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Grassed Waterway for Runoff Control

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1 Purpose and Scope

1.1 Purpose

The purpose of this Engineering Practice is to furnish planning and design criteria and construction and maintenance information, for constructed grassed waterways. Grassed waterways are constructed to transport runoff from terraces, diversions, or natural flow concentrations without excess erosion or flooding.

1.2 Scope

This Engineering Practice covers all engineering phases of planning, design, construction, and maintenance of natural or constructed channels that are to be vegetated and used for water disposal. Grassed waterways with stone centers are included in the Engineering Practice. Grassed waterways provide some filtering of sediment or other water borne contaminants but should not be planned to function as filter strips. Additional special provisions for capacity, selection of vegetative species, and maintenance may be necessary to address filtering concerns.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies unless noted. For undated references, the latest approved edition of the referenced document (including any amendments) applies.

ASAE EP260.5, Design and Construction of Subsurface Drainage Systems on Agricultural Lands in Humid Areas

ASAE EP407, Agricultural Drainage Outlets — Open Channels

3 Soil and Water Conservation Systems

3.1 System Components

A grassed waterway is a graded channel that is established with suitable vegetation to carry runoff water to a stable outlet to reduce erosion.

Grassed waterways are a component of an erosion control or water management plan which may include structural practices such as terraces, open channel outlets, subsurface drains, and water and sediment control basins; and management practices such as contour farming, crop rotations, contour stripcropping, conservation tillage, and crop residue management and use.

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3.2 Function of System. For grassed waterways to function effectively, the combination of structural and management practices should, at a minimum, protect the natural resource base by meeting acceptable soil losses, maintaining water quality, and avoiding deterioration of the soil and water conservation system. These practices should minimize environmental impacts and maximize beneficial use of water, land, and other natural resources.

4 Site Investigations

4.1 Reconnaissance and Surveys

4.1.1 Initial Site Selection. An initial reconnaissance should establish the extent and severity of the resource problem, determine topographic conditions, hydrologic information, and significant soil conditions on the site. Land owner preference and needs need to be determined. Adequacy of outlet areas for the grassed waterway should be investigated to ensure the design discharge through the waterway can be safely and legally conveyed from the site.

4.1.2 Preliminary Design Surveys. The installation of terraces and diversions changes the surface drainage pattern. Grassed waterways used as outlets for terraces or diversions should be installed prior to construction of the terrace or diversion. The approximate final layout of these practices should be known before choosing the final layout (location) of the grassed waterway. Adequate field information to estimate the location of terraces or diversions and locate existing underground utilities and subsurface drains is needed prior to establishing the final location of the grassed waterway.

4.1.3 Final Design Surveys. Adequate survey information should be gathered so that grades and cross sections of the final channel will fit the lay of the land with a minimum of grading. Waterways should follow their natural flow path, if possible. Exercise caution when trying to straighten natural curves. Extent of waterway as well as potential construction cost can be estimated in terms of functionality. Construction can be analyzed to determine if stability and capacity limitations are met.

4.1.4 Alignment. The best waterway is a well-vegetated natural draw because it: (1) provides a flat, stable grade (2) is most favorable to vegetative growth; and (3) has sufficient depth to outlet diversions, terraces, and crop row drainage. Sometimes a waterway may be located on a field boundary if it minimizes a terrace design with shorter rows. Waterways should extend far enough upslope to be a suitable outlet for associated terraces or diversions.

5 Design Criteria

5.1 Design Capacity. Grassed waterways should be able to discharge the peak runoff expected from a minimum storm of 10 year frequency, 24 hour duration. When the waterway slope is less than 1% out-of-bank flow may be permitted if such flow will not cause significant erosion. Site conditions may exist where high valued crops or urban situations need greater levels of protection. In such cases, the minimum discharge of the waterway should be sufficient to remove the excess water before crops are damaged. Discharge capacity should be determined using Manning's equation, the continuity equation, and geometric relationships. The maximum flow retardance condition anticipated with the highest retardance class or maximum stem length and density as shown in Table 1 should be used to determine Manning's "*n*" in Figure 1. In Figure 1, C_I is allied to the "Retardance Curve Index" in Table 1.

5.2 Design Issues. Channel capacity is determined using maximum flow and anticipated retardance. Channel stability should be determined using minimum expected values for the cover condition (as expressed by the vegetal cover factor or the selection of a permissible velocity) and the retardance (as expressed by the retardance curve index or retardance class). Manning's formula applies to uniform flow in channels. In most instances of typical grassed waterway installations, the assumption of uniform flow is valid. However, the use of a constant value of Manning's "*n*" for shallow, vegetated waterways subject to intermittent flow is not usually correct. Under the influence of velocity and depth of flow, vegetation bends and oscillates. Research has shown that Manning's "*n*" varies with *VR*, the product of velocity (*V*) and hydraulic radius (*R*), as shown in Figure 1. Manning's "*n*" is also influenced by the type, height and density of vegetation present in the channel (Table 1). When vegetation is expected to be significantly shorter or much less dense than that described in the Table 1 the retardance curve index should be adjusted accordingly. Compare the computed value of the erosionally effective stress on the soil or the mean velocity in the channel to the allowable value from Tables 2 or 3.

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