

## CONSERVATION PRACTICE STANDARD

### GRASSED WATERWAY

(Ac.)

#### CODE 412

#### DEFINITION

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

#### PURPOSE

- 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.

**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.

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.

Avoid channel slopes between 0.7 and 1.3 of the critical slope except for short transition sections. Supercritical flow shall be restricted to straight reaches. Waterways or outlets with supercritical flow shall discharge into an energy dissipator to reduce discharge velocity to less than critical.

Transitions between mild (subcritical) and steep (supercritical) slopes should be designed with the following:

- a) Smooth water surface, such that the transition head losses do not exceed  $0.10h_v$  for convergence, and  $0.02h_v$  for divergence.
- b) Water surface edges converging at not greater than  $28^\circ$  or diverging at not greater than  $25^\circ$  – with the centerline.

The junction of a waterway and any other channel (diversion, terrace, etc.) should intersect horizontally at an angle not greater than  $55^\circ$ .

**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 design flow.

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.

**Drainage.** When needed to establish or maintain vegetation on sites having prolonged flows, high water tables, or seepage problems, use Subsurface Drain (PA606), Underground Outlet (PA620), or other suitable measures in waterway designs.

Where drainage practices are not practicable or sufficient to solve these seepage problems, use conservation practice Lined Waterway or Outlet (PA468) in place of Grassed Waterway (PA412).

**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.

**Stone Center Waterways.** In areas where field stone or other rock sources are available, a stone center may assist in establishment of the waterway and reduce problems with prolonged flows and wetness. A gravel bedding or geotextile fabric should be used under the rock to prevent erosion of the soil. The stone center portion should carry the one-year, 24-hour duration peak discharge. The maximum permissible velocity may be increased by one (1) foot-per-second.

Installation shall follow Figure 7-11 and stone size determined from in EFH 650.16, or Hydraulic Engineering Circular 11 (FHWA 1989).

**Natural Waterways.** "Natural" grassed waterways (plow skips and swales) meet this standard when all the following conditions are met:

1. Permanent vegetation has been established and there is no rill erosion in the waterway.
2. Runoff is able to enter the waterway along the entire length (no plowing parallel to the centerline of the waterway).
3. A minimum width of 20 feet and a maximum width of 50 feet are maintained with a maximum depth of 1.0 foot and a minimum depth of 0.4 foot.
4. The waterway is not used for an outlet of a diversion or terrace, unless capacity and stability are checked and adequate.

**Erosion Control Mat.** Geosynthetic, three-dimensional, erosion control mats manufactured for that purpose may be used to stabilize waterways. The design velocity or shear stress shall not exceed the manufacturer's recommendations.

**Vegetative Establishment.** Establish vegetation as soon as possible using the criteria listed under "Establishment of Vegetation" in the conservation practice standard Critical Area Planting (PA342) and/or the state planting guide.

Establish vegetation as soon as conditions permit. Use mulch anchoring, nurse crop, rock or straw or hay bale dikes, fabric or rock checks, 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 waterway during establishment.

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

## 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 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.

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.

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.

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.

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.

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

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

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.

## 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 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 and etc. to stabilize grade during vegetation establishment.
- 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 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 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 waterway.
- Control noxious weeds.
- Do not use waterways as a field road. Avoid crossing with heavy equipment when wet.
- Lift tillage equipment off the waterway when crossing and turn off chemical application equipment.

## REFERENCES

- USDA, ARS. 1987. Stability design of grass-lined open channels. Agriculture Handbook 667.
- USDA, NRCS. 2007. National Engineering Handbook, Part 650, Engineering Field Handbook, Chap. 7, Grassed waterways.