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 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.

PURPOSE

To provide water for livestock, fish and wildlife, recreation, fire control, develop renewable energy systems, and other related uses, and to maintain or improve water quality.

CONDITIONS WHERE PRACTICE APPLIES

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).

General Criteria Applicable to All Ponds

All Federal, State and local requirements shall be addressed in the design.

A protective cover of vegetation shall be established on all exposed areas of embankments, spillways and borrow areas as climatic conditions allow, according to the guidelines in conservation practice standard 342, Critical Area Planting.

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. A drainage area to surface area ratio of 10:1 will provide a reliable water supply to replenish evaporation and seepage losses. 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. Ponds for stock water or scale fish production shall provide a minimum water depth of 6 feet over 20 percent of the water surface area at spillway level for embankment ponds and 25 percent of the surface area for pit or dugout ponds. For catfish ponds, a depth of 4 to 5 feet is satisfactory. The majority of the water area should have a depth greater than 2.0 feet. Deepening of the pond edge may be desirable to control growth of undesirable vegetation, to improve fish habitat, or to supply embankment borrow material.

Side slope of the deepened area should be between 3:1 and 1.5:1 with the finished bank 3 inches or more above crest of principal spillway. Woody vegetation and scattered trees in the pool area may be left standing in small tributary inlets and other selected locations to enhance the fishery habitat but should not exceed 10 percent of the pool area.

CRITERIA

Design Criteria for Embankment Ponds

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 for site suitability. Soil materials shall be classified 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 not be 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 insure 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. For dams less than 20 ft 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	Top width
(feet)	*(feet)*
Less than 10	6
10 – 14.9	8
15 – 19.9	10
20 – 24.9	12
25 – 34.9	14
35 or more	15

Side slopes. The combined upstream and downstream side slopes of the settled embankments shall not be 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, 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 and 69).

Freeboard. 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.

Settlement. The design height of the dam shall be increased by the amount needed to insure that after settlement the height of the dam equals or exceeds the design height. This increase shall not be less than 5 percent, except where detailed soil testing and laboratory analyses show that a lesser amount is adequate. Without analysis, a minimum of 5 percent shall be added to fill heights constructed with compaction equipment or having each layer covered by the wheel track of construction equipment during the fill placement process. Without compaction or wheel track coverage, 10 percent added fill height shall be required.

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.

For dams with a drainage area of 20 acres or less, the pipe crest elevation shall not be less than 0.5 ft below the crest of the emergency spillway. For dams with a drainage area over 20 acres, this difference shall not be less than 1.0 ft.

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. Pipe conduits designed for pressure flow must have adequate anti-vortex devices.

The capacity of the pipe conduit shall be adequate to discharge long-duration, continuous, or frequent flows without flow through the emergency spillways. The diameter of the pipe shall not be 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.

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 not be 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.

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 unreinforced concrete. 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.

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.

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 less	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 gage for corrugated metal pipe [2-2/3-in x ½-in corrugations][1/]

Fill Height (ft)	Minimum gauge for steel pipe with diameter (in) of ___					
	21 and less	24	30	36	42	48
1 - 15	16	16	16	14	12	10
15 - 20	16	16	16	14	12	10
20 - 25	16	16	14	12	10	10

Fill Height (ft)	Minimum thickness (in) of aluminum pipe[2/] with diameter (in) of ___			
	21 and less	24	30	36
1 - 15	0.06	0.06	0.075	0.075
15 - 20	0.06	0.075	0.105	0.105
20 - 25	0.06	0.105	0.105	---- [3/]

1/ Pipe with 6-, 8-, and 10-in diameters has 1-1/2 in x ¼-in corrugations.
2/ Riveted or helical fabrication.
3/ Not permitted.

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. 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 inches in diameter.

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

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.

Drainage Diaphragm. The drainage diaphragm shall function both as a filter for adjacent base soils and a drain for seepage that it intercepts. 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 drainage diaphragm 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 inches 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.

Anti-seep Collars. 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 but not more than 25 feet. The minimum spacing shall be 10 feet. Collar material shall be compatible

with pipe materials. The antiseep collar(s) shall increase by 15% the seepage path along the pipe.

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.

Other Outlets. 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. Concrete for risers, riser base, and anti-seep collars shall consist of a mix containing a minimum of 6 bags per cubic yard and a maximum net water content of 7 gallons per bag of cement.

Calculate riser and pipe capacities in accordance with procedures set forth in Chapters 3 and 6, Engineering Field Manual for Conservation Practices, 1984 (Rev.). Calculations shall ensure that full pipe flow occurs when the water surface is at the emergency spillway crest elevation. Weir flow shall go directly to pipe flow without experiencing orifice flow at the riser crest or orifice flow at the barrel entrance.

Riser floatation shall be checked and a factor of safety of 1.5 provided against uplift. The weight of submerged soil vertically above the riser base may be used to calculate upleft balance of forces.

Pipe conduit inlets may be drop inlet spillway, hooded inlet, canopy inlet, siphons, or tee inlet to satisfactorily discharge water from the impoundment. Conduit grades shall be greater than 1 percent but not steeper than 25 percent. For multiple conduit installations, the minimum spacing between the sides of conduits shall be the greater of 2 feet or 2 times the conduit diameter but need not be greater than 5 feet.

Auxiliary spillways. Auxiliary spillways convey large flood flows safely past earth embankments and have historically been referred to as “Emergency Spillways”.

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: 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 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.

Table 4:Minimum auxiliary spillway capacity

			Minimum design storm[2]	
Drainage area (Ac.)	Effective height of dam[1] (Ft.)	Storage (Ac-Ft)	Frequency (Years)	Minimum duration (Hours)
20 or less	20 or less	< than 50	10	24
20 or less	> than 20	< than 50	25	24
> than 20		< than 50	25	24
All others			50	24

1. As defined under “Conditions where Practice Applies”.

2. Select rain distribution based on climatological region.

Discharge and detention storage reductions may be used for ponds having a 10-inch diameter or larger conduit with 1) computer flood routing procedures or 2) shortcut flood routing method from Chapter 11, Engineering Field Manual (EFM) for Conservation Practices. The minimum emergency spillway capacity for ponds without conduit and ponds with conduit less than 10 inches in diameter shall be in accordance with procedures in Chapter 11, EFM or with the following Table 5.

Table 5: Minimum storage and spillway capacity. 1/

Peak 2/ Runoff	Type Spillway	Floodwater Storage	Bottom Width 3/ Hp = 1.0 V = 3.5 fps	Hp = 1.1 V = 4.0 fps	Hp = 1.2 V = 4.5 fps	Hp = 1.3 V = 5.0 fps
0-25 cfs	Veg.	0	16	12	10	10
25-50 cfs	Veg.	0	32	24	18	16
50-75 cfs	Veg.	0	56	42	34	28
75-100 cfs	Veg. & conduit	1' stage	60	44	36	30
100-150 cfs	Veg. & conduit	1' stage	98	74	60	50
150-200 cfs	Veg. & conduit	1' stage	--	92	72	60
200+	Floodrouting procedures required for all pipe conduit and vegetative spillways.					

1/ Applicable to ponds having less than 50 AF total storage to the earth spillway crest. Ponds having more than 20 acres drainage area shall have a conduit spillway.

2/ Peak runoff computed in accordance with EFM Chapter 2 procedures and Table 6 requirements. A 15 percent peak Q reduction has been included in pond with a pipe spillway.

3/ For stable vegetative spillway conditions only and exit slopes between 2 percent and 7 percent. When an erosive soil condition, exit channel slope drop off, or poor cover condition exists in the vegetative spillway outlet, a conduit and temporary detention storage will be provided for the entire applicable storm runoff.

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 emergency 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 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. The emergency spillway control section shall have a level grade for a minimum distance of 10 feet, 25 feet for drainage areas exceeding 50 acres.

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 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 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.

Criteria for Excavated Ponds

Runoff. Provisions shall be made for a pipe and auxiliary spillway, if needed, that will meet the capacity requirements of Table 4. Runoff flow patterns shall be considered when locating the pit 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. 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.

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 construction and leveling surrounding landscape

5. Hauled away.

Pond Clean-Out

Reduced water volume capacity of existing ponds, excavated or embankment types, having a surface area of 0.2 acres or less, shall be restored by removal of accumulated sediment to the extent practical. During the sediment removal process, steps shall be taken to maintain stable side slopes. All excavated sediment shall be placed in accordance with the criteria for excavated material section of this standard, unless otherwise approved by the local or other appropriate engineer. After clean-out, the pond shall be in compliance with the requirements of this standard.

Additionally, for embankment ponds, any work determined to be necessary by the appropriate engineer shall be performed to meet the requirements of this standard. This work may include addressing principal and/or auxiliary spillways and levee slopes.

CONSIDERATIONS

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.

Vegetation. All exposed areas of the embankment, earth spillway, and borrow area(s) shall be protected with vegetation. Vegetation will be applied in accordance with Conservation Practice Standard 342, Critical Area Planting. Fencing shall be provided for proper management of livestock grazing use.

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

Fish and Wildlife**.** Project location and construction should minimize the impacts to existing fish and wildlife habitat.

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

- Effects 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 the 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

- 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.

OPERATION AND MAINTENANCE

An operation and maintenance plan shall be developed and reviewed with the landowner or individual responsible for operation and maintenance.

REFERENCES

Technical Release 56, “A guide for Design and Layout of Vegetative Wave Protection for Earth Dam Embankments”

Technical Release 69, “Riprap for Slope Protection Against Wave Action”

Engineering Field Manual

Engineering Field Handbook, Part 650

National Engineering Handbook:
Section 5: Hydraulics
Section 11: Drop Spillways
Section 14: Chute Spillways

NRCS Conservation Practice Standard:
342 – Critical Area Planting
382 – Fence

Natural Resources Conservation Service
Construction Specifications

POND

1. SCOPE

Work shall consist of constructing the pond and include all clearing, excavation, fill placement, installation for pipe spillway, drains, and other features to lines, grades, and elevations as specified on the drawings and staked in the field. The location of the embankment shall be as shown on furnished drawings or as staked in the field.

2. SITE PREPARATION

The pool area shall be cleared to the extent desired and as shown on the plans. Trees shall be cut as flush with the ground as practical and burned, buried at designated locations, or anchored to the pond bottom.

Clearing of the staked foundation, spillway, and borrow area(s) shall include removal of logs, stumps, roots, sod, and other trash that would prevent a good bond between the foundation and fill material.

3. EXCAVATION

Topsoil from foundation, emergency spillway, and borrow area(s) shall be stockpiled for spreading on the completed dam and spillway as needed to help establish vegetation.

Existing stream channels crossing the foundation area shall be deepened and widened as necessary to remove all stones, gravel, sand, sediment, stumps, roots, organic matter and other objectionable material and to accommodate compaction equipment. Side slopes of the channels and other foundation surfaces shall be left no steeper than 1:1. The foundation area shall be thoroughly scarified before placement of the fill material. Moisture shall be added and soil compacted as necessary so that the first layer of fill material will be bonded to the foundation.

The cutoff trench shall be excavated to the depths, bottom width and side slopes shown on the plans. Material removed from the cutoff trench which is free of boulders, roots, organic matter and other objectionable material may be placed in the downstream one-third of the fill. All excess water shall be removed from the trench and the foundation area when fill material is being placed.

Excavated ponds shall be constructed to conform to the shapes, lines and grades shown on the drawings or as staked in the field. 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.

4. FILL PLACEMENT

The material placed in the fill shall be free of all sod, roots, frozen soil, stones over six inches in diameter, and other objectionable material.

Placing and spreading of the fill material shall begin at the lowest point of the foundation and brought up in approximately horizontal layers not exceeding eight inches thick. These layers shall be reasonably uniform in thickness and shall extend over the entire area of the fill. The earth hauling or compacting equipment shall be operated over each layer so that reasonable compaction of the fill material will be obtained. A minimum of 5 percent shall be added to fill heights constructed with compaction equipment or having each layer covered by the wheel track of construction equipment during the fill placement process. Without compaction

or wheel track coverage, 10 percent added fill height shall be required.

The distribution and gradation of materials throughout the fill 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 material of varying texture and gradation, the more impervious material shall be placed in the upstream and center portions of the fill. Construction of the fill shall be undertaken only at such times when the moisture content of the fill material will permit a satisfactory degree of compaction and bonding or when moisture can be satisfactorily added and incorporated in dry soil material as it is being placed. The embankment, emergency spillway, and borrow areas shall be finished to a smoothness so the surface can be readily traveled upon by farm type equipment.

Final construction shall be considered satisfactory when:

Excavation elevations are within $\pm$ 0.2 foot of design grade or modified grade. Excavation slopes may be flatter than designed but not steeper.

Fill elevations are not less than design height plus settlement. Fill above the required settlement elevation will require extra fill material to maintain side slopes within design limits.

Fill slopes may be flatter than designed but may not be steeper and shall be uniform throughout their length. Allowance for anticipated settlement may be considered when calculating side slopes for construction check.

Selected backfill material shall be placed around structures, pipe conduits, and drainfill or antiseep collars at about the same rate on all sides to prevent damage from unequal loading. Fill adjacent (within one foot) to these components shall be compacted to a density equivalent to that of the surrounding fill by hand tamping or by using manually directed power tampers or plate vibrators. Care shall be taken during backfill around pipe conduit to prevent uplift of pipe. Preparation of a shaped bed with one-inch of moist, loose soil supporting about one-third of pipe circumference will help ensure the pipe to soil contact.

Drainfill material placed next to the pipe conduit or other structural features shall be kept free of contaminating fill materials by either placing in a cleanly excavated trench or by keeping the drainfill at least one foot above the adjacent earthfill.

5. CONSTRUCTION MATERIALS

Pipe conduit shall conform to appropriate ASTM and federal specifications. Antiseep collars shall be of materials compatible with that of the pipe and shall be installed so that they are water tight. The pipe shall be installed according to the manufacturer's instructions and be firmly and uniformly bedded throughout its length to the specified line and grade shown on the drawings.

Used welded steel pipe shall of good quality, free of pits, dents, or other items that might reduce the durability, capacity, or planned life of the structural measure.

Spillway conduit installation shall be considered satisfactory when the conduit is within $\pm$ 0.2 foot of design grade, has a positive slope toward the outlet, has the required appurtenances (bands, antiseep collars, risers, cathodic protection, etc.) attached, has all surface coating damage repaired, and has adequate backfill and compaction applied.

Concrete used for antiseep collars, riser base, riser crest perimeter protection, or pipe inlet protection shall consist of a mix containing a minimum of six bags per cubic yard and a maximum net water content of seven gallons per bag of cement. A minimum 24 hours curing time shall be allowed before fill material is placed against the concrete. Concrete shall be placed and finished in an acceptable manner. Reinforcing steel shall be placed as indicated on the plans and shall be held securely in place during concrete placement. Subgrades and forms shall be installed to line and grade,

and the forms shall be mortartight and unyielding as the concrete is placed.

Filter and drainage diaphragm materials shall have a gradation equal to the fine concrete aggregate gradation listed in the Mississippi State Highway Department, "Standard Specifications for Road and Bridge Construction." The drain shall have a minimum 2-foot thickness of uncontaminated filter material.

6. PROTECTION

A protective cover of vegetation shall be established over all the exposed surfaces of the embankment, spillway, excavation disposal, and borrow area(s). Temporary vegetation may be used until permanent vegetation can be established. The embankment and spillway shall be fenced to protect vegetation from livestock.

Surface drainage shall be provided around excavation disposal areas and other areas for non-erosive entry of runoff into the pond or for non-erosive disposal of runoff away from the pond embankment.

7. MEASUREMENT

Excavation volumes from core trench, foundation stripping, stream channel cleanout, etc., shall be calculated from design sections, surveyed cross sections, or other acceptable methods. Fill material in the embankment shall be calculated to the neat lines of the design section and added to the excavation volume for total borrow volume needed. No additional volume will be added for settlement. Calculations will be to the nearest 1.0 cubic yard.

Measurement of conduit and conduit riser shall be the purchased length. Each antiseep collar, connecting band, riser fabrication, and anti-vortex baffle will be individually itemized and accounted for.

Concrete for the riser base, antiseep collar(s), and riser crest protection shall be measured to the neat lines of the design dimensions. Reinforcement steel, wire mesh, and any forming required will be included in payment for the concrete. Concrete will be calculated to the nearest 0.1 cubic yard.

Measurement for vegetation plantings area will cover all disturbed areas (embankment, emergency spillway, borrow area, etc). Areas will be measured to the nearest 0.1 acre.

8. VEGETATION DETAILS

Seeding Date: _____ _____ _____
Seed Type: _____ _____ _____
Seed Rate: _____ _____ _____
Soil Preparation: _____
_____
Fertilizer: _____Rate _____#/acre
Lime: _____Rate _____#/acre
Mulch: _____Rate _____#/acre
Lime: _____Rate _____#/acre
Other: _____: _____

9. CONSTRUCTION DETAILS

_____

_____

_____