Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

# GRASSED WATERWAY

## CODE 412

## (ac)

### 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:

- Convey runoff from terraces, diversions, or other water concentrations without causing erosion or flooding
- Prevent gully formation
- 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.

**Stability**

Determine the minimum depth and width requirements for stability of the grassed waterway using the procedures in the NRCS National Engineering Handbook (Title 210), Part 650, Chapter 7, “Grassed Waterways,” or Agricultural Research Service Agriculture Handbook 667, “Stability Design of Grass-Lined Open Channels.” Base stability computations on the peak runoff expected from a 10-year, 24-hour duration storm.

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.

Ensure that the vegetative species selected are suited to the 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 a trapezoidal waterway less than 100 feet unless multiple or divided waterways or other means are provided to prevent meandering of low flows.

**Side slopes**
Keep the side slopes flatter than a ratio of 2 horizontal to 1 vertical (2:1). Flatten the side slopes as needed to accommodate the equipment used for maintenance, tillage, and harvesting 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 design flow.

Provide 0.5 feet of freeboard above the designed depth when flow must be contained to prevent damage. Provide freeboard above the designed depth based on capacity conditions when the vegetation has the maximum expected retardance. To achieve the freeboard, extend side slopes at a slope equal to or flatter than the side slope of the design cross section.

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

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

Where drainage practices are not practicable or adequate to solve these seepage problems, use NRCS CPS Lined Waterway or Outlet (Code 468) in place of NRCS CPS Grassed Waterway (Code 412).

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

**Vegetative establishment**
Establish vegetation as soon as possible using the criteria listed under “Establishment of Vegetation” in NRCS CPS Critical Area Planting (Code 342) and/or Oklahoma Plant Materials Technical Note 21. Use mulch; nurse crop; rock, straw, or hay bale dikes; fabric or rock checks; filter fences; or runoff diversion to protect the vegetation until it is established. Planting a close-growing crop (e.g., small grains or grasses) on the contributing watershed prior to construction of the grassed waterway can also significantly reduce the flow through the waterway during establishment. Provide livestock and vehicular crossings as necessary to prevent damage to the waterway and its vegetation.

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

Establishment to alfalfa is permitted in grassed waterways or outlets when the design slope is gentle (< 2 percent) and the design velocity for stability is less than 3 feet per second.

When the design slope is less than 1 percent and the design stability velocity is less than 2 feet per second, the waterway may be vegetated with close spaced high residue crops.

## CONSIDERATIONS

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 established vegetation above the flow area will increase filtering of sediment and pathogens, and it will increase infiltration of runoff and nutrient removal.

Where sediment control is the primary concern, consider using vegetation in the waterway that 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. Provide for regular cleaning out of the waterway when trapping sediment in this manner.

Implement best management practices and use a system of additional conservation practices or a soil health management system in conjunction with the grassed waterway to minimize upstream runoff and concentrated flow.

Tillage and crop planting often takes place parallel to the waterway, resulting in preferential flow paths and erosion along the edges of the waterway. Consider installation of measures that ensure the 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.

Livestock and vehicle crossings should occur perpendicular to the waterway. Consider locating crossings to minimize potential damage to the waterway. Crossing design must not interfere with design-flow capacity.

Avoid areas where unsuitable plant growth-limiting subsoil and/or substratum material, such as salts, acidity, root restrictions, etc., may be exposed during implementation of the practice. Where areas cannot be avoided, seek recommendations from a soil scientist for improving the condition; or, if not feasible, consider over-cutting the waterway and add topsoil over the cut area to facilitate vegetative establishment.When dispersive clays are present and unavoidable, 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.

Avoid or protect, if possible, important wildlife habitat, such as woody cover or wetlands, when determining the location of the grassed waterway. Avoid placing trees and shrubs in or near the grassed waterway so they do not interfere with hydraulic functions or send roots into associated subsurface drainage. 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.

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

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

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 for wildlife. These can become population sinks where wildlife attracted to an area experience reproductive loss due to predation. Mowing may be appropriate to enhance wildlife values, but should be conducted to avoid peak nesting seasons and reduced winter cover whenever possible.

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

For all organic or transitioning-to-organic operations, follow all National Organic Program rules.

## PLANS AND SPECIFICATIONS

Prepare plans and specifications for a grassed waterway 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.
- Dimensions of the waterway, including length, grade, top width, bottom width, depth, and side slopes as applicable.
- 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 waterway capacity, vegetative cover, and outlet stability. Vegetation damaged by machinery, herbicides, or erosion must be repaired promptly.
- Protect the waterway from concentrated flow by using diversion of runoff or mechanical means of stabilization, such as silt fences, mulching, hay bale barriers, etc., to stabilize grade during vegetation establishment as necessary.
- After vegetation is established, remove any temporary measures, such as diversions or silt fences,

that were installed so as to not interfere with design flow.

- 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. Fill, compact, and reseed damaged areas immediately. Remove sediment deposits to maintain capacity of the grassed waterway.
- Avoid use of herbicides or pesticides that would be harmful to the vegetation or pollinating insects in and adjacent to the waterway area.
- Avoid using waterways as turn rows during tillage and cultivation operations.
- Mow or periodically graze vegetation to maintain capacity, reduce sediment deposition, and maintain suitable plant composition and vigor.
- Apply supplemental nutrients as needed to maintain the desired species composition and stand density of the waterway.
- Control noxious weeds.
- Do not use waterways as a field road. Avoid crossing with heavy equipment when wet.
- Lift tillage equipment and turn off chemical application equipment when crossing the waterway.

## REFERENCES

USDA Agricultural Research Service. 1987. Stability Design of Grass-Lined Open Channels. Agriculture Handbook Number 667. Washington, D.C. https://naldc-legacy.nal.usda.gov/catalog/CAT87216054

USDA NRCS. 2007. National Engineering Handbook (Title 210), Part 650, Chapter 7, Grassed Waterways. Washington, D.C. https://directives.sc.egov.usda.gov/