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 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.

This practice is not applicable where its construction would destroy important woody wildlife cover or wetlands and the present watercourse is not seriously eroding.

CRITERIA

General Criteria Applicable to All Purposes

Plan, design, and construct grassed waterways to comply with all federal, state, and local laws and regulations.

Determine the minimum depth and width requirements for stability and capacity 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. This can be accomplished by utilizing the Waterway Design Tool in the NRCS Engineering Field Tools suite of engineering programs.

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. The minimum capacity of the grassed waterway in such cases shall contain the peak runoff from the 2-year, 24-hour storm. Ensure that the design capacity, at a minimum, will remove the water before crops are damaged.

For watersheds where natural drainage systems are well defined, the peak runoff rate for the desired frequency storm shall be computed using methods outlined in Chapter 2 of the Engineering Field Handbook (EFH). For watersheds in north central Iowa where natural surface drainage systems are poorly defined and many potholes exist, the runoff for the portion of the drainage area with poorly defined surface drainage may be computed using the appropriate drainage curve. This peak runoff shall be added to the runoff from the remainder of the drainage area to obtain a design discharge for the waterway. Refer to the Iowa Drainage Guide to determine the appropriate drainage curve.

Drainage Area Reduction. Any part of the drainage area above well-maintained closed end level terraces or tile outlet terraces may be considered as controlled and omitted from the drainage area when computing the design discharge. Increase the design discharge to account for the controlled flow from tile outlet terraces that drain into the waterway. This tile outlet discharge may be treated as a base flow of 0.05 cfs per acre. Do not reduce the drainage area if the terraces in the watershed have substantially reduced storage due to sediment accumulation, poor vegetation, or other signs of poor maintenance.

Stability. Design the waterway for stability based on the erodibility of the soil in the waterway. When using the vegetal retardance option for design, use the projected worst condition of the vegetation after it has been established.

The minimum velocity of the waterway after vegetation is established shall be 1.5 feet per second (fps) for a 10-year, 24-hour peak runoff event. The minimum velocity may be disregarded for waterways with a drainage area of less than 30 acres.

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.

Trapezoidal waterways shall have a minimum bottom width of 10 feet and parabolic waterways shall have a minimum top width of 30 feet if they will be crossed with farm equipment. These dimensions are not required for small drainage areas meeting the criteria for the Special Treatment Areas described below.

Side slopes. Keep the side slopes flatter than a ratio of three 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.

The minimum design depth of a waterway shall be 1.0 foot.

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

Where drainage practices are not practicable or sufficient to solve these seepage problems, use Lined Waterway or Outlet (468) in place of Grassed Waterway (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 or other suitable outlet.

Vegetative Establishment. Establish vegetation as soon as possible using the criteria listed under "Establishment of Vegetation" in Critical Area Planting (342) 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.

Runoff Diversion. The designer shall ensure that runoff from adjacent areas will enter the waterway by directing spoil placement or other measures such as diversions. See Diversion (362) for design criteria.

Temporary earth side-diversions may be installed, when required, to protect a new waterway from erosion due to runoff from adjacent areas. These diversions shall be shown on the drawings as 1 foot or less in height unless design calculations indicate diversions of greater height are needed. All temporary diversions over 1 foot in height shall be designated on the drawings and documentation for the higher diversion recorded in the design file. Temporary diversions shall be removed when vegetation in the waterway becomes established. Place spoil from removed temporary diversions in a manner that ensures runoff from adjacent areas will enter the waterway.

Special Treatment Areas

Areas meeting the following criteria may be shaped to a parabolic cross section with a minimum top width of 20 feet and minimum depth of 0.75 feet. The area will be seeded the same as any grassed waterway. The 10-year, 24-hour capacity will not need to be calculated for these areas.

- The drainage area at the outlet is less than 6 acres.
- The vegetated area begins within 250 feet of the top of the watershed area and extends for no more than 500 feet downslope.
- The grade is between 3 percent and 10 percent; however, the grade may exceed 10 percent when the drainage area is less than 3 acres.
- The outlet for the area is stable (i.e. a level or gently sloping area, joins the flowline of a waterway, or other structural measure, etc.).
- The area does not serve as an outlet for a diversion or terrace.

CONSIDERATIONS

Small areas within cropland and areas upslope from a grassed waterway may need to be shaped and seeded to control minor gully erosion. Areas treated in this manner will normally be small furrow sized ephemeral gullies. Large gullies usually indicate the need for more extensive design considerations.

If minimum velocities cannot be maintained, consider using Surface Drainage, Field Ditch (607), or Surface Drainage, Main or Lateral (608).

A side slope steeper than 6:1 may be difficult to cross.

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.

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.

The following list of Construction Specifications is intended as a guide to selecting the appropriate specifications for each specific project. The list includes most, but may not contain all, of the specifications needed for a specific project:

- IA-5 Pollution Control
- IA-46 Tile Drains for Land Drainage
- IA-412 Grassed Waterways
- IA-620 Underground Outlets

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.
- Avoid tillage and planting operations parallel to the grassed waterway. Parallel operations may divert runoff water from the grassed waterway and lead to the formation of gullies adjacent to the waterway.
- 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

Iowa State University. 1987. Iowa Drainage Guide, Special Report 13. Ames, Iowa.

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.