NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

POND

(No.)
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 combining the excavation and the embankment methods are classified as embankment ponds if the depth of water impounded against the embankment at auxiliary spillway elevation is 3 feet or more.

PURPOSE

This practice supports one or more of the following purposes.

- Provide water for livestock,
- Provide water for fish and wildlife,
- Provide water for recreation,
- Provide water for fire control,
- Develop renewable energy sources,
- Provide water for irrigation,
- Provide water for crop and orchard spraying,
- Provide water for other related uses, and
- Maintain or improve water quality.

CONDITIONS WHERE PRACTICE APPLIES

This standard establishes the minimum acceptable quality for the design and construction of low-hazard ponds where:

1. Failure of the dam will not result in loss of life; 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 auxiliary spillway (historically been referred to as “emergency spillways”). The effective height of the dam is the difference in elevation, in feet, between the auxiliary spillway crest and the lowest point in the original cross section taken along the centerline of the dam. If there is no auxiliary spillway, the top of the dam is the upper limit for storage and effective height calculations.
3. The effective height of the dam is 35 feet or less.

CRITERIA

General Criteria Applicable to All Purposes

All planned work shall comply with all Federal, state, and local laws, rules, and regulations. Ponds may need to be approved or permitted by the appropriate Florida Water Management District (WMD) or other permitting agency.

Impact to cultural resources, wetlands and Federal and state protected species shall be evaluated and avoided or minimized to the extent practicable during planning, design and

implementation of this conservation practice in accordance with established National and Florida policy, General Manual (GM) Title 420-Part 401; Title 450-Part 401, Title 190-Parts 410.22 and 410.26, National Planning Procedures Handbook (NPPH) Florida Supplements to Parts 600.1 and 600.6, National Cultural Resources Procedures Handbook (NCRPH), National Food Security Act Manual (NFSAM), and the National Environmental Compliance Handbook (NECH).

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

Drainage area. The drainage area contributing to 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 for the intended purpose. The water quality of runoff from the drainage area shall be suitable for the water's intended use.

Reservoir area. The topography and geology of the site shall permit storage of water at a depth and volume that will 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.

Protection. Seed or sod the exposed surfaces of the embankment, earth spillway, borrow area, and other areas disturbed during construction as necessary to prevent erosion. All areas shall be vegetated in accordance with Florida NRCS conservation practice standard Critical Area Planting, Code 342. If feasible, stock pile existing topsoil and spread over the disturbed areas to facilitate re-vegetation.

CRITERIA FOR EMBANKMENT PONDS

Dam Safety. The downstream area below the embankment or dam must be evaluated carefully to determine what impact a sudden breach of the proposed dam would have. This evaluation must consider all existing improvements and those improvements that may reasonably be expected to occur during the useful life of the structure. The results of this examination provides for determining the proper hazard class of the dam. Only low hazard dams, as defined in National Engineering Manual (NEM) Part 520.21, are to be designed under this standard. A potential impact study shall be made and distributed in accordance with NEM Part 520.28 for inventory size dams.

Geological investigations. Geologic investigations shall be in accordance with NEM Part 531, Geology, Subpart A – Geological Investigations. Pits, trenches, borings, review of existing data or other suitable means of investigation shall be conducted to characterize materials within the embankment foundation, auxiliary spillway and borrow areas. Classify soil materials using the Unified Soil Classification System (USCS).

Maintain a permanent record of all soil borings and test pits in the design folder.

Foundation cutoff. Provide a cutoff of relatively impervious material under the dam if necessary to reduce seepage through the foundation. Locate the cutoff 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 (minimum of 1.0 foot) and 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 of the cutoff trench shall not be steeper than one horizontal to one vertical (1:1).

Seepage control. Include seepage control if (1) pervious layers are not intercepted by the cutoff, (2) seepage could create 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 filters and drains; (2) reservoir blanketing; or (3) a combination of these measures.

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 feet for one-way traffic and 26 feet for two-way traffic. Where necessary, use guardrails or other safety measures that meet the requirements of the responsible road authority. For dams less than 20 feet in height, maintenance considerations or construction equipment limitations may require increased top widths from the minimum shown in Table 1.

Table 1 - Minimum Top Width for Dams

Total height of embankment 1/, ft	Top width, ft
< 10	6
10 - 14.9	8
15 - 19.9	10
20 - 24.9	12
25 - 34.9	14
≥ 35	15

1/ Total height of embankment for determining the top width is the difference in elevation between the lowest point on top of dam and the lowest elevation at the downstream toe.

Side slopes. The combined upstream and downstream side slopes of the settled embankments shall not be less than five horizontal to one vertical (5:1) and neither slope shall be steeper than two horizontal to one vertical (2:1). All slopes must be designed to be stable, even if flatter side slopes are required. Downstream or upstream berms can be used to help achieve stable embankment sections.

Slope Protection. If needed to protect the slopes of the dam from erosion, special measures, such as berms, rock riprap, sand-gravel, soil cement, or special vegetation, shall be provided (Technical Releases 56, “A guide for Design and Layout of Vegetative Wave Protection for Earth Dam Embankments” and 69, “Riprap for Slope Protection Against Wave Action” contain design guidance).

Freeboard. The minimum elevation of the top of the settled embankment shall be 1.0 foot above the water surface in the reservoir with the auxiliary spillway flowing at design depth. The minimum difference in elevation between the crest of the auxiliary spillway and the settled top of the dam shall be 2.0 feet for all dams having more than a 20-acre drainage area or more than 20 feet in effective height.

Settlement. Increase the height of the dam by the amount needed to ensure that after settlement the height of the dam equals or exceeds the design height. This increase shall not be less than 5 percent of the height of the dam, except where detailed soil testing and laboratory analyses or experience in the area 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 lined spillways are used, or where the rate and duration of flow can be safely handled by a vegetated or earth spillway.

For dams with a drainage area of 20 acres or less, the principal spillway crest elevation shall not be less than 0.5 feet below the auxiliary spillway crest elevation. For dams with a drainage area over 20 acres, this difference shall not be less than 1.0 foot.

When design discharge of the principal spillway is considered in calculating peak outflow through the auxiliary spillway, the crest elevation of the inlet shall be such that the design discharge will be generated in the conduit before there is discharge through the auxiliary spillway.

Pipe conduits designed for pressure flow must have adequate anti-vortex devices. 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 auxiliary spillways. The diameter of the principal spillway pipe shall not be less than 6-inches. Pipe conduits used solely as a supply pipe through the dam for watering troughs and other appurtenances shall not be less than 1-1/4 inches in diameter.

If the pipe conduit diameter is 10 inches or greater, its design discharge may be considered when calculating the peak outflow rate through the auxiliary spillway.

Pipe conduits shall be ductile iron, welded steel, corrugated steel, corrugated aluminum, reinforced concrete (pre-cast or site-cast), or plastic. Pipe conduits through dams of less than 20 feet total height may also be cast iron or un-reinforced concrete.

Pipe conduits shall be designed and installed to withstand all external and internal loads without yielding, buckling, or cracking. Rigid pipe shall be designed for a positive projecting condition. Flexible pipe shall be designed for a maximum deflection of 5 percent. The modulus of elasticity for PVC pipe shall be assumed as one-third of the amount designated by the compound cell classification to account for long-term reduction in modulus of elasticity. Different reductions in modulus may be appropriate for other plastic pipe materials.

The minimum acceptable plastic pipe shall be as shown in Table 2.

The minimum thickness of corrugated metal pipe shall be as shown in Table 3.

Connections of flexible pipe to rigid pipe or other structures shall be designed to accommodate differential movements and stress concentrations.

All pipe conduits shall be designed and installed to be water tight by means of couplings, gaskets, caulking, waterstops, or welding. Joints shall be designed to remain watertight under all internal and external loading including pipe elongation due to foundation settlement.

Pipe conduits shall have a concrete cradle or bedding if needed to provide improved support for the pipe to reduce or limit structural loading on pipe to allowable levels.

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.

All steel pipe and couplings shall have protective coatings in areas that have traditionally experienced pipe corrosion, or in embankments with saturated soil resistively less than 4000 ohms-cm or soil pH less than 5. Protective coatings shall be asphalt, polymer over galvanizing, aluminized coating or coal tar enamel as appropriate for the pipe type. Plastic pipe that will be exposed to direct sunlight shall be ultraviolet-resistant and protected with a coating or shielding, or provisions provided for replacement as necessary

The pipe conduit shall have a minimum slope of 0.5 foot per 100 feet (after foundation settlement) to provide positive drainage.

Renewable Energy. Renewable energy systems shall meet applicable industry design standards and shall be in accordance with manufacturer's recommendations. Hydropower systems shall be operated and maintained in accordance with manufacturer's recommendations.

Cathodic Protection. 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.

Seepage control. Provide seepage control along a pipe conduit spillway if any of the following conditions exist:

1. The effective height of dam is greater than 15 feet.
2. The conduit is of smooth pipe larger than 8 inches in diameter.
3. The conduit is of corrugated pipe larger than 12 inches in diameter.

Control seepage along pipes extending through the embankment by use of a filter diaphragm, unless it is determined that anti-seep collars will adequately serve the purpose.

Filter diaphragm. The filter diaphragm shall function both as a filter for adjacent base soils and a drain for seepage that it intercepts. The filter diaphragm shall be designed according to National Engineering Handbook, Part 628 Dams, Chapter 45, Filter Diaphragms.

The filter diaphragm shall outlet at the embankment downstream toe using (1) a drain backfill envelope continuously along the pipe to where it exits the embankment or (2) a closed conduit. The drain fill envelope shall be protected from surface erosion.

Table 2 - Acceptable Plastic Pipe for use in Earth Dams [1/]

Type of plastic pipe	Nominal pipe size, inches	Maximum depth of fill over pipe, feet
Smooth Wall PVC Pipe [2/]		
SDR 26 [1/]	4 - 12	10
SDR 21 [1/]	4 - 12	13
SDR 17 [1/]	4 - 12	17
SDR 13.5 [1/]	4 - 12	20
Schedule 40 [1/]	4	15
Schedule 40 [1/]	6 - 12	10
Schedule 80 [1/]	4	20
Schedule 80 [1/]	6 - 12	15
Corrugated Smooth-Lined Polyethylene and PVC [3/]		
PVC, HDPE	4 - 18	15
PVC, HDPE	24 - 36	10

1/ Plastic pipe manufactured to conform to ASTM Specifications other than those listed may be used with the maximum fill limits shown provided the pipe meet or exceed the requirements of the listed pipes for materials, wall thickness, and joint water tightness. Pipe having a wall thickness different from the listed pipes may be used provided the calculated long term deflection for the designed fill height and installation conditions does not exceed 5 percent.

2/ Polyvinyl chloride pipe, PVC 1120 or PVC 1220, conforming to ATSM-D1785 or ATSM-D2241.

3/ Polyethylene, Type III, Class C, Category 4 or 5 conforming to ASTM D1248 and D3350 and AASHTO M252 or M294, Type S: PVC; ASTM F949.

Table 3 - Minimum Gage/Thickness for Corrugated Metal Pipe (2-2/3-in x ½-in corrugations)[1/] and Smooth Steel Pipe

Fill Height Over Pipe feet	Steel CMP [2/] Diameter in inches					Aluminum CMP [3/] Diameter in inches						Smooth Steel [4/] Diameter in inches		
	≤ 24	30	36	42	48	≤ 21	24	30	36	42	48	≤ 21	21-34	34-48
1 to < 15	16	16	14	12	10	16	16	14	14	12	10	0.125	0.188	0.250
15 to < 20	16	16	14	12	10	16	14	12	12	10	10	0.188	0.250	0.250
20 to ≤ 25 [5/]	16	14	12	10	10	16	12	10	--[6/]	--[6/]	--[6/]	0.250	0.312	0.375

1/ Pipe with 6-, 8-, and 10-inch diameters has 1-1/2 in x ¼-in corrugations.

2/ Pipe conforming to ASTM A760, A761, and A762.

3/ Riveted or helical fabrication. Pipe conforming to ASTM B745.

4/ Pipe conforming to ASTM A53.

5/ When fill height over pipe exceeds 25 feet, individually design the pipe using procedures in National Engineering Handbook (NEH) Part 636, Chapter 52, Structural Design of Flexible Conduits.

6/ Not Permitted

Anti-seep collars. When anti-seep collars are used in lieu of a filter diaphragm, they shall be installed around the pipe conduit or pond drain pipe within the normal saturated zone. When one collar is used, it will be placed at the centerline of dam. Additional collars will be equally spaced alternately between the fill centerline and the upstream end and downstream end of the conduit with a spacing not to exceed 14 times the maximum projection of the collar, measured perpendicular to the pipe, but not more than 25 feet. The minimum spacing shall be 10 feet. The anti-seep collar shall increase the seepage path by at least 15 percent along the pipe.

Anti-seep collars and their connections to the pipe shall be watertight. The collar material shall be compatible with pipe materials. Metal anti-seep collars and their connections to the pipe shall extend a minimum of 18 inches in all directions from the pipe. Reinforced concrete collars shall have a minimum thickness of 6 inches and shall extend a minimum of 2.0 feet in all directions from the pipe except when the pipe is bedded on rock. Concrete collars will not be used with corrugated metal pipe. On plastic pipes, use flexible collars of 30 mil or thicker plastic, PVC, or rubber sheeting attached with stainless steel clamps or waterproof tape and caulked to ensure water tightness.

The following formula may be used to calculate the number of collars.

$$\text{No. of collars} = \frac{\text{Length of Conduit Within Normal Saturation Zone}}{14 \times \text{Minimum Projection of Collar}} - 1$$

The length of conduit within normal saturation zone shall be taken along the pipe barrel from the upstream toe to the midpoint between the centerline of the dam and downstream slope of the dam at the pipe outlet.

Trash Guard. To prevent clogging of the conduit, an appropriate trash guard shall be installed at the inlet or riser unless the watershed does not contain trash or debris that could clog the conduit.

Safety. For safety, all vertical drop inlets will be constructed to prevent accidental injury to livestock and humans. This may be accomplished by using a horizontal antivortex baffle, trash rack, or guardrail.

Other outlets. Provide a pipe with a suitable valve to drain the pool area if needed for proper pond management or if required by state or local law, rules, or regulations. The principal spillway conduit may be used as a pond drain if it is located where it can perform this function.

Antivortex devices. Closed conduit spillways designed for pressure flow must have adequate antivortex devices. Antivortex devices shall be designed in accordance with ARS-NC-33, Hydraulics of Closed Conduit Spillways, Part XIV.

Hood Inlet. A hood inlet may be used when installed in the dam abutment with any size of pipe barrel. The section of pipe on which the hood is installed must be at least 12 feet long and compatible with the pipe material used. The hood shall be on top of the pipe and project three-fourths of the diameter of the pipe. The vertical distance between the invert of the pipe and control section of the auxiliary spillway shall be no less than 1.8 times the diameter of the pipe.

Siphon Spillway. A siphon pipe spillway is a closed conduit system formed in the shape of an inverted "V", positioned so that the invert of the bend (CREST) of the upper passageway is at normal water surface elevation. The initial discharge of the siphon, as the reservoir level rises above normal, is similar to flow over a weir. Siphoning action begins after the air in the siphon pipe has been exhausted, usually at a depth over the crest equal to about ⅓ the pipe diameter. An air vent is provided to break the siphoning action when the reservoir water surface is drawn down to normal pool elevation. Because of the negative pressure that exists within the siphon when flowing full, the pipe joints must be airtight and the pipe must be sufficiently rigid to withstand the collapsing forces. Welded steel or plastic pipe with glued joints should be used. Pipe joints using rubber gasketed joints may not be sufficiently airtight to function properly in a siphon system.

The following minimum criteria shall apply to siphon spillway systems, in addition to other applicable criteria listed elsewhere in this standard. The total drop of the siphon will be limited to a maximum of 20 feet. A 2-inch diameter vent pipe will be used on siphon pipes up through 8 inches in diameter and a 4-inch diameter vent pipe will be used for siphons

10 inches through 16 inches in diameters. Pipe used for siphons shall be smooth steel or smooth plastic pipe with a minimum wall thickness equivalent to Schedule 40 or SDR 26. The siphon will have an elbow on the downstream end or will be submerged during flow to completely seal the end of the pipe. If an elbow is used, it will have a ¼ inch to ⅜ inch weep hole drilled in the bottom of the elbow to ensure that water does not freeze in the pipe and possibly prevent the siphon from functioning. The pipe will be buried through the dam and the downstream section of the pipe will be buried or will have adequate anchors and restraints to prevent thrust forces and vibrations from breaking the pipe. The vent pipe will be protected by a perforated pipe sleeve to prevent floating debris from clogging the vent. The total area of the perforations in the vent pipe sleeve should equal at least four times the vent pipe area. The inlet to the siphon shall have a perforated section which will exclude trash, turtles, fish, etc. The perforated inlet section must have an open area equivalent to at least two times the cross sectional area of the siphon pipe.

Auxiliary spillways. Auxiliary spillways convey large flood flows safely past earth embankments. An auxiliary 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 auxiliary spillway:

1. a conduit with a cross-sectional area of 3 ft^2 or more,
2. an inlet that will not clog, and
3. an elbow designed to facilitate the passage of trash.

The minimum capacity of a natural or constructed auxiliary 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 auxiliary 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 auxiliary spillway or from the elevation that would be attained if the entire design storm were impounded, whichever is lower. Auxiliary spillways shall provide for passing the design flow at a safe velocity to a point downstream where the dam will not be endangered.

Constructed auxiliary 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 or in-situ rock. 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 feet, the auxiliary spillway shall have a bottom width of not less than 10 feet.

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 auxiliary spillway shall fall within the range established by discharge requirements and permissible velocities. Auxiliary spillway design shall be in accordance with National Engineering Handbook, Part 628 Dams, Chapter 50, Earth Spillway Designs.

Structural auxiliary spillways. If chutes or drops are used for principal spillways or auxiliary spillways, they shall be designed according to the principles set forth in the National Engineering Handbook, Part 650, Engineering Field Handbook 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.

Table 4 - Minimum Spillway Capacity

			Minimum Design Storm Frequency [2/]		
Drainage Area	**Effective Height of Dam[1/]**	**Storage**	**Principal spillway**	**Auxiliary Spillway**	**Minimum duration**
acre	feet	acre feet	year	year	hour
≤ 20	≤ 20	< 50	2	10	24
≤ 20	> 20	< 50	2	25	24
> 20 to ≤ 100	≤ 20	< 50	2	25	24
> 20 to ≤ 100	> 20	< 50	5	50	24
> 100 to < 250	≤ 20	< 50	5	25	24
> 100 to < 250	> 20	< 50	5	50	24
≥ 250	≤ 20	< 50	10	25	24
All Others			10	50	24

1/ As defined under "Conditions"
2/ Select rainfall distribution based on climatological region

CRITERIA FOR EXCAVATED PONDS

Site Investigation. Site suitability and design shall be based on adequate investigations and surveys as described in the National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 11, Ponds and Reservoirs. The suitability of the soils for the excavated pond shall be part of the design.

Runoff. If needed, provide for a pipe and auxiliary spillway that will meet the capacity requirements of Table 4. Consider runoff flow patterns when locating the excavated pond and placing the spoil.

Side slopes. Side slopes of excavated ponds shall be stable and shall not be steeper than one horizontal to one vertical (1:1). If livestock will access water directly from the pond, provide a watering ramp of ample width. The ramp shall extend to a depth of 3 feet below the anticipated low water elevation at a slope no steeper than four horizontal to one vertical (4:1).

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. Place the material excavated from the pond so that its weight will not endanger the stability of the pond side slopes and 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 feet, 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 feet from the edge of the pond.
3. Shaped to a designed form that blends visually with the landscape.
4. Used for low embankment construction and leveling of surrounding landscape.
5. Hauled away from the site.

Additional Criteria for Providing Livestock Water

The required storage shall be calculated using 1.5 times the sum of the following:

1. The specified minimum gallons per animal per day as stated in Florida NRCS conservation practice standard Watering Facility, Code 614 for the estimated number of days.
2. The net evaporation loss for the design days of storage.
3. Seepage loss based on the best available data.

Additional Criteria for Fish and Wildlife

Design the reservoir for a maximum amount of water in excess of three feet in depth. Management of ponds for fish production shall be in accordance with Florida NRCS conservation practice standard Fish Pond Management, Code 399.

Additional Criteria for Recreation

The volume of water should be sufficient to exceed evaporation and seepage losses and maintain a desirable water level. The water must be free of pollution, especially where it is to be used for swimming.

Additional Criteria for Fire Control

Fire control shall be incorporated into the structure design by incorporating an underground piping system which connects the reservoir to a dry hydrant. Minimum water storage, location of intake pipe, etc., shall meet the requirement of Florida NRCS conservation practice standard Dry Hydrant, Code 432. The pump shall be of sufficient capacity and hoses shall be of sufficient length to reach the structures to be protected.

Additional Criteria for Irrigation

The capacity of the pond shall be adequate to meet the irrigation requirement of the planned crop(s). The required capacity shall be based on the irrigation requirements of the crops to be irrigated, the effective rainfall expected during the growing season, the application efficiency of the irrigation method used, the losses due to evaporation and seepage, and the expected inflow into the pond.

Provide for additional storage for the estimated volume of sediment that will be deposited during the life of the structure.

Additional Criteria for Crop and Orchard Spraying

The volume of water in the pond shall exceed the anticipated amount of water needed for spray applications and must be available when needed.

Suitable means should be provided to convey water from the pond to the spray tank. To prevent contamination of the water supply from the spray tank into which chemicals are injected, the design must incorporate backflow prevention equipment as required by Chapters 487.064 F.A.C. (pesticides) and 567.087 F.A.C. (fertilizers).

Chemigation shall be applied in conformance with NRCS Florida conservation practice standards Nutrient Management, Code 590 and Pest Management, Code 595.

Additional Criteria for Maintaining and Improving Water Quality

Water quality problems include sediment, fertilizers, pesticides, litter, oils, and solvents. A reduction of peak flows to a receiving stream or water body will slow water flow and thereby carry less suspended solids. Ponds designed for water quality improvement of downstream water bodies shall be designed so that the first flush of a storm event will be retained within the pond and later storm water flow will be the first flows released through the principal spillway. In addition, the pond will be designed with a permanent pool deep enough to hold water all year and with shallow areas (littoral zones) with dense vegetation. These practices will increase sedimentation of suspended solids, reduce re-suspension of sediments by wave action, remove floating debris from storm water, and aid in mosquito control.

CONSIDERATIONS

For construction and maintenance issues, consider using embankment top width of at least 8 feet.

Visual resource design. Carefully consider the visual design of ponds 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.

Fish and Wildlife. Project location, construction, and potential breach should minimize the impacts to existing fish and wildlife habitat, especially federal and state protected species. Consider ways to mitigate impacts if possible.

When feasible, structure should be retained, such as trees in the upper reaches of the pond and stumps in the pool area. Upper reaches of the pond can be shaped to provide shallow areas and wetland habitat.

If fish are to be stocked, consider criteria and guidance in Florida NRCS conservation practice standard Fishpond Management, Code 399.

Vegetation. Consider placement and selection of vegetation to improve fish and wildlife habitat and species diversity.

Water Quantity. Consider effects upon components of the water budget, especially:

- Effects on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge.
- Variability of effects caused by seasonal or climatic changes.
- Effects on downstream flows and impacts to environment such as wetlands, aquifers, and; social and economic impacts to downstream uses or users.
- Potential for multiple purposes.

Water Quality

- Consider effects on erosion and the movement of sediment, pathogens, and soluble and sediment-attached substances that are carried by runoff.
- Effects on the visual quality of onsite and downstream water resources.
- Short-term and construction-related effects of this practice on the quality of downstream water courses.
- Effects of water level control on the temperatures of downstream water to prevent undesired effects on aquatic and wildlife communities.
- Effects on wetlands and water-related wildlife habitats.
- Effects of water levels on soil nutrient processes such as plant nitrogen use or denitrification.
- Effects of soil water level control on the salinity of soils, soil water, or downstream water.
- Potential for earth moving to uncover or redistribute toxic materials such as saline soils.

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.

The plans and specifications shall include as a minimum, but not limited to, the following:

- Location and plan view of pond.
- Profiles and cross-sections of the embankment, spillway(s), cutoff trench, and borrow areas for embankment ponds.
- Typical cross-sections and elevations of excavated ponds.
- Location of geologic soil boring and plot of USCS classification.
- Size and type of conduits and appurtenances.
- Foundation preparation and compaction requirements.
- Details of seepage control.
- Embankment earthfill zoning.
- Requirements of diverting water, dewatering site and waste disposal.
- Vegetative requirements.

OPERATION AND MAINTENANCE

An operation and maintenance (O&M) plan will be prepared for each pond site. The O&M plan shall be provided to and reviewed with the landowner. All ponds must be adequately maintained through their expected life. Special considerations shall be given for maintenance needs during the planning, design, and construction of the pond.

The minimum requirements to be addressed in the O&M plan include, but are not limited to, the following items:

- The pond should be inspected periodically and especially after heavy rains to determine whether it is functioning properly or if repairs are needed.
- Appurtenances such as trash racks, outlet structures, and valves shall be kept free of trash and replaced when needed.
- Rills on the slopes of the dam and eroded areas in the earth spillway shall be filled with suitable material, compacted, seeded and fertilized as needed.
- If seepage through or under the dam occurs, proper corrective measures shall be taken immediately.
- The vegetative cover on the dam and earth spillway shall be maintained by mowing and fertilizing or burning when needed. Trees can cause leaks and safety hazards and should not be permitted on the embankment or in the auxiliary spillway.
- When needed, fencing and watering troughs will be provided to protect the pond and vegetation from livestock.
- Erosion at the principal spillway outlet shall be repaired and if necessary protected to prevent additional erosion.

REFERENCES

ARS-NC-33, Hydraulics of Closed Conduit Spillways, Part XIV

AASHTO Standards
M252, M294
ASTM Standards
A53, A760, A761, A762, B745, D1248, D1785,D2244, D3350, F949
Chapters 487.064 F.A.C. (pesticides) and 567.087 F.A.C. (fertilizers)
Florida NRCS Conservation Practice Standards
Critical Area Planting, Code 342
Dry Hydrant, Code 432
Fish Pond Management, Code 399
Nutrient Management, Code 590
Pest Management, Code 595
Watering Facility, Code 614
General Manual
Title 420-Part 401
Title 450-Part 401
Title 190-Parts 410.22 and 410.26
National Cultural Resources Handbook
National Engineering Handbook, Part 628 Dams, Chapter 45, Filter Diaphragms
National Engineering Handbook, Part 628 Dams, Chapter 50, Earth Spillway Designs
National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 11
National Engineering Handbook, Section 5
National Engineering Handbook, Section 11
National Engineering Handbook, Section 14
National Engineering Manual (NEM) Part 520.21, 520.28, and 531
National Environmental Compliance Handbook
National Food Security Act Manual
National Planning Procedures Handbook
Florida Supplements to Parts 600.1 and 600.6
NRCS Technical Release 56 and 69