system, the runoff drainage from the terrace system shall not be allowed to enter the grassed waterway until proper vegetation is established.

Provide livestock and vehicular crossings as necessary to prevent damage to the waterway and its vegetation.

CONSIDERATIONS

General Considerations

Vegetative Establishment
The vegetation should be well established before large flows are permitted in the channel.

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If a grassed waterway is proposed to be constructed in a field that has an established terrace system conveying runoff drainage to the proposed location of the grassed waterway and this drainage is planned to be diverted or blocked from entering the grassed waterway, then careful planning should be implemented to prevent excessive erosion from occurring in the area adjacent to the newly constructed grassed waterway until vegetation is properly established. Examples of some planning implementation options are:

- Breach the contributing terraces to a width equivalent to the top width of the proposed grassed waterway in a staggered pattern, so that a gully will not form through the terrace system.
- Remove all terraces in the contributing terrace system. Refer to the Oklahoma NRCS CPS, *Land Smoothing (466).*

The importance of implementing an erosion control method in the contributing drainage area prior to the establishment of adequate vegetation in a newly constructed grassed waterway is even more critical when the land slope exceeds 5%.

Use irrigation in dry regions or supplemental irrigation as necessary to promote germination and vegetation establishment.

Water-tolerant vegetation may be an alternative to subsurface drains or stone center waterways on some wet sites.

Wildlife
Avoid or protect, if possible, important wildlife habitat, such as woody cover or wetlands when determining the location of the grassed waterway. If trees and shrubs are incorporated, they should be retained or planted in the periphery of grassed waterways so they do not interfere with hydraulic functions. Medium or tall bunch grasses and perennial forbs may also be planted along waterway margins to improve wildlife habitat. Waterways with these wildlife features are more beneficial when connecting other habitat types; e.g., riparian areas, wooded tracts and wetlands. When possible, select plant species that can serve multiple purposes, such as benefiting wildlife, while still meeting the basic criteria needed for providing a stable conveyance for runoff.

Wildlife habitat benefits can be provided by adding width of appropriate vegetation to the sides of the waterway. Care should be taken to avoid creating small isolated planting zones that could become population sinks where wildlife attracted to an area experience reproductive loss due to predation.

Consider including diverse legumes, forbs, and flowering plants such as milkweeds that provide pollen and nectar for native bees and other pollinators. In dry regions, these sites may be able to support flowering forbs with higher water requirements and thus provide bloom later in the summer.

Other Considerations
The construction of a grassed waterway can disturb large areas and potentially affect cultural resources. Be sure to follow state cultural resource protection policies before construction begins.

Establish filter strips on each side of the grassed waterway to improve water quality.

Where environmentally-sensitive areas need to be protected from dissolved contaminants, pathogens, or sediment in runoff, consider establishment of an increased width of vegetation on the waterway above the flow area. Increasing the width of the waterway above the flow area will increase filtering of sediment and pathogens as well as increase infiltration of runoff and increase nutrient removal. Where sediment control is the primary concern, consider using vegetation in the waterway which can withstand partial burial and adding sediment control measures above the waterway such as residue management. Consider increasing the channel depth and/or designing areas of increased width or decreased slope to trap and store sediment to reduce the amount of sediment that leaves a field. Be sure to provide for regular cleaning out of the waterway when trapping sediment in this manner.

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Tillage and crop planting often takes place parallel to the waterway, resulting in preferential flow – and resulting erosion – along the edges of the waterway. Consider installation of measures that ensure that runoff from adjacent areas will enter the waterway. Measures such as directing spoil placement or small swales can direct this preferential flow into the grassed waterway.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for grassed waterways that describe the requirements for applying the practice according to this standard. As a minimum include:

- A plan view of the layout of the grassed waterway.
- Typical cross sections of the grassed waterway(s).
- Profile(s) of the grassed waterway(s).
- Disposal requirements for excess soil material.
- Site-specific construction specifications that describe in writing the installation of the grassed waterway. Include specification for control of concentrated flow during construction and vegetative establishment.
- Vegetative establishment requirements.

OPERATION AND MAINTENANCE

Provide an operation and maintenance plan to review with the landowner. Include the following items and others as appropriate in the plan.

- Establish a maintenance program to maintain grassed waterway capacity, vegetative cover, and outlet stability. Vegetation damaged by machinery, herbicides, livestock traffic, or erosion must be repaired promptly.
- All vegetative treatment types shall be protected from concentrated flow and grazing until vegetation is established.
- Minimize damage to vegetation by excluding livestock whenever possible, especially during wet periods. Permit grazing in the waterway only when a controlled grazing system is being implemented.
- Inspect grassed waterways regularly, especially following heavy rains. Damaged areas will be filled, compacted, and seeded immediately. Remove sediment deposits to maintain capacity of grassed waterway.
- Avoid use of herbicides that would be harmful to the vegetation or pollinating insects in and adjacent to the waterway area.
- Avoid using grassed waterways as turn-rows during tillage and cultivation operations.
- Mow or periodically graze vegetation to maintain capacity and reduce sediment deposition. Mowing may be appropriate to enhance wildlife values, but must be conducted to avoid peak nesting seasons and reduced winter cover.
- Apply supplemental nutrients as needed to maintain the desired species composition and stand density of the grassed waterway.
- Control noxious weeds.
- Do not use as a field road. Avoid crossing with heavy equipment when wet.
- Lift tillage equipment off the grassed waterway when crossing and turn off chemical application equipment.
- Immediately repair any vandalism, vehicular, or livestock damage.
- Remove all foreign debris that hinders system operation.
- Eradicate or otherwise remove all rodents or burrowing animals. Immediately repair any damage caused by their activity.

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- Replace weathered or displaced rock riprap to constructed grade.

REFERENCES

USDA, NRCS. 2007 National Engineering Handbook, Part 650, Engineering Field Handbook, Chap. 7, Grassed Waterways

USDA, Agricultural Research Service. 1987. Agricultural Handbook 667, Stability Design of Grass-lined Open Channels

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