STRUCTURE FOR WATER CONTROL
(CODE 587)

DESCRIPTION

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

The practice may be applied as a management component of a water management system to control the stage, discharge, distribution, delivery, or direction of water flow.

CONDITION

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

POLICIES

1. To 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 designed to operate under open channel conditions. Typical structures: drops, chutes, turnouts, surface water inlets, head gates, pump boxes, and stilling basins.

2. To control the elevation of water in drainage or irrigation ditches. Typical structures: checks, flashboard risers, check dams.

3. To control the division or measurement of irrigation water. Typical structures: division boxes and water measurement devices.

4. To keep trash, debris, or weed seeds from entering pipelines. Typical structure: debris screen.

5. To control the direction of channel flow resulting from tides and high water or backflow from flooding. Typical structures: tide and water management gates.

6. To 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: water level control structures, flashboard risers, pipe drop inlets, and box inlets.

7. To convey water over, under, or along a ditch, canal, road, railroad, or other barriers. Typical structures: bridges, culverts, flumes, inverted siphons, and long span pipes.

8. To modify water flow to provide habitat for fish, wildlife, and other aquatic animals. Typical structures: chutes, cold water release structures and flashboard risers.

9. To provide silt management in ditches or canals. Typical structure: sluice.

10. To supplement a resource management system on land where organic waste or commercial fertilizer is applied.

11. To create, restore, or enhance wetland hydrology.

This standard does not apply to structural components of irrigation pipelines or to subsurface drains or grade stabilization structures.

CONSIDERATIONS

When planning, designing, and installing this practice, the following items should be considered:

Water Quantity

1. Effects on the water budget, especially on volume and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge.

2. Potential for a change in the rate of plant growth and transpiration because of changes in the volume of water in the soil.

3. Effects on downstream flows or aquifers that would affect other water uses or users.

4. Effects on the field water table to ensure that it will provide a suitable rooting depth for the anticipated crop.

5. Potential use for irrigation management to conserve water.

6. Existence of cultural resources in the project area and any project impacts on such resources.

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

Water Quality

1. Effects of construction on aquatic life.

2. 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.

3. Effects on the movement of dissolved substances below the root zone and to ground water.

4. Effects of field water table on salt content in the root zone.

5. Short term and construction related effects of this practice on the quality of downstream water.

6. Effects of water level control on the temperature of downstream waters and their effects on aquatic and wildlife communities.

7. Effects on wetlands or water related wildlife habitats.

8. Effects on the turbidity of downstream water resources.

Design alternatives presented to the client should address economics, ecological concerns, and acceptable level of risk for design criteria as it relates to hazards to life or property.

CRITERIA

Design structures as part of an approved engineering plan.

Perform work in conformance with all federal, state, and local laws, rules, and regulations.

Vegetation complying with Critical Area Planting standard (code 342) shall be established on all disturbed earth surfaces. Where soil, climate or site specific conditions preclude establishing permanent vegetation, other protective means such as mulches, or gravels, shall be used.

The structure shall be fenced, if necessary, to protect the vegetation.

Structures shall not be installed that have an adverse effect on septic filter fields.

The water level upstream of water control structures shall not be raised on adjacent landowners without their permission.

Make provisions as needed for maintenance. Care must be used to insure that the area's visual resources are not damaged. If watercourse fisheries are important, special precautions or design features may be needed to insure continuation of fish migrations.

Use variable crest spillways (stop logs in inlets or control boxes) in the design when needed to permit regulation of water levels.

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 10year 24hour 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 100year 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.

Antiseep 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 anti-vortex 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 hood-type 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 - and its appurtenances will be galvanized and fully bituminous coated and must meet the requirements of AASHTO Specification M190 type with watertight coupling bands.

Aluminum Pipe - and its appurtenances must meet the requirements of AASHTO Specification M196 or M211 with watertight coupling bands or flanges.

Aluminum Coated Steel Pipe - and its appurtenances must meet the requirements of AASHTO Specification M27479I. Coupling bands must be composed of the same material as the pipe and be watertight.

Reinforced Concrete Pipe - must meet the requirements of ASTM specification C76. Joints must be watertight.

Plastic Pipe Materials – PVC pipe must be PVC 1120 or PVC 1220 conforming to ASTM D1785 or ASTM D2241. 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 non-woven and must meet the requirements of Maryland Department of Transportation, State Highway Administration Standard specifications for Construction and Materials, Section 921.09, 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 IA 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.

SPECIFICATIONS

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

Specify on the plans the location, grades, dimensions, materials, and hydraulic and structural requirements for the individual structure. Provisions must be made for necessary maintenance. Care must be used to protect the surrounding visual resources. If watercourse fisheries are important, special precautions or design features may be needed to facilitate continuation of fish migrations.

When feasible, install tide gates with the top of the outlet end of the pipe at or below the elevation of mean low tide. The drainage channels to and from the tide gates shall have ample depth and section to accept the design discharge during tidal fluctuations. Set gates so they will swing freely during tidal fluctuations. Pipes installed on soft foundations shall be given sufficient camber to offset loads imposed by trench backfill and dikes.

Perform work in areas free from water. Construct and maintain all temporary dikes, levees, cofferdams, drainage channels, and stream diversions necessary to protect the areas to be occupied by the permanent works.

OPERATION AND MAINTENANCE

Provide a written operation and management plan and review with the land manger. The plan shall be site specific and include but not be limited to the following:

Structures will be checked and necessary maintenance, including removal of debris, shall be performed after major storms and at least semiannually. Water level management and timing shall be adequately described wherever applicable.

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. Soil investigation, auger logs 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, ENG28, 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 CPA6. 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 NRCS practice standards.

REFERENCES

1. Maryland Department of the Environment, Water Management Administration, 1994 Maryland Standards and Specifications for Soil Erosion and Sediment Control;

2. Maryland Department of the Environment; Code of Maryland Regulations; Construction of Non-Tidal Waters and Flood Plains; www.dsd.state.md.us.

3. Maryland Department of the Environment, Water Management Administration, Maryland's Guidelines to Waterway Construction, May 1999;

4. Maryland Department of Transportation, State Highway Administration, Standard Specifications for Construction Materials, January, 2001;

5. U.S. Department of Transportation, Federal Highway Administration, Hydraulic Engineering Circular No. 5, Hydraulic Charts for the Selection of Highway Culverts, December 1965;

6. USDA Natural Resources Conservation Service, National Engineering Handbook, Part 650;

7. USDA Natural Resources Conservation Service, Maryland Field Office Technical Guide, Section IV, Standards and Specifications.