Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

STRUCTURE FOR WATER CONTROL

CODE 587

(no)

DEFINITION

A structure in a water management system that conveys water, controls the direction or rate of flow, maintains a desired water surface elevation, or measures water.

PURPOSE

Apply this practice as a component of a water management system to:

- control the stage, discharge, distribution, delivery, or direction of water flow

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to a permanent structure needed as an integral part of a water control system to serve one or more of the following functions:

- Convey water from one elevation to a lower elevation within, to, or from a water conveyance system such as a ditch, channel, canal, or pipeline. Typical structures include drops, chutes, turnouts, surface water inlets, head gates, pump boxes, and stilling basins.
- Control the elevation of water in drainage or irrigation ditches. Typical structures include checks, flashboard risers, and check dams.
- Control the division or measurement of irrigation water. Typical structures include division boxes and water measurement devices.
- Keep trash, debris or weed seeds from entering pipelines. Typical structures include trash racks and debris screens.
- Control the direction of channel flow resulting from tides and high water or backflow from flooding. Typical structures include tide and water management gates.
- Control the water table level, remove surface or subsurface water from adjoining land, flood land for frost protection, or manage water levels for wildlife or recreation. Typical structures include water level control structures,flashboard risers, pipe drop inlets, and box inlets.
- Convey water over, under, or along a ditch, canal, road, railroad, or other barriers. Typical structures include bridges, culverts, flumes, inverted siphons, and long span pipes.
- Modify water flow to provide habitat for fish, wildlife, and other aquatic animals. Typical structures include chutes, cold water release structures, and flashboard risers.
- Provide silt management in ditches or canals. Typical structures include sluice gates and sediment traps.
- Supplement a resource management system on land where organic waste or commercial fertilizer is applied.
- Create, restore, or enhance wetland hydrology.

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CRITERIA

General Criteria Applicable to All Purposes

All structures designed under this standard must comply with applicable Federal, Tribal, State, and local laws, rules, and regulations. Obtain all required permits before construction begins.

Seed or sod the exposed surfaces of earthen embankments, earth spillways, borrow areas, and other areas disturbed during construction in accordance with the criteria in NRCS Maryland Conservation Practice Standard (CPS) Critical Area Planting (Code 342). When necessary to provide surface protection where climatic conditions preclude the use of seed or sod, use the criteria in Maryland CPS Mulching (Code 484) to install inorganic cover material such as gravel.

Do not raise the water level upstream of water control structures on adjacent landowners without their permission.

Site Selection

Adequate investigation shall be made to insure that:

1. The site for the water control structure is stable;
2. When the planned work of improvement is installed, it will perform as intended in the most efficient manner;
3. The water level upstream of the water control structure will not be raised on adjacent landowners without their permission;
4. The water control structure will not have an adverse effect on septic filter fields.

Capacity

The structure capacity shall be appropriate for the intended practice or purpose.

For farm ditches, size the minimum capacity of the water control structure on the drainage removal rates. These rates are determined from the drainage curves found in Chapter 14 of the Engineering Field Handbook.

For main ditch outlets, size the minimum capacity of the water control structure for the lesser of the calculated discharge from the existing ditch capacity or the peak flow from a 10-year 24-hour storm.

For all other locations, size the capacity of the water control structure on the required discharge to meet the total system design capacity.

Vegetation

Use the Maryland conservation practice standard for Critical Area Planting (Code 342) to determine seedbed preparation, liming, fertilizing, seeding and mulching requirements and appropriate grass species to be established based on site conditions and use. Do not use plants listed on the Maryland noxious weed list. Construction should be scheduled so that completion occurs during periods suitable for the establishment of vegetation. Provide fencing when needed to protect the structure from livestock or other from other uses.

Permits

Maryland Department of Environment (MDE) and/ or the Corps of Engineers regulates activities conducted in perennial and intermittent waters, wetlands, and the 100-year floodplain. At their discretion, MDE and Corps field reviewers may waive notification and permit requirements for minor activities, especially those involving small on-farm drainage ditches. It is the owner’s responsibility to contact MDE

and/or the Corps to make a determination whether a permit will be required before a new practice can be installed.

Freeboard

The elevation of the top of the embankment or any other critical control point shall be a minimum of 0.5 foot above the design high water elevation.

Anti-seep Collars

Provide anti-seep collars on any pipe conduit greater than 6 inches in diameter through an earth fill greater than 4 feet in height. All anti-seep collars and their connections to the conduit shall be watertight and made of material compatible with the conduit. Extend collar dimensions a minimum of 2 feet in all directions around the pipe and be placed a minimum of two feet from pipe joints except where flanged joints are used.

Outlets

Protects outlets to the extent that design flows will not result in erosion downstream of the structure. Maximum, permissible flow velocities at design capacity are as follows:

Soil Texture	Maximum Flow Velocity
Sand and sandy loam	2 ½ ft. per second
Silt loam	3 ft. per second
Sandy clay loam	3 ½ ft. per second
Clay loam	4 ft. per second
Clay, fine gravel graded loam to cobbles	5 ft. per second
Graded silt to cobbles	5 ½ ft. per second
Shale, hardpan and coarse gravels	6 ft. per second

Anti-vortex Devices

Drop inlet spillways are to have adequate antivortex devices. Splitter type anti-vortex devices shall be placed in line with the barrel. An anti-vortex device is not required if weir control is maintained in the riser through all flow stages.

Trash Racks

Provide a trash rack on all pipe and inlet structures. Openings for trash racks shall be no larger than ½ of the barrel conduit diameter, but in no case less than 6 inches.

Flush grates for trash racks are not acceptable. Inlet structures that have flow over the top shall have a non-clogging trash rack such as a hoodtype inlet extending a minimum of 8 inches below the weir openings, which allows passage of water from underneath the trash rack into the riser.

Anti-flotation

Analyze all riser structures for flotation assuming all orifices and pipes are plugged. The factor of safety against flotation is 1.2 or greater.

Gates

The gates shall be free swinging and designed to prevent the flap from pivoting inside the seat and wedging in the open position. Rubber check valves may be used in place of gates.

Earth Embankment

The minimum top width of the embankment is eight feet. When the embankment is also to be utilized by vehicles, the minimum width is twelve feet.

The side slopes shall not be steeper than 2:1. Slopes must be designed to be stable in all cases, even if flatter side slopes are required.

Embankments within a surface drainage ditch shall have a minimum bottom width of 8 times the height of the embankment and be crowned a minimum of 1 foot over the top of the lower existing ditch bank.

Pipe Conduits

Extend pipe conduits through an embankment 2 feet beyond the toe of slope on both ends. All pipes shall have a minimum cover of 12 inches. All pipe joints must be of like material and watertight. Any metal pipe shall be at least 15 gage. Pipes used in salt or brackish water will be either corrugated aluminum or plastic.

Bed pipe firmly and uniformly throughout its entire length. Where rock or soft, spongy, or other unstable soil is encountered, all such material shall be removed and replaced with suitable earth compacted to provide adequate support.

Materials

All materials shall be durable and have a life expectancy consistent with the design frequency but in no case less than 10 years.

Corrugated Metal Pipe

Corrugated Metal Pipe and its appurtenances will be galvanized and fully bituminous coated and must meet the requirements of AASHTO Specification M-190 type with watertight coupling bands.

Aluminum Pipe

Aluminum Pipe and its appurtenances must meet the requirements of AASHTO Specification M-196 or M-211 with watertight coupling bands or flanges.

Aluminum Coated Steel Pipe

Aluminum Coated Steel Pipe and its appurtenances must meet the requirements of AASHTO Specification M-274. Coupling bands must be composed of the same material as the pipe and be watertight.

Reinforced Concrete Pipe

Reinforced Concrete Pipe must meet the requirements of ASTM specification C-76. Joints must be watertight.

Plastic Pipe Materials

PVC pipe must be PVC 1120 or PVC 1220 conforming to ASTM D-1785 or ASTM D-2241. Corrugated High Density Polyethylene (HDPE) pipe, couplings and fittings must meet the requirements of AASHTO M294 Type S with watertight joints.

Rock

Gravel (aggregates) and rock riprap must meet the requirements of Maryland Department of Transportation, State Highway Administration Standard Specifications for Construction and Materials, Sections 901.01 and 901.02 respectively.

Geotextile

Geotextile may be woven or nonwoven and must meet the requirements of Maryland Department of Transportation, State Highway Administration Standard specifications for Construction and Materials, Section 919.01, Class SE.

Concrete

Concrete must meet the minimum requirements of Maryland Department of Transportation, State Highway Administration Standard Specifications for Construction and Materials, Section 902, Mix No. 3 (3,500 psi), Type I cement. Other mixes may be used when design computations are completed.

Gates

Gates shall be of cast iron, cast steel, aluminum, or fabricated steel. When used in salt or brackish water, the gate shall be of cast iron or aluminum metal and equipped with bronze bushings, hinge bars, assembly nuts, and bolts. Attach a pipe stub of two feet or more at the factory, or the gate may be attached to a head wall.

Safety
Design measures necessary to prevent serious injury or loss of life in accordance with requirements of Title 210, National Engineering Manual (NEM), Part 503, Safety.

Cultural Resources
Evaluate the existence of cultural resources in the project area and any project impacts on such resources. Provide conservation and stabilization of archeological, historic, structural, and traditional cultural properties when appropriate.

CONSIDERATIONS

Consider the following items when planning, designing, and installing this practice:

- Effects on the water budget, especially on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge.
- Potential for a change in the rate of plant growth and transpiration because of changes in the volume of soil water.
- Effects on downstream flows or aquifers that would affect other water uses or users.
- Effects on the field water table to ensure that it will provide a suitable rooting depth for the anticipated crop.
- Potential use for irrigation management to conserve water.
- Effect of construction on aquatic life.
- Effects on stream system channel morphology and stability as it relates to erosion and the movement of sediment, solutes, and sediment-attached substances carried by runoff.
- Effects on the movement of dissolved substances below the root zone and to ground water.
- Effects of field water table on salt content in the root zone.
- Short term and construction-related effects of this practice on the quality of downstream water.
- Effects of water level control on the temperatures of downstream waters and their effects on aquatic and wildlife communities.
- Effects on wetlands or water-related wildlife habitats.
- Effects on the turbidity of downstream water resources.

- Conservation and stabilization of archeological, historic, structural, and traditional cultural properties when appropriate.

PLANS AND SPECIFICATIONS

Prepare plans and specifications that describe the requirements for applying the practice according to this standard. As a minimum, include—

- A plan view of the layout of the structure for water control.
- Typical profiles and cross sections of the structure for water control.
- Structural drawings adequate to describe the construction requirements.
- Requirements for vegetative establishment and mulching, as needed.
- Safety features.
- Site-specific construction and material requirements.

OPERATION AND MAINTENANCE

Prepare an operation and maintenance plan for the operator.

As a minimum, include the following items in the operation and maintenance plan:

- Periodic inspections of all structures, earthen embankments, spillways, and other significant appurtenances.
- Prompt removal of trash from pipe inlets and trash racks.
- Prompt repair or replacement of damaged components.
- Prompt removal of sediment when it reaches predetermined storage elevations.
- Periodic removal of trees, brush, and undesirable species.
- Periodic inspection of safety components and immediate repair if necessary.
- Maintenance of vegetative protection and immediate seeding of bare areas as needed.

SUPPORTING DATA AND DOCUMENTATION

The following is a list of the minimum data and documentation to be recorded in the case file:

1. Location of the practice on the conservation map.
2. Assistance notes which include dates of site visits, name or initials of the person who made the visit, specifics as to alternatives discussed, decisions made, and by whom.

Field Data and Survey Notes

Record field data and survey notes on appropriate MD forms and engineering paper. The following is a list of the minimum data needed:

1. Plan view sketch to indicate stream meandering and limits of stream protection as appropriate.
2. Site access.
3. Location of the proposed structure for water control
4. Profile of the existing conditions between the starting point and destination as appropriate with elevations of critical control points such as low cropland or banks.
5. Cross-sections as appropriate.
6. Topographic survey as needed for the location and elevation of the structure for water control components and appurtenances.

7. Geologic investigation to determine any special construction needs.

Design Data

Record design data on appropriate engineering paper. For guidance on the preparation of engineering plans see chapter 5 of the EFH, Part 650. The following is a list of the minimum required design data:

1. Show on the plans, the job class, the plan view sketch and final grading plan, location map, all system components, material, utility notification, and construction specifications.
2. Soil type and soil loss calculations as necessary.
3. Design computations including information on determination of drainage area and design flow.
4. Structural details of all components and outlet protection with dimensions and special requirements noted, including the structure design elevation, type and size of structure and components. Include gage or thickness of metal.
5. Cross-sections and profiles of the structures and watercourses as appropriate.
6. Vegetative plan. Include the seedbed preparation, seeding species and rate, lime, fertilizer and mulching requirements.
7. Special safety requirements.
8. Estimated quantities.
9. Written Operation and Maintenance plan.

Construction Check Data

Record the construction check data on survey notepaper, ENG-28, or other appropriate engineering paper. Survey data will be plotted in red on the as-built plans. The following is a list of minimum data needed for as-built documentation:

1. Documentation of site visits on CPA-6. Include the date, who performed the inspection, specifics as to what was inspected, all alternatives discussed, and decisions made and by whom.
2. Dimensions of all structures, components, and outlet protection installed.
3. Cross sections and profiles of completed structures as appropriate.
4. Statement on type and rate of seeding applied.
5. Documentation of materials certification and construction changes.
6. Sign and date check-notes and plans by someone with appropriate approval authority. Include statement that practice meets or exceeds plans and Maryland practice standards.

REFERENCES

American Association of State Highway and Transportation Officials. Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter, AASHTO M294.

American Association of State Highway and Transportation Officials. Standard Specification for Asphalt-Coated Corrugated Metal Culvert Pipe and Pipe-Arches, AASHTO M190.

American Association of State Highway and Transportation Officials. Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains, AASHTO M196.

American Association of State Highway and Transportation Officials. Standard Specification for Helically Corrugated Aluminum Alloy Culvert Pipe, AASHTO M211.

American Association of State Highway and Transportation Officials. Standard Specification for Steel Sheet, Aluminum-Coated (Type 2), for Corrugated Steel Pipe, AASHTO M274.

American Society for Testing and Materials. Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe, ASTM C76.

American Society for Testing and Materials. Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120, ASTM D1785.

American Society for Testing and Materials. Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series), ASTM D2241.

Maryland Department of Transportation, *State Highway Administration, Standard Specifications for Construction and Materials*, July 2018.

USDA NRCS. National Engineering Handbook (NEH), Part 636, Structural Engineering. Washington, DC.

USDA NRCS. NEH, Part 650, Engineering Field Handbook. Washington, DC.

USDA NRCS. National Engineering Manual. Washington, DC.