USDA
NATURAL RESOURCES
CONSERVATION SERVICE

DELAWARE CONSERVATION
PRACTICE STANDARD

GRADE STABILIZATION STRUCTURE (NO.)

CODE 410

DEFINITION

A structure to control the grade and head cutting in natural or artificial channels.

This standard applies to all types of grade stabilization structures. They may be a combination of earth embankments and mechanical spillways and may be full-flow or detention-type structures. It applies to channel side-inlet structures installed to lower the water from a field elevation, a surface drain, or a waterway to a deeper outlet channel. It does not apply to structures designed to control the rate of flow or to regulate the water level in channels - Code 587, Structure for Water Control.

PURPOSE

To stabilize the grade and control erosion in natural or artificial channels, to prevent the formation or advance of gullies, and to enhance environmental quality and reduce pollution hazards.

CONDITIONS WHERE PRACTICE APPLIES

In areas where the concentration and flow velocity of water requires structures to stabilize the grade in channels or to control gully erosion, special attention shall be given to maintaining or improving habitat for fish and wildlife where applicable.

CONSIDERATIONS

Planning considerations for water quantity and quality:

Quantity

- Effects on volumes and rates of runoff, evaporation, deep percolation and ground water recharge.
- Effects of the structure on soil, water and resulting changes in plant growth and transpiration.

Quality

- Ability of structure to trap sediment and sediment-attached substances carried by runoff.
- Effect of structure on the susceptibility of downstream stream banks and stream beds to erosion.
- Effects of the proposed structure on the movement of dissolved substances to ground water.
- Effects on the visual quality of downstream water resources.

CRITERIA

The structure must be designed for stability after installation. The crest of the inlet must be set at an elevation that stabilizes upstream head cutting.

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service

Embankment Dams

Class (a) dams having a product of storage times the effective height of the dam of 3,000 or more, those more than 35 ft. in effective height, and all class (b) and class (c) dams shall meet or exceed the requirements specified in Technical Release No. 60 (TR-60).

Class (a) dams having a product of storage times the effective height of the dam of less than 3,000 and an effective height of 35 ft. or less shall meet or exceed the requirements specified for Ponds (378).

The effective height of the dam is the difference in elevation, in feet, between the emergency spillway crest and the lowest point in the cross section along the center line of the dam. If there is no emergency spillway, the top of the dam is the upper limit.

Pond Size Dams

If mechanical spillways are required, the minimum capacity of the principal spillway shall be that required to pass the peak flow expected from a 24-hour duration design storm of the frequency shown in Table 1, less any reduction because of detention storage.

If the effective height of the dam is less than 20 ft. and the emergency spillway has a stable grade throughout its length with no over-falls and has good vegetation to its reentry into the downstream channel, the principal spillway capacity may be reduced but can be no less than 80 percent of the 2-year frequency, 24-hour duration storm.

If criteria values exceed those shown in Table 1 or the storage capacity is more than 50-acre ft., the 10-year frequency, 24-hour duration storm must be used as the minimum design storm.

Grade stabilization structures with settled fill height of less than 15 ft. and 10-year frequency, 24-hour storm runoff less than 10 acre-ft., shall be designed to control the 10-year frequency storm without overtopping. The mechanical spillway, regardless of size, may be considered in design and an emergency spillway is not required if the combination of storage and mechanical spillway discharge will handle the design storm. The embankment can be designed to meet the requirements for Water and Sediment Control Basins (638) rather than the requirements for Ponds (378).

Full-flow Open Structures

Drop, chute, and box inlet drop spillways shall be designed according to the principles set forth in the Engineering Field Manual for Conservation Practices, the National Engineering Handbook, and other applicable NRCS publications and reports. The minimum capacity shall be that required to pass the peak flow expected from a design storm of the frequency and duration shown in Table 2, less any reduction because of detention storage. If criteria values exceed those shown in Table 2, the minimum design 24-hour storm frequency is 25 years for the principal spillway and 100 years for the total capacity. Structures must not create unstable conditions upstream or downstream. Provisions must be made to insure reentry of bypassed storm flows.

Toe wall drop structures can be used if the vertical drop is 4 ft. or less, flows are intermittent, downstream grades are stable, and tail water is at or near the crest of the weir at design flow.

The ratio of the capacity of drop boxes to road culverts shall be as required by the Delaware Department of Highways or as shown in Table 2 or 3, as applicable, less any reduction because of detention storage, which is greater. The drop box capacity (attached to a new or existing culvert) must equal or exceed the culvert capacity at design flow.

Island-type Structures

If the mechanical spillway is designed as an island-type structure, its minimum capacity shall equal the capacity of the down stream channel. For channels with very small drainage areas, the mechanical spillway should carry at least the 2-

year, 24-hour storm or the design drainage curve runoff. The minimum emergency spillway capacity shall be that required to pass the peak flow expected from a design storm of the frequency and duration shown in Table 2 for total capacity without over topping the mechanical spillway headwall extensions. Provisions must be made for safe reentry of bypassed flow as necessary.

Table 1.—Criteria for determining minimum capacity of the principal spillway for dams with storage capacity of less than 50 acre-feet.

Maximum Drainage Area For Indicated Rainfall			Effective Height Of Dam	Frequency of Minimum Design, 24-Hour Duration Storm
0-3"	**3-5"**	**5+ "**		
Acres			Ft.	Yr.
200	100	50	35 or less	2
400	200	100	20 or less	2
400	200	100	20-35	5
600	400	200	20 or less	5

1n a 5-year frequency, 24-hour duration storm.

Table 2.—Criteria for determining minimum capacity of full-flow open structures

Maximum Drainage Area For Indicated Rainfall			Vertical Drop	Frequency of Minimum Design, 24-Hour Duration Storm	
				Principal Spillway Capacity	Total Capacity
0-3"	**3-5"**	**5+"**			
Acres			Ft.	Yr.	Yr.
1,200	450	250	5 or less	5	10
2,200	900	500	10 or less	10	25

1n a 5-year frequency, 24-hour duration storm.

Table 3.—Criteria for determining minimum capacity of side-inlet, open-weir, or pipe-drop-drainage structure.

Maximum Drainage Area For Indicated Rainfall			Vertical Drop	Frequency of Minimum Design, 24-Hour Duration Storm	
				Principal Spillway Capacity	Total Capacity
0-3"	**3-5"**	**5+"**			
Acres			Ft.	Yr.	Yr.
1,200	450	250	0-5	0-10	--
1,200	450	250	5-10	10-20	10
2,200	900	500	0-10	0-20	25

In a 5-year frequency, 24-hour duration storm.

Side-inlet Drainage Structures

The design criteria for minimum capacity of open-weir or pipe structures used to lower surface water from field elevations or lateral channels into deeper open channels are shown in Table 3. The minimum principal spillway capacity shall equal the design drainage curve runoff for all conditions. For criteria values larger than those shown in Table 3, the 50-year frequency storm shall be used for minimum design of total capacity.

Landscape Resources

In highly visible public areas and those associated with recreation, careful consideration should be given to landscape resources. Landforms, structural materials, water elements, and plant materials should visually and functionally complement their surroundings. Excavated material and cut slopes should be shaped to blend with the natural topography. Shore lines can be shaped and islands created to add visual interest and valuable wildlife habitat. Exposed concrete surfaces may be formed to add texture or finished to reduce reflectiveness and to alter color contrast. Site• selection can be used to reduce adverse impacts or create desirable focal points.

General Criteria

Earth embankment and emergency spillways of structures for which criteria are not provided under the standard for Ponds (378) or in TR-60 must be stable for all anticipated conditions. If earth spillways are used, they must be designed to handle the total capacity flow indicated in Tables 2 or 3 without overtopping the dam. The foundation preparation, compaction, top width, and side slopes must ensure a stable dam for anticipated flow conditions. Discharge from the structure shall be sufficient that no crop damage results from flow detention.

Necessary sediment storage capacity must equal the expected life of the structure, unless a provision is made for periodic cleanout.

The earth embankment pond structures are potentially hazardous and safety precautions must be taken to prevent serious injury or loss of life. Protective guardrails, warning signs, fences, or lifesaving equipment shall be added as needed.

If the area is used for livestock, the structure, earth fill, vegetated spillways, and other areas should be fenced as necessary to protect the structure. Near urban areas, fencing may be necessary to control access and exclude traffic that may damage the structure or to prevent serious injury or death to trespassers.

Protection

The exposed surfaces of the embankment, earth spillway, borrow area, and other areas disturbed during construction shall be seeded or sodded as necessary to prevent erosion. If climatic conditions preclude the use of vegetation, non-vegetative coverings, such as gravel or other mulches, may be used.

PLANS AND SPECIFICATIONS

Plans and specifications for installing grade stabilization structures shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

Specified materials shall provide the stability, durability, and safety characteristics required to achieve the planned objective.

Specifications for grade stabilization structures within the scope of the standard for Ponds (378) shall, as a minimum, be commensurate with those for ponds. Grade stabilization structures within the scope of Technical Release 60 shall be constructed according to the guide specifications in the National Engineering Handbook, Section 20.

Measures and construction methods that enhance fish and wildlife values shall be incorporated as needed and practical.

Construction operations shall be carried out in such a manner that erosion and air and water pollution will be minimized and held within legal limits.

Fencing and stabilization of disturbed areas are to be specified where required.

All disturbed areas shall be seeded in accordance with rates and methods in the standard for Critical Area Stabilization - Code 342.

The completed job shall present a workmanlike finish.

SUPPORTING DATA AND DOCUMENTATION

1. Installation and construction check notes are to be kept in sufficient detail to show that the practice meets this standard and any applicable specifications. The minimum requirements are as follows:

a. Measurements and elevations of the completed structure as required to show that the planned dimension, elevations, and quantities were obtained in construction;

b. A listing of materials used and a record of quality evaluations performed as required .by National Engineering Manual, Part 512.23.

c. If vegetative stabilization is required, record a statement as to its adequacy or status.

2. Measurements and computations for quantities are to be recorded and filed only to the extent that they are required to determine the

number of practice units performed, or as requested by the landuser.