POND

Code 378

Definition

A water impoundment made by constructing a dam or an embankment or by excavating a pit or dugout.

In this standard, ponds constructed by the first method are referred to as embankment ponds, and those constructed by the second method are referred to as excavated ponds. Ponds constructed by both the excavation and the embankment methods are classified as embankment ponds if the depth of water impounded against the embankment at spillway elevation is 3 ft or more. The depth of water impounded is defined as the difference between the spillway inlet elevation and the channel elevation at the point of discharge.

Purpose

To provide water for livestock, fish and wildlife, recreation, fire control, crop and orchard spraying, and other related uses, and to maintain or improve water quality. This standard also applies to stormwater management ponds that are not within the scope of SCS Technical Release No. 60.

Scope

This standard establishes the minimum acceptable quality for the design and construction of ponds if:

1. Failure of the dam will not result in loss of life; in damage to homes, commercial or industrial buildings, main highways, or railroads; or in interruption of the use or service of public utilities.

2. The product of the storage times the effective height of the dam is less than 3,000. Storage is the volume, in acre-feet, in the reservoir below the elevation of the crest of the emergency spillway. 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 taken along the centerline of the dam. If there is no emergency spillway, the top of the dam is the upper limit.

3. The effective height of the dam is 35 ft or less, and the dam is hazard class (a). See Appendix A of this standard for structure (hazard) classification definitions.

4. Dams that exceed the scope of this standard shall be designed and constructed to meet the requirements of SCS Technical Release No. 60.

Conditions where practice applies

Site conditions. Site conditions shall be such that runoff from the design storm can be safely passed through (1) a natural or constructed emergency spillway, (2) a combination of a principal spillway and an emergency spillway, or (3) a principal spillway.

Drainage area. The drainage area above the pond must be protected against erosion to the extent that expected sedimentation will not shorten the planned effective life of the structure. The drainage area shall be large enough so that surface runoff and groundwater flow will maintain an adequate supply of water in the pond. The quality shall be suitable for the water's intended use.

Reservoir area. The topography and soils of the site shall permit storage of water at a depth and volume that ensure a dependable supply, considering beneficial use, sedimentation, season of use, and evaporation and seepage losses. If surface runoff is the primary source of water for a pond, the soils shall be impervious enough to prevent excessive seepage losses or shall be of a type that sealing is practicable. The sediment storage volume shall be no less than the expected sediment accumulation during a period equal to the design life.

Planning considerations

Water Quantity

1. Effects upon components of the water budget, especially effects on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge. The drainage area for wet ponds should be at least four (4) acres for each acre-foot of water. These requirements may be reduced if a dependable source of groundwater or diverted surface water contributes to the pond.

2. Variability of effects caused by seasonal or climatic changes.

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

4. Potential for multiple use.

5. Effects on the volume of downstream flow to prohibit undesirable environmental, social or economic effects.

Water Quality

1. Effects on erosion and the movement of sediment, pathogens, and soluble and sediment attached substances that are carried by runoff.

2. Effects on the visual quality of onsite and downstream water resources.

3. Short-term and construction-related effects of this practice on the quality of downstream water courses.

4. Effects of water level control on the temperatures of downstream water to prevent undesired effects on aquatic and wildlife communities.

5. Effects on wetlands and water-related wildlife habitats.

6. Effects of water levels on soil nutrient processes such as plant nitrogen use or denitrification.

7. Effects of soil water level control on the salinity of soils, soil water, or downstream water.

8. Potential for earth moving to uncover or redistribute toxic materials such as saline soils.

Design criteria for embankment ponds

Foundation. A foundation investigation is required on all embankment ponds. As a minimum it shall include information along the centerline of the proposed dam, in the emergency spillway location, and the planned borrow area. The type of equipment used and the extent of the investigation will vary from site to site. All investigations shall be logged using the Unified Soil Classification System.

Foundation cutoff. A cutoff of relatively impervious material shall be provided under the dam if necessary. The cutoff shall be located at or upstream from the centerline of the dam. It shall extend up the abutments as required and be deep enough to extend into a relatively impervious layer or provide for a stable dam when combined with seepage control. The cutoff trench shall have a bottom width adequate to accommodate the equipment used for excavation, backfill, and compaction operations. Side slopes shall be no steeper than one horizontal to one vertical.

Seepage control. Seepage control is to be included if (1) pervious layers are not intercepted by the cutoff, (2) seepage creates swamping downstream, (3) such control is needed to ensure a stable embankment, or (4) special problems require drainage for a stable dam. Seepage may be controlled by (1) foundation, abutment, or embankment drains; (2) reservoir blanketing; or (3) a combination of these measures.

Earth embankment. The minimum top width for a dam is shown in Table 1. If the embankment top is to be used as a public road, the minimum width shall be 16 ft for one-way traffic and 26 ft for two-way traffic. Guardrails or other safety measures shall be used where necessary and shall meet the requirements of the responsible road authority.

Table 1.-Minimum top width for dams

Total height of embankment	Top Width
ft	ft
10 or less	6
10-15	8
15-20	10
20-25	12
25-35	14
35 or more	15

The combined upstream and downstream side slopes of the settled embankments shall be no less than five horizontal to one vertical, and neither slope shall be steeper than two horizontal to one vertical. All slopes must be designed to be stable.

If needed to protect the slopes of the dam, special measures, such as berms, rock riprap, sand-gravel, soil cement, or special vegetation, shall be provided (Technical Releases 56 and 69).

The minimum elevation of the top of the settled embankment shall be 1 ft above the water surface in the reservoir with the emergency spillway flowing at design depth. The minimum difference in elevation between the crest of the emergency spillway and the settled top of the dam shall be 2 ft for all dams having more than a 20-acre drainage area or more than 20 ft in effective height.

The design height of the dam shall be increased by the amount needed to ensure that after settlement the height of the dam equals or exceeds the design height. This increase shall be no less than 5 percent, except where detailed soil testing and laboratory analyses show that a lesser amount is adequate.

Principal spillway. A pipe conduit, with needed appurtenances, shall be placed under or through the dam, except where rock, concrete, or other types of mechanical spillways are used, or where the rate and duration of flow can be safely handled by a vegetated or earth spillway.

The crest elevation shall be no less than 0.5 ft below the crest of the emergency spillway for dams having a drainage area of 20 acres or less, and no less than 1 ft for those having a drainage area of more than 20 acres.

When design discharge of the principal spillway is considered in calculating peak outflow through the emergency spillway, the crest elevation of the inlet shall be such that the full flow will be generated in the conduit before there is discharge through the emergency spillway. The inlets and outlets shall be designed to function satisfactorily for the full range of flow and hydraulic head anticipated.

The capacity of the pipe conduit shall be adequate to discharge long-duration, continuous, or frequent flows without flow through the emergency spillways. See Table 4 for additional requirements. The diameter of the pipe shall be no less than 4 in. If the pipe conduit diameter is 10 in or greater, its design discharge may be considered when calculating the peak outflow rate through the emergency spillway. Runoff rates and volumes shall be determined using one or more of the following references:

1. SCS Engineering Field Manual
2. SCS National Engineering Handbook, Section 4, "Hydrology"
3. SCS Technical Release 55, "Urban Hydrology for Small Watersheds"
4. SCS Technical Release 20, "Computer Program for Project Formulation"

Pipe conduits under or through the dam shall meet the following requirements. The pipe shall be capable of withstanding external loading without yielding, buckling, or cracking. Flexible pipe strength shall be no less than that necessary to support the design load with a maximum of 5 percent deflection. The inlets and outlets shall be structurally sound and made of materials compatible with those of the pipe. All pipe joints shall be made watertight by the use of couplings, gaskets, caulking, or by welding.

For dams 20 ft or less in effective height, acceptable pipe materials are cast-iron, steel, corrugated steel or aluminum, asbestos-cement, concrete, plastic, vitrified clay with rubber gaskets, and cast-in-place reinforced concrete. Asbestos-cement, concrete, and vitrified clay pipe shall be laid in a concrete bedding. Plastic pipe that will be exposed to direct sunlight shall be made of ultraviolet-resistant materials and protected by coating or shielding, or provisions for replacement should be made as necessary. Connections of plastic pipe to less flexible pipe or structures must be designed to avoid stress concentrations that could rupture the plastic.

For dams more than 20 ft in effective height, conduits shall be plastic, reinforced concrete, cast-in-place reinforced concrete, corrugated steel or aluminum, or welded steel pipe. The maximum height of fill over any principal spillway steel or aluminum pipe must not exceed 25 ft. Pipe shall be watertight. The joints between sections of pipe shall be designed to remain watertight after joint elongation caused by foundation consolidation. Concrete pipe shall have concrete bedding or a concrete cradle, if required. Cantilever outlet sections, if used, shall be designed to withstand the cantilever load. Pipe supports shall be provided when needed. Other suitable devices such as a Saint Anthony Falls stilling basin or an impact basin may be used to provide a safe outlet. Protective coatings of asbestos-bonded, asphalt coated, or vinyl coating on galvanized corrugated metal pipe, or coal tar enamel on welded steel pipe should be provided in areas that have a history of pipe corrosion, or where the saturated soil resistivity is less than 4,000 ohms-cm, or where soil pH is lower than 5.

Specifications in tables 2 and 3 are to be followed for polyvinyl chloride (PVC), steel, and aluminum pipe.

Cathodic protection is to be provided for coated welded steel and galvanized corrugated metal pipe where soil and resistivity studies indicate that the pipe needs a protective coating, and where the need and importance of the structure warrant additional protection and longevity. If cathodic protection is not provided for in the original design and installation, electrical continuity in the form of joint-bridging straps should be considered on pipes that have protective coatings. Cathodic protection should be added later if monitoring indicates the need.

Practice standard 430-FF provides criteria for cathodic protection of welded steel pipe.

Seepage control along a pipe conduit spillway shall be provided if any of the following conditions exist:

1. The effective height of dam is greater than 15 ft.

2. The conduit is of smooth pipe larger than 8 in. in diameter.

3. The conduit is of corrugated pipe larger than 12 in. in diameter.

Table 2.-Acceptable PVC pipe for use in earth dams[1]

Nominal pipe size	Schedule for standard dimension ratio (SDR)	Maximum depth of fill over pipe
in		ft
4 or smaller	Schedule 40	15
	Schedule 80	20
	SDR 26	10
6, 8, 10, 12	Schedule 40	10
	Schedule 80	15
	SDR 26	10

[1]Polyvinyl chloride pipe, PVC 1120 or PVC 1220, conforming to ATSM-D-1785 or ATSM-D-2241.

Table 3.-Minimum gauge for corrugated metal pipe [2-2/3-in x 1/2-in corrugations][1]

Fill height (ft)	Minimum gauge for steel pipe with diameter (in) of-						Minimum thickness (in)[2] of aluminum pipe with diameter (in) of-			
	21 and less	24	30	36	42	48	21 and less	24	30	36
1-15	16	16	16	14	12	10	0.06	0.06	0.075	0.075
15-20	16	16	16	14	12	10	.06	.075	.105	.105
20-25	16	16	14	12	10	10	.06	.105	.135	[3]

[1] Pipe with 6-, 8-, and 10-in diameters has 1-1/2 in x 1/4-in corrugations.
[2] Riveted or helical fabrication.
[3] Not permitted.

Seepage along pipes extending through the embankment shall be controlled by use of a filter and drainage diaphragm, unless it is determined that antiseep collars will adequately serve the purpose.

The drain is to consist of sand meeting fine concrete aggregate requirements (at least 15% passing the No. 40 sieve but no more than 10% passing the No. 100 sieve). If unusual soil conditions exist, a special design analysis shall be made.

The drain shall be a minimum of 2 ft thick and extend vertically upward and horizontally at least three times the pipe diameter, and vertically downward at least 18 in. beneath the conduit invert. The drain diaphragm shall be located immediately downstream of the cutoff trench, approximately parallel to the centerline of the dam.

The drain shall be outletted at the embankment downstream toe, preferably using a drain backfill envelope continuously along the pipe to where it exits the embankment. Protecting drain fill from surface erosion will be necessary.

When antiseep collars are used in lieu of a drainage diaphragm, they shall have a watertight connection to the pipe. Maximum spacing shall be approximately 14 times the minimum projection of the collar measured perpendicular to the pipe. Collar material shall be compatible with pipe materials. The antiseep collar(s) shall increase by 15% the seepage path along the pipe.

Closed conduit spillways designed for pressure flow must have adequate antivortex devices.

To prevent clogging of the conduit, an appropriate trash guard shall be installed at the inlet or riser.

A pipe with a suitable valve shall be provided to drain the pool area if needed for proper pond management or if required by State law. The principal spillway conduit may be used as a pond drain if it is located where it can perform this function.

Supply pipes through the dam to watering troughs and other appurtenances shall have an inside diameter of not less than 1-1/4 in.

Table 4.-Minimum spillway capacity

Drainage area	Effective height of dam[1]	Storage	Minimum design storm[2]		
			Frequency		
			Prin. Splwy.	Emer. Splwy.	Minimum duration
acre	ft	acre-ft	yr	yr	hr
20 or less	20 or less	Less than 50	5	10	24
20 or less	More than 20	Less than 50	10	25	24
More than 20	20 or less	Less than 50	10	25	24
All others		-	25	50	24

[1] As defined under "Scope."
[2] Select rain distribution based on climatological region.

Emergency spillways. Emergency spillways convey large flood flows safely past earth embankments.

An emergency spillway must be provided for each dam, unless the principal spillway is large enough to pass the peak discharge from the routed design hydrograph and the trash that comes to it without overtopping the dam. The following are minimum criteria for acceptable use of a closed conduit principal spillway without an emergency spillway: a conduit with a cross-sectional area of 3 ft^2 or more, an inlet that will not clog, and an elbow designed to facilitate the passage of trash.

The minimum capacity of a natural or constructed emergency spillway shall be that required to pass the peak flow expected from a design storm of the frequency and duration shown in Table 4, less any reduction creditable to conduit discharge and detention storage.

The emergency spillway shall safely pass the peak flow, or the storm runoff shall be routed through the reservoir. The routing shall start either with the water surface at the elevation of the crest of the principal spillway or at the water surface after 10 days' drawdown, whichever is higher. The 10-day drawdown shall be computed from the crest of the emergency spillway or from the elevation that would be attained if the entire design storm were impounded, whichever is lower. Emergency spillways shall provide for passing the design flow at a safe velocity to a point downstream where the dam will not be endangered.

Constructed emergency spillways are open channels that usually consist of an inlet channel, a control section, and an exit channel. They shall be trapezoidal and shall be located in undisturbed or compacted earth. The side slopes shall be stable for the material in which the spillway is to be constructed. For dams having an effective height exceeding 20 ft, the emergency spillway shall have a bottom width of not less than 10 ft.

Upstream from the control section, the inlet channel shall be level for the distance needed to protect and maintain the crest elevation of the spillway. The inlet channel may be curved to fit existing topography. The grade of the exit channel of a constructed emergency spillway shall fall within the range established by discharge requirements and permissible velocities.

Structural emergency spillways. If chutes or drops are used for principal spillways or principal emergency or emergency spillways, they shall be designed according to the principles set forth in the Engineering Field Manual for Conservation Practices and the National Engineering Handbook-Section 5, Hydraulics; Section 11, Drop Spillways; and Section 14, Chute Spillways. The minimum capacity of a structural spillway shall be that required to pass the peak flow expected from a design storm of the frequency and duration shown in Table 4, less any reduction creditable to conduit discharge and detention storage.

Visual resource design. The visual design of ponds shall be carefully considered in areas of high public visibility and those associated with recreation. The underlying criterion for all visual design is appropriateness. The shape and form of ponds, excavated material, and plantings are to relate visually to their surroundings and to their function.

The embankment may be shaped to blend with the natural topography. The edge of the pond may be shaped so that it is generally curvilinear rather than rectangular. Excavated material

can be shaped so that the final form is smooth, flowing, and fitting to the adjacent landscape rather than angular geometric mounds. If feasible, islands may be added for visual interest and to attract wildlife.

Design criteria for excavated ponds

Runoff. Provisions shall be made for a pipe and emergency spillway if necessary. Runoff flow patterns shall be considered when locating the pit and placing the spoil (see table 4).

Side slopes. Side slopes of excavated ponds shall be stable and shall be no steeper than one horizontal to one vertical. Flatter side slopes are strongly recommended for safety. If livestock will water directly from the pond, a watering ramp of ample width shall be provided. The ramp shall extend to the anticipated low water elevation at a slope no steeper than three horizontal to one vertical.

Perimeter form. If the structures are to be used for recreation or are highly visible to the public, the perimeter or edge should be curvilinear.

Inlet protection. If surface water enters the pond in a natural or excavated channel, the side slope of the pond shall be protected against erosion.

Excavated material. The material excavated from the pond shall be placed so that its weight will not endanger the stability of the pond side slopes and so that it will not be washed back into the pond by rainfall. It shall be disposed of in one of the following ways:

1. Uniformly spread to a height that does not exceed 3 ft, with the top graded to a continuous slope away from the pond.

2. Uniformly placed or shaped reasonably well, with side slopes assuming a natural angle of repose. The excavated material will be placed at a distance equal to the depth of the pond but not less than 12 ft from the edge of the pond.

3. Shaped to a designed form that blends visually with the landscape.

4. Used for low embankment and leveling.

5. Hauled away.

Plans and specifications

Plans and specifications for installing ponds shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. See page S-378-1 for items to be considered in development of the construction drawings and specifications.

Substantiating Data for Documentation

Installation and construction check notes shall be kept in sufficient detail to determine if the practice meets standards and specifications. Minimum requirements as applicable are:

1. Profile notes along centerline of top of completed embankment.

2. Cross section notes at one or more locations on the completed embankment.

3. Profile notes along centerline of earth spillway.

4. Cross section notes of earth spillways as needed to determine whether planned grade and dimensions have been met.

5. Location, size, type, grade, and/or pertinent elevations of the principal spillway, trickle tube, influent and/or effluent lines, and all other required appurtenances.

6. Depth and area of normal pool if these minimums are a part of specifications.

7. Maximum and minimum operational elevations.

8. Statement on condition or adequacy of clearing of the site and reservoir if this is a part of the plan.

9. Statement as to the condition or adequacy of vegetation on the embankment, spillway, and other disturbed areas.

10. Information on whether pond has been stocked.

11. Information on whether design features for fish management were incorporated.

12. Type and adequacy of sealing treatment.

13. Type and location of fencing and safety features where appropriate.

Sufficient survey will be made to determine quantities if required by the drawings and specifications or to determine number of practice units as applicable.

Measurements and computations for quantities will be recorded and filed to the extent that they are required to determine the number of practice units performed, or as requested by the landuser.

SOIL CONSERVATION SERVICE

DELAWARE

CONSTRUCTION SPECIFICATIONS FOR

POND (378)

These construction specifications apply to all ponds designed to meet the requirements of practice standard Pond (378).

Embankment Ponds

Foundation Preparation

The foundation area shall be cleared of trees, logs, stumps, roots, brush, boulders, sod, and rubbish. Where needed to establish vegetation, the topsoil and sod are to be stockpiled and spread on the completed dam and spillways. Foundation surfaces shall be sloped to no steeper than 1:1. The foundation area shall be thoroughly scarified before placement of the fill material. The surface shall, if necessary, have water added and be compacted so that the first layer of fill material may be compacted and bonded to the foundation.

The cutoff trench and any other required excavations shall be excavated to the lines and grades shown on the drawings or as staked in the field. To the extent they are suitable, excavated materials are to be used in the embankment.

Existing stream channels in the foundation area shall be sloped no steeper than 1:1 and deepened and widened as necessary to remove all stones, gravel, sand, stumps, roots, and other objectionable material and to accommodate compaction equipment.

Foundation areas shall be kept free of standing water when fill is being placed on them.

Fill Placement

The material placed in the fill shall be free of detrimental amounts of sod, roots, frozen soil, stones over six (6) inches in diameter (except for rock fills), and other objectionable material.

Backfill material shall be placed around structures, pipe conduits, and antiseep collars at approximately the same rate on all sides to prevent damage from unequal loading.

The placing and spreading of fill material shall be started at the lowest point of the foundation and the fill brought up in horizontal layers of such thickness that the required compaction can be obtained. The fill shall be constructed in continuous horizontal layers except where openings or sectionalized fills are called for. In those cases, the slope of the bonding surfaces between embankment in-place and embankment to be placed will not be steeper than three (3) horizontal to one (1) vertical. The bonding surface is to be treated the same as that specified for the foundation so as to ensure a good bond with the new fill.

The distribution and gradation of materials shall be such that there will be no lenses, pockets, streaks, or layers of material differing substantially in texture or gradation from the surrounding material. Where it is necessary to use materials of varying texture and gradation, the more impervious material shall be placed in the center and upstream portions of the fill. Where zoned fills of substantially differing materials are specified, the zones shall be placed according to lines and grades shown on the drawings.

Moisture Control

The moisture content of the fill material shall be such that the required compaction can be obtained. Material that is too wet shall be dried to meet this requirement. Material that is too dry shall have water added and mixed until the requirement is met.

Compaction

The construction equipment shall be operated over the areas of each layer of fill in a way that will result in the required compaction. Special equipment shall be used when the required compaction cannot be obtained without it.

When a minimum required density is specified, each layer of fill shall be compacted as necessary to achieve a density not less than that specified.

Fill adjacent to structures, pipe conduits, and antiseep collars shall be compacted to a density equivalent to that of the surrounding fill by means of hand tamping or manually-directed

power tampers or plate vibrators. Compaction adjacent to concrete structures will not be started until the concrete has attained sufficient strength to support the load.

Erosion Protection

Vegetation shall be established on all exposed surfaces of the embankment, spillway, and borrow area where soil and climatic conditions permit. Where soil or climatic conditions preclude the use of vegetation, and erosion protection is needed, non-vegetative means such as mulches or gravel may be used. In some cases, temporary vegetation may be used until conditions are right for establishment of permanent vegetation. The embankment and spillway shall be fenced where necessary to protect the vegetation.

Seedbed preparation, seeding, fertilizing, and mulching shall comply with the SCS Standards and Specifications for Critical Area Planting, Practice Code 342.

Principal Spillways

Corrugated metal pipe and its fittings shall conform to the standards set forth in the appropriate American Society of Testing Materials Designation(s) suitable for the intended purpose. These may include, but not be limited to, ASTM A-760, A-762, A-849, A-885, B-745, and B-790. Antiseep collars are to be of materials compatible with the pipe and installed so as to be watertight. The pipe shall be installed in accordance with the manufacturer's instructions. The pipe shall be firmly and uniformly bedded throughout its length and shall be installed to line and grade as shown on the drawings.

Concrete

Concrete shall receive the detail in mix design and testing consistent with the size and requirements of the job. Mix requirements or necessary strength should be specified. Type of cement, air entrainment, slump, aggregate or other properties are to be specified where necessary. All concrete is to consist of a workable mix that can be placed and finished in an acceptable manner. Necessary curing should be specified. Reinforcing steel is to be placed as indicated in the drawings and held securely in place during concrete placement. Subgrades and forms are to be installed to line and grade and the forms are to be mortar tight and unyielding as the concrete is placed.

Drainage Diaphragm, Foundation, and Embankment Drains

Drainage diaphragm, foundation, and embankment drains, when required, will be placed to line and grade as shown on the drawings. Detailed requirements for drain material and any required pipe will be shown in the drawings and specifications for the job.

Embankment and Excavated Ponds

All completed construction shall conform to the lines, grades, and elevations shown on the drawings or as staked in the field.

Construction operations shall be carried out in such a manner and sequence that erosion and air and water pollution will be minimized and held within legal limits. All work will be conducted in a skillful and professional manner.

The completed job shall present a professional appearance.

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

Fencing and cover to control erosion and pollution shall be established as needed.

Appropriate safety measures, such as warning signs, rescue facilities, fencing, etc., shall be included in the construction drawings and specifications.

An operation and maintenance plan shall be agreed to by the owner and operator.

APPENDIX A

STRUCTURE (HAZARD) CLASSIFICATION
FOR
POND (378)

Structure Classification

All structures (dams) will be reviewed and classed according to factors and procedures outlined in 520.21 of Subchapter C, Subpart C - Dams, SCS National Engineering Manual as supplemented herein. The class ("a," "b," and "c") as contained in this document is related to the damage that might result from a sudden major breach of the earth embankment. Structure classification and land use for runoff determination must take into consideration the anticipated changes in land use throughout the expected life of the structure. The classification of a dam is the responsibility of the designer, and subject to review and concurrence of the approving authority.

The classification of a dam is determined only by the potential hazard from failure not by the criteria. Classification factors in the National Engineering Manual, as supplemented, are given below:

Class "a" - Structures located in rural, agricultural, or urban areas dedicated to remain in flood tolerant usages where failure may damage non-resident buildings, agricultural land, floodplains, or county roads.

Class "b" - Structures located in predominantly rural or agricultural areas where failure may damage isolated homes, main highways or minor railroads, or cause interruption of use or service of relatively important public utilities.

Class "c" - Structures located where failure may cause loss of life or serious damage to homes, industrial and commercial buildings, important public utilities, main highways, or railroads.

Where breach analysis has indicated that overtopping of downstream roads will occur, the following guidelines will be used:

Class	Depth of Flow (d) ft.
"a"	d is less than or equal to 1.0
"b"	d is greater than 1.0 but less than 3.0
"c"	d is greater than 3.0

Urban areas are defined as metropolitan areas, cities, and suburbs, including areas in transition from agriculture to residential-industrial.

Technical Guide
Section IV
September 1990
SCS, Delaware

APPENDIX B

AMENDED SMALL POND DESIGN REQUIREMENTS
FOR
URBAN STORMWATER MANAGEMENT PONDS
CONSTRUCTED UNDER
CHAPTER 40, TITLE 7, DELAWARE CODE, JUNE 15, 1990

These requirements supplement and, in some situations, replace the criteria contained in the Code 378 when the purpose for the pond is to meet local and State requirements established for stormwater management.

The page number in Code 378 where the supplements or replacement requirements must be made are listed along with the revised text.

Page 4 - first paragraph first sentence

Foundation cutoff. A cutoff of relatively impervious material shall be provided under the dam.

Page 4 - new paragraph at the bottom of the page

The floor of the pond shall be graded as flat as possible to permit uniform ponding. Side slopes leading to the floor should be no steeper than three horizontal to one vertical. Approximately one foot below the normal pool elevation, a ten foot level bench shall be provided.

Pond slopes above the normal pool elevation also shall be no steeper than three horizontal to one vertical and a reverse slope bench, at least ten feet wide must be provided approximately one foot above the normal pool elevation.

Page 5 - fifth paragraph beginning with "The crest elevation" shall be replaced with the following:

The crest elevation of the principal spillway for all stormwater management ponds shall be no less than one foot below the crest of the emergency spillway.

Page 7 - center paragraph regarding seepage control

Seepage control along a pipe conduit spillway shall be provided. Anti-seep collars shall be installed around all conduits through earth fills according to the following criteria.

1. Sufficient collars shall be placed to increase the seepage length along the conduit by a minimum of 15 percent of the pipe length located within the saturation zone.

2. The normal saturation zone shall be determined by projecting a line at a slope of four horizontal to one vertical from the point where the normal water meets the upstream slope to a point where this line intersects the invert of the pipe conduit.

3. Maximum collar spacing shall be 14 times the minimum projection above the pipe. The minimum collar spacing shall be 5 times the minimum projection.

4. Anti-seep collars should be placed within the saturated zone. In cases where the spacing limit will not allow this, at least one collar will be in the saturated zone.

5. All anti-seep collars and their connections to the conduit shall be watertight and made of material compatible with the conduit.

6. Collar dimensions shall extend a minimum of two feet in all directions around the pipe.

Page 8 - disregard the discussion regarding the drainage diaphragm

Page 8 - replace the last sentence on the page and replace with the following:

Drop inlet spillways must all have adequate antivortex devices.

Low stage releases shall have a non-clogging trash rack.

Page 9 - Table 4 must be modified for stormwater management

Table 4.-Minimum spillway capacities

Drainage Area	Effective Height of Dam	Storage	Minimum design storm		
			Frequency		
			Prin. Splwy.	Emer. Splwy.	Minimum duration
acre	ft	acre-ft	yr	yr	hr
20 or less	Any	Less than 50	10	100	24
More than 20	20 or less	Less than 50	10	100	24
All others			25	100	24

Page 10 - Second paragraph beginning with "Construction," second sentence

They shall be trapezoidal and shall be located in undisturbed earth. Emergency spillways on stormwater management ponds shall not be located on fill material.

Page 11 - "Design criteria for excavated ponds," second paragraph, first sentence

Side slopes. Side slopes of excavated ponds shall be stable and shall not be steeper than three horizontal to one vertical. A 10 foot level bench shall be provided one foot below the normal pool elevation. Pond slopes above the normal pool elevation shall be no steeper than three horizontal to one vertical and a reverse slope bench, at least ten feet wide, shall be located one foot above the normal pool elevation.

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
_____, DELAWARE

SCS-PS-378
348-349-402

POND OR DAM

OPERATION AND MAINTENANCE PLAN

OPERATOR_____DATE_____

ADDRESS_____

_____

A properly operated and pond or dam is an asset to your farm. This pond or dam was designed and installed to collect and provide storage of runoff water for beneficial use. The estimated life span of this installation is at least ten years. The life of the structure can be assured and usually increased by developing and carrying out a good operation and maintenance program.

This conservation practice will require you to perform periodic maintenance and may also require operational items to maintain satisfactory performance. Here are some recommendations to help you develop a good operation and maintenance program.

GENERAL RECOMMENDATIONS

- Periodically inspect the spillways and inlets for proper functioning for their ability to maintain the water level to design elevations.

- Periodically check the elevation of the earthfills and restore to grade, if necessary.

- Maintain vigorous growth of desirable vegetative coverings. This includes reseeding, fertilization and controlled application of herbicides when necessary. Periodic mowing will be needed to control height and growth of woody vegetation. Maintain the embankment and emergency spillway by mowing. Do not mow during the nesting season (April 1 to August 1).

- If fences are installed, they shall be maintained to prevent unauthorized or livestock entry.

- Immediately remove any blockage or obstructions of spillways, trash racks and pipelines.

- Remove debris that may accumulate in the pond and immediately upstream or downstream from the pond.

- Determine and eliminate causes of settlement or cracks in the earthen sections and repair damage.

- Check all rock riprap for accelerated weathering and displacement. Replace to original grade.

- Repair or replace rusted or damaged metal.

- Eradicate or otherwise remove all rodents or burrowing animals and repair any damage caused by their activity.

- Immediately repair any vehicular or livestock damage to any earthfills, spillways and outlets.

- Make sure all structure drains are functional and soil is not being transported through the drainage system; repair if not functioning. The screens and/or rodent guards shall also be kept in place.

- Prevent the growth of woody vegetation on embankments. Tree growth on the dam will create leaks.

SPECIFIC RECOMMENDATIONS FOR YOUR INSTALLATION

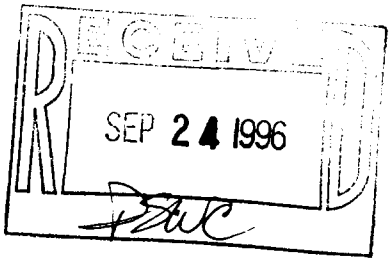
CONTACT YOUR LOCAL SOIL CONSERVATION SERVICE OFFICE FOR ANY ADDITIONAL TECHNICAL ASSISTANCE YOU MIGHT NEED FOR IMPLEMENTATION OF THIS OPERATION AND MAINTENANCE PLAN FOR YOUR STRUCTURE.

United States
Department of
Agriculture

Natural Resources
Conservation
Service

Suite 101
1203 College Park Drive
Dover, Delaware 19904-8713

September 19, 1996



Mr. Randy Greer
Div. of Soil & Water Cons.
DNREC, P.O. Box 1401
Dover, DE 19903

Dear Mr. Greer:

SUBJECT: NRCS Pond Standard 378

I am sending you this memo as a follow-up to our conversation regarding the use of smooth bore, corrugated plastic pipe in ponds. The NRCS Pond Standard 378 requires that embankment pond principal spillway pipe be capable of withstanding the design load with a maximum of 5 percent deflection. Corrugated plastic pipe typically needs to deflect more than 5 percent to develop its full strength. Thus, corrugated plastic pipe is unsuitable for an embankment pond. However, for an excavated pond or a combination excavated and low embankment (less than 3 feet of water impounded), there is no such restriction on the pipe material.

Please call me if you have any further questions regarding the use of corrugated plastic pipe in NRCS 378 Ponds.

Sincerely,

Ronald F. Gronwald

RONALD F. GRONWALD
State Conservation Engineer

cc:
John Barwick, Sussex Conservation District