

**NATURAL RESOURCES CONSERVATION SERVICE
PACIFIC ISLANDS AREA**

CONSERVATION PRACTICE STANDARD

GRASSED WATERWAY

(Ac.)
CODE 412

DEFINITION

A natural or constructed channel that is shaped or graded to required dimensions and established with suitable vegetation.

PURPOSE

This practice may be applied as part of a conservation management system to support one or more of the following purposes:

- to convey runoff from terraces, diversions, or other water concentrations without causing erosion or flooding
- to reduce gully erosion
- to protect/improve water quality.

CONDITIONS WHERE PRACTICE APPLIES

In areas where added water conveyance capacity and vegetative protection are needed to control erosion resulting from concentrated runoff and where such control can be achieved by using this practice alone or combined with other conservation practices.

This standard applies to natural or constructed channels. Grassed waterways with stone centers, completely stoned, and nonvegetated waterways are also included.

CRITERIA

General Criteria Applicable to All Purposes

Grassed waterways shall be planned, designed, and constructed to comply with all

Federal, State, and local laws and regulations.

Capacity. The minimum capacity shall be that required to convey the peak runoff expected from a storm of 10-year frequency, 24-hour duration. 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 in such cases shall be the capacity required to remove the water before crops are damaged.

Waterway capacity shall be calculated by one of the following methods:

1. *For grass channels, natural vegetated channels or channels with vegetation of grass and sugarcane or pineapple, use a "B" retardance and:

 - a. *The design tables and supplements in the National Engineering Handbook, Part 650, Engineering Field Handbook (EFH), Chapter 7, or*
 - b. *Software approved by the Common Computing Environment (CCE) or*
 - c. *SCS TP-61, "Handbook of Channel Design for Soil and Water Conservation," or*
 - d. *Agricultural Research Service (ARS) Agricultural Handbook 657, "Stability Design of Grass-Lined Open Channels."**
2. *For waterways planted entirely to sugarcane or pineapple, use Manning's formula with an "n" value 0.12.*

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service [State Office](#) or visit the [electronic Field Office Technical Guide](#).

NRCS, PI
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Velocity. Design velocities shall not exceed those obtained by using the procedures, "n" values, and recommendations in the NRCS Engineering Field Handbook (EFH) Part 650, Chapter 7, or Agricultural Research Service (ARS) Agricultural Handbook 667, Stability Design of Grass-lined Open Channels or for areas with soil erosion resistance groups, Table 1.

TABLE 1
Maximum Waterway Velocities (fps)

Vegetation	Channel slope range-%	Soil erosion resistance group			
		I	II	III	IV
Recommended Grass	0-5	10.0	9.0	8.0	6.0
Recommended grass with sugarcane or pineapple	5-10	9.0	8.0	7.0	5.0
	over 10	8.0	7.0	6.0	4.0
Nonvegetated, Sugarcane or pineapple	all	5.5	4.5	3.5	2.5
Natural Vegetation	0-5	8.0	7.0	6.0	4.0
	5-10	6.0	5.0	4.0	3.0

Soil erosion resistance groups are found in the Part 650, EFH, Chapter 2, Exhibit 2-4.

Stone waterways with rock material 3 inches to 10 inches shall not exceed velocities of 6 ft/sec. Higher velocities may be used with the approval of an engineer. Rock sizes may be determined using EFH, Part 650, Chapter 7, Exhibit 7-6.

Design velocities for waterways shall be calculated by one of the following methods:

1. Grass channels, natural vegetated channels, or channels with grass and sugarcane or pineapple, use "D" retardance and:
 - a. the design tables and supplements in Part 650, EFH, Chapter 7 or

- b. Software approved by the CCE such as the Ohio Engineering Programs, or
 - c. SCS-TP-61, or
 - d. Agricultural Research Service (ARS) Agricultural Handbook 657.
2. Waterways planted entirely to sugarcane, pineapple or nonvegetated use Manning's formula with an "n" value of 0.03.
 3. Stone waterways that are smooth and uniform, use Manning's formula with an "n" value of 0.03. Jagged and irregular stone channels use Manning's "n" value of 0.04.

Cross Section. Waterway cross sections may be parabolic, trapezoidal or "V" shaped. Typical waterway cross sections are shown in Part 650, EFH, Chapter 7, Figure 7-3. If the waterway side slopes are to be planted in sugarcane or pineapple, the side slopes should be flat enough to permit farming operations.

Width. The bottom width of trapezoidal waterways shall not exceed 100 feet unless multiple or divided waterways or other means are provided to control meandering of low flows.

Side Slopes. Side slopes shall not be steeper than a ratio of two horizontal to one vertical. They shall be designed to accommodate the equipment anticipated to be used for maintenance and tillage/harvesting equipment that will cross the waterway.

Depth. The minimum depth of a waterway that receives water from terraces, diversions, or other tributary channels shall be that required to keep the design water surface elevation at, or below the design water surface elevation in the tributary channel, at their junction when both are flowing at design depth.

Freeboard above the designed depth shall be provided when flow must be contained to prevent damage. Freeboard shall be

provided above the designed depth when the vegetation has the maximum expected retardance.

Drainage. Designs for sites having prolonged flows, a high water table, or seepage problems shall include Subsurface Drain (Code 606), Underground Outlet (Code 620), Stone Center Waterway or other suitable measures to avoid saturated conditions.

Outlets. All grassed waterways shall have a stable outlet with adequate capacity to prevent ponding or flooding damages. The outlet can be another vegetated channel, an earthen ditch, a grade-stabilization structure, filter strip or other suitable outlet.

Vegetative Establishment . Grassed waterways shall be vegetated according to NRCS Conservation Practice Standard Critical Area Planting, Code 342.

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

Establish vegetation as soon as conditions permit. Use mulch anchoring, nurse crop, rock, straw or hay bale dikes, filter fences, or runoff diversion to protect the vegetation until it is established. *Supplemental irrigation may be warranted. Vegetation should be well established before large flows are permitted in the channel.*

The waterway cross section should be vegetated by one of the following methods:

- 1. The entire cross section established to a recommended grass species. A listing of suitable grass species is available in the Pacific Islands Area Area Vegetative Guide @ ftp://ftp-fc.sc.egov.usda.gov/HI/pub/technotes/vegetative/veg_7_pi_vegetative_guide/.*
- 2. The entire cross section established to natural vegetation. This method will be limited to locations receiving more than 30 inches of annual rainfall, on waterway slopes less than 10 percent,*

and where there is a proven ability for desirable natural vegetation to establish itself.

Waterways with natural vegetation shall be fertilized in accordance with soil test recommendations immediately after construction. Refer to the Nutrient Management (Code 590) standard and specification when working with the land user on a fertilizer program.

- 3. A combination channel with the middle one-half of the cross section established to a recommended grass species and the remaining section planted in sugarcane or pineapple. For trapezoidal sections, the entire bottom width shall be established to a recommended grass species.*
- 4. The entire channel or a combination channel with the center of the cross section lined with rock. For trapezoidal sections, the entire bottom width shall be rocked. The side slopes may be planted with the recommended grass species, natural grass, or nonvegetated. A gravel bedding or geotextile should be placed under the rock to prevent erosion of the underlying soil.*
- 5. The entire waterway cross section planted in sugarcane or pineapple.*
- 6. Nonvegetated waterways may be used where vegetation will interfere with farming operations and not cause erosion.*

CONSIDERATIONS

Important wildlife habitat, such as woody cover or wetlands, should be avoided or protected if possible when siting 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. Mid- 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.

Water-tolerant vegetation may be an alternative 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.

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

Add width of appropriate vegetation to the sides of the waterway for wildlife habitat.

PLANS AND SPECIFICATIONS

Plans and specifications for grassed waterways shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose(s). *Plans (design drawings) shall include the waterway:*

- a. *location*
- b. *length,*
- c. *width (top and bottom),*
- d. *side slopes,*
- e. *depth,*
- f. *invert slope and*
- g. *profile.*

Plans should also specify:

- a. *grass species,*
- b. *recommended establishment time and method,*
- c. *fertilizer recommendations and*
- d. *rock sizes for stone waterways.*

Plans should specify if irrigation will be needed for the establishment or maintenance of the vegetative cover.

OPERATION AND MAINTENANCE

The Pacific Islands Area Operation and Maintenance Plan for Grassed Waterway shall be prepared for and reviewed with the client. The plan shall include the following items and others as appropriate.

A maintenance program shall be established to maintain waterway capacity, vegetative cover, and outlet stability.

Vegetation damaged by machinery, herbicides, or erosion must be repaired promptly.

Seeding 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.

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.

Landowners should be advised to avoid areas where forbs have been established when applying herbicides. Avoid using waterways as turn-rows during tillage and cultivation operations. Prescribed burning and mowing may be appropriate to enhance wildlife values, but must be conducted to avoid peak nesting seasons and reduced winter cover.

Mow or periodically graze vegetation to maintain capacity and reduce sediment deposition.

Control noxious weeds.

Do not use as a field road. Avoid crossing with heavy equipment when wet