SOIL CONSERVATION SERVICE

WEST VIRGINIA

ENGINEERING STANDARD

POND (No.)

Definition

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

Ponds constructed by the first of these methods are referred to hereafter as "Embankment Ponds" and those constructed by the latter method as "Excavated Ponds." Ponds resulting from both excavation and embankment are classified as "Embankment Ponds" where the depth of water impounded against the embankment at emergency spillway elevation is 3 feet or more.

Scope

This standard establishes the minimum acceptable quality for the design and construction of ponds located in predominantly rural or agricultural areas when:

1. Failure of the structure 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 does not exceed 3,000 where the storage is defined as the original volume, in acre-feet, in the reservoir at the elevation of the crest of the emergency spillway and the effective height of the dam is defined as the difference in elevation, in feet, between the emergency spillway crest and the lowest point in the cross section along the centerline of the pond. If there is no emergency spillway, the top of dam elevation is the upper limit.

3. The effective height of the dam does not exceed 35 feet.

Purpose

Ponds are constructed to provide water for livestock, fish, wildlife, recreation, fire control, crop and orchard spraying, and other related uses, and to maintain or improve water quality.

Condition Where Practice Applies

Site Conditions

Site conditions shall be such that the rate of runoff that can be expected to occur for the emergency spillway design storm can be safely passed through (1) a natural or constructed emergency spillway, or (2) a combination of a principal 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 normal sedimentation will not shorten the planned effective life of the structure. The effective life of the structure will vary with landowners intended use; however, it will normally not be less than 20 years.

The drainage area shall be at least 3 acres for each acre-foot of water to be stored when the soils within the drainage area are classified in hydrologic soil groups C or D. For drainage areas with soils in hydrologic soil groups A or B, the drainage area shall be at least 4 acres for each acre-foot of water stored. These minimum drainage areas may be decreased only when there is some other dependable source contributing water to the pond. The water quality shall be suitable for its intended use.

Reservoir Area

The topography and soils of the site shall permit storage of water at a depth and volume which will ensure a dependable supply, considering beneficial use, sedimentation, season of use, and evaporation and seepage losses.

Where 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.

Federal, State, and Local Laws

All federal, state, and local laws, rules, and regulations governing activities along streams, pollution abatement, health, and safety shall be adhered to. The owner or operator shall be responsible for securing all required permits or approvals and for performing in accordance with such laws and regulations. SCS employees are not to assume responsibility for procuring these permits, rights, or approvals or for enforcing laws and regulations. They may provide the landowner or operator with technical information needed to obtain the required rights, or approvals to construct, operate, and maintain the practice.

Permits may be required from the following agencies:

1. U.S. Army Corps of Engineers
2. West Virginia Department of Natural Resources (Erosion and Sediment Control Plan)
3. West Virginia Public Lands Corporation

Embankments for nonagricultural use that will be 6 feet or more in height, measured from the stream bottom at the downstream toe and that will or can impound 50 acre-feet or more of water will require that the owner submit an application for a certificate of approval. Embankments that will be 25 feet or more in height and that will or can impound 15 acre-feet or more of water will require that the owner submit an application for a certificate of approval from the state.

Farm ponds constructed and used primarily for agricultural purposes including, but not limited to, livestock watering systems, irrigation, retention of animal wastes, or fish culture, and having no potential for loss of human life are exempt from the certificate of approval.

Design Criteria

Site Investigation, Earth Embankment, Foundation, and Foundation Cutoff

Planning, design, and construction shall be in accordance with provisions contained in WV Engineering Standard 377, Earth Embankment.

Special measures, such as berms, rock riprap, sand-gravel, soil cement, or special vegetation shall be provided as necessary to protect the slopes of the dam, and shall be designed according to criteria contained in WV Engineering Standard 580, Streambank and Shoreline Protection.

Principal Spillways

A pipe conduit with related 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 vegetated earth or rock emergency spillway. For ponds with effective heights of 15 ft. or less, pipe conduit spillways may be located on fill through the embankment in a configuration that allows the shortest conduit length. Principal spillways other than pipe conduits must be approved by the State Conservation Engineer.

The approving employee may waive the requirement for a pipe spillway in ponds having an effective height of 15 feet or less located in areas where there is no spring flow into the reservoir at any time, and the drainage area is equal to or less than the following size:

Land Resource Area (Technical Guide, Section I-B)	Drainage Area
125, 126, and 127	6 Ac.
128, and 147	15 Ac.

The approving employee may also waive the requirements for a principal spillway on excavated ponds with drainage areas less than 10 acres, provided an emergency spillway is installed or any needed embankment is constructed with slopes no steeper than 3 horizontal to 1 vertical upstream and 5 horizontal to 1 vertical downstream.

A. Conduit

The capacity of the pipe conduit shall be adequate to discharge long duration, continuous, or frequent flows without flow through the emergency spillway. The minimum size shall be in accordance with Table 1. Where the pipe spillway is 10 inches or greater and has an entrance or riser equipped with an antivortex device and trash rack, the design discharge may be considered in designing the emergency spillway. Pipe spillways requiring design on a storm frequency basis will be routed in accordance with the procedures contained in the Engineering Field Manual for ponds with drainage areas less than 500 ac. and in Technical Release No. 20 for ponds with drainage areas exceeding 500 ac., however, the pipe size shall be no smaller than the minimum diameter shown.

Table 1
Principal Spillway Criteria

Drainage Area (Acres)	Effective 1/ Height (Ft.)	Pipe Size (In.) or Minimum Design Storm
Less than 10	35 or less	4"
10 to 20	35 or less	6"
20 to 30	35 or less	10"
30 to 50	35 or less	12"
50 to 75	15 or less	15" 2/
	More than 15 up to 35	5 year-24 hr. (Min. 12")
75 to 100	15 or less	18" 2/
	More than 15 up to 35	5 year-24 hr. (Min. 15")
100 to 150	15 or less	24" 3/
	More than 15 up to 35	5 year-24 hr. (Min. 18")
150 to 200	15 or less	30" 3/
	More than 15 up to 35	5 year-24 hr. (Min. 24")
200 or more	15 or less	5 year-24 hr. (Min. 24")
	More than 15 up to 20	10 year-24 hr. (Min. 24")
	More than 20 up to 35	25 year-24 hr. (Min. 24")

1/ Effective height is the difference in elevation (feet) between the low point along the centerline of the pond and the crest of the emergency spillway.

2/ Minimum pipe diameter may be reduced by as much as 3" from the diameter shown, provided a 5 yr-24 hr design storm is routed through the structure and the smaller diameter pipe is found to be adequate.

3/ Minimum pipe diameter may be reduced by as much as 6" from the diameter shown, provided a 5 yr-24 hr design storm is routed through the structure and the smaller diameter pipe is found to be adequate.

United States Department of Agriculture
Soil Conservation Service
75 High St. Rm 301
Morgantown, WV 26505

June 12, 1991

WEST VIRGINIA BULLETIN NO. WV210-1-13

SUBJECT: Guidance for using sidehill type principal spillways

Purpose: To give instruction on how sidehill principal spillways may be installed.

Expiration Date: This Bulletin Expires When The Contents Have Been Noted and the information filed appropriately.

Filing Instructions: File a copy of this bulletin following page 378-3 of standard 378, Pond.

Field reviews of principal spillway installations have shown that sidehill type principal spillways are being installed improperly.

The purpose of a sidehill inlet is to allow the pipe to be installed on an excavated surface rather than a fill surface. It is not to allow a short pipe to be installed high up on the slope, giving a very short pipe length. Several pipes have been installed with the outlet far up on the abutment. This is causing the discharge to flow down the abutment face and resulting in erosion and instability of the abutment as an outlet channel is cut into the slope.

The following sentence will be added to the first paragraph under Principal Spillways in standard 378, page 3. Until standard 378 is revised this notice should be filed with 378, page 3.

"All principal spillways shall have the pipe extend to a stable grade at the deepest part of the cross-section on the centerline of dam, or into the existing drainage way below the dam."

Michael M Blaine
Michael M. Blaine
State Conservation Engineer

DIST: O, LThomas

B. Conduit Spillway Inlets

Principal spillway inlets will be drop inlets, hood inlets with baffle plate or canopy inlets, for all ponds with drainage areas greater than 50 ac. and those where principal spillway flow will be considered in designing the emergency spillway. Inlets shall be constructed of materials compatible with the principal spillway conduit. The type of inlet used will be based on site conditions, spillway location, hydraulic design, and conduit materials.

Risers for drop inlet spillways will be designed with sufficient anchorage to prevent flotation, with a factor of safety of 1.5. Concrete risers, 5 ft. or less in height, shall have a minimum wall thickness of 6 inches and be reinforced with one layer of welded wire fabric (6"x6" - 8 gage x 8 gage minimum). All other concrete risers shall be designed as described under structural spillways, in this standard.

When principal spillway flow will be considered in design of the emergency spillway, inlets will be designed such that full pipe flow occurs in the principal spillway conduit prior to flow through the emergency spillway. Inlets will be designed and minimum stages of water surface shall be established using the procedures contained in the EFM, Chapter 3, WV Supplement for Hydraulic Criteria for Canopy, Hood, and Drop Inlet Spillways.

Where principal spillway flow is to be considered in design of the emergency spillway, and for all ponds with drainage areas greater than 50 ac., the inlet will be equipped with an antivortex device and trash guard. Trash guards shall have openings no larger than three fourths of the spillway pipe diameter, and no smaller than 4 inches in the least dimension.

Guard rails are to be used on all principal spillway systems where safety hazards exist. They shall have a minimum height of 3 feet and openings not greater than 18 inches in the least dimension. Steel pipes (1 1/4" diameter minimum) or angle irons (1" x 1" x 1/4" thick minimum) shall be used.

C. Conduit Spillway Outlets

Principal spillway outlets will be designed to be stable and provide for release of flow at non-erosive velocities, as follows. Cantilever outlet sections, if used, shall be designed to withstand the cantilever load, and pipe supports shall be provided when needed. Pipe supports will be installed on all pipes where the length of the cantilever portion, measured along the invert of the pipe, is more than 35% of the total length of the last joint of pipe for pipe diameters 15 inches and less, or more than 20% of the total length of the last joint of pipe for pipe diameters greater than 15 inches.

Energy dissipating outlet structures such as an impact basin, SAF outlet or those meeting the requirements of procedures contained in the EFM, Chapter 7, or Design Note 6, will be considered for all pipe outlets. As a minimum, erosion protection shall be provided at all pipe outlets, 10" to 15" in diameter, by installing a splash pad. The splash pad may be 4 in. thick concrete or 12 in. thick 3" to 9" rock riprap and will be 2 times the pipe diameter in length and width. Rock in splash pads may be durable field stone. Splash pads should be considered for pipe diameters less than 10" when there is a potential for excessive scouring at the outlet.

Pipe outlets, for conduits 15 inches in diameter and larger, shall have designed energy dissipating outlet measures.

When designed energy dissipating outlet measures are installed, the last joint of the principal spillway conduit shall be installed on a slope no steeper than 4%.

The invert elevation of all principal spillway conduit outlets shall be a minimum of 1.0 ft. above the outlet channel.

Drainpipe or Gates

All ponds having a permanent pool area of 1 acre or more or an effective height of 15 feet or more shall have a drain and valve system capable of draining the pond in 10 days. Other ponds shall be provided with a similar system to drain the pond when needed for proper pond management. If a drainpipe is used, it shall be constructed of pipe as shown under materials in this standard, and in no case shall be less than 1 1/4 inches inside diameter. The principal spillway pipe may be used as a pond drain when properly gated for this purpose, or the water supply pipe may be used if it provides adequate capacity.

Watering Facilities

A water supply pipe equipped with a suitable valve and riser shall be installed in all ponds built primarily for livestock water. It shall lead to a watering trough constructed in accordance with the engineering and standard for Trough or Tank (614). Pipes supplying water to troughs or other facilities shall have a minimum inside diameter of 1 1/4 inches. The portion of the pipe under the embankment shall be constructed of pipe as shown under materials in this standard. The riser inlet shall be a perforated standpipe with sufficient perforations to maintain the required flow. A floating water supply inlet may be installed in lieu of a perforated riser, in which case flexible polyethylene pipe may be used for the portion of the pipe not under the embankment.

Where it is not possible to install a water supply pipe and trough or tank, a fenced concrete, gravel or treated wood access ramp shall be provided. The ramp shall extend to the anticipated low water level at a slope no steeper than 10% and shall be a minimum of 8 ft. wide. Concrete ramps will be 4 inches thick over 4 inches of gravel, with a rough surface. Gravel ramps will be 4 inches thick over an 8 inch thick layer of 4" to 8" stone or a layer of filter fabric. Wood ramps will be constructed of 2 inch thick (minimum) lumber laid perpendicular to the slope. Individual planks will be fastened together and the ramp will be anchored to prevent flotation.

Fencing

Ponds will be permanently fenced when livestock will or may be present. The fence will enclose the reservoir, earthfill, and emergency spillway, including the outlet section. If a concrete or gravel ramp is constructed for livestock access to the reservoir, it will be fenced to allow only sufficient access for watering purposes. The fence will be located so it will not interfere with the operation of the emergency spillway.

The fence shall be constructed in accordance with the WV standards for Livestock Exclusion (472) or Fencing (382).

Conduit Seepage Control

Seepage control will not be required on water supply pipes or drainpipes less than 4 inches in diameter. Seepage along pipe conduit spillways 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. Seepage control will 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.

The drainage diaphragm shall be 2 ft. thick parallel to the centerline of the pipe, project at least 18 inches below the bottom of the pipe, and project at least three times the pipe diameter above and to the sides of the pipe, except that the maximum projection above and to the sides of the pipe does not need to be greater than 3 ft. The diaphragm will be located immediately downstream of the cutoff trench cut slope.

The outlet for the drainage diaphragm will be a sand bedding or envelope along the principal spillway. It will be 18 inches deep, from the pipe centerline down, and 3 times the pipe diameter wide, with a minimum width of 2 feet. It will extend to the downstream toe of the embankment. The outlet end will be protected from erosion by use of a 6" thick gravel layer and 9" thick rock riprap layer or other suitable method.

The drain diaphragm and outlet will be constructed of sand meeting the requirements of fine concrete aggregate (ASTM C33 - At least 15% passing the No. 40 sieve but no more than 10% passing the No. 100 sieve). When soils with high piping potential are used and the effective height of the dam is 25 ft. or greater, the gradation of the drain material will be determined using the requirements of Soil Mechanics Note 1.

Riprap, for erosion protection at the drain outlet, shall be durable stone approximately 3" to 9" in size. If a riprap outlet structure is designed for the principal spillway, the riprap shall meet the gradation requirements of the outlet structure.

When antiseep collars are used in lieu of a drainage diaphragm, they shall have a watertight connection to the pipe and will be constructed of materials compatible with the pipe. The number and size of antiseep collars shall be such that the seepage path along the pipe is increased by 15%. Collars will project a minimum of 2 ft. in all directions from the outside of the pipe and will be spaced no further than 14 times the pipe diameter apart.

Concrete collars shall be a minimum of 6" thick. Concrete collars on pipes 18" and larger in diameter and in ponds with effective heights greater than 15 ft. will have one layer of steel reinforcement, meeting temperature and shrinkage requirements in National Engineering Handbook, Section 6, placed at the centerline of the collar (No. 4 bars - 12 inches center to center in both directions for 6-inch concrete thickness). When the fill height over collars exceeds 20 ft., the collar shall be designed with a 3-inch batter, resulting in a 6 in. thickness at the top to a 9 in. thickness at the bottom. Concrete collars will not be used on plastic pipe.

Metal collars will be 16 gage minimum if corrugated and 1/4 in. minimum thickness if flat steel, and will be provided with protective coatings and cathodic protection when such protection is required for the conduit.

Plastic collars will be 8 mil. minimum thickness with a wood, metal or plastic frame for support during construction. Plastic collars will not be used on conduits larger than 12 inches in diameter.

Materials For Principal Spillway Pipe, Drainpipe Or Water Supply Pipe

The pipe shall be capable of withstanding the 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 following pipe materials are acceptable for the effective heights of ponds and conditions listed:

Table 2
Pipe Materials

Type of Pipe	Minimum Schedule, Thickness or Gage	Maximum Diameter (in.)	Maximum Depth of Fill over Pipe (Ft.)
Plastic, PVC 1120 or 1220	ASTM D1785, Sch. 40	4"	15
		12"	10
	ASTM D1785, Sch. 80	4"	20
		12"	15
	ASTM D2241, SDR 26	4"	10
		12"	10
Reinforced Concrete	ASTM C 76 or ASTM C 655	48"	35
Cast in Place Reinforced Concrete	(Designed according to NEH Section 6)	(Area=16ft^2)	35
Zinc coated Corrugated steel 6" to 10" dia. - 1 1/2"x1/4" corrugations and 12" to 48" dia. - 2 2/3"x1/2" corrugations	Fed. Spec. 16 gage WW-P-405	24"	25
		30"	20
	Fed. Spec. 14 gage WW-P-405	30"	25
		36"	20
	Fed. Spec. 12 gage WW-P-405	36"	25
		42"	20
	Fed. Spec. 10 gage WW-P-405	42"	20
		48"	25
Corrugated aluminum 6" to 10 " dia. - 1 1/2"x1/4" corrugations and 12" to 48" dia. - 2 2/3"x1/2" corrugations	Fed. Spec. 0.06" WW-P-402	21"	25
		24"	15
	Fed. Spec. 0.075" WW-P-402	24"	20
		36"	15
	Fed. Spec. 0.105" WW-P-402	24"	25
		36"	20
	Fed. Spec. 0.135" WW-P-402	30"	25
Welded Steel Pipe	ASTM A53, A120, A134, A135 or A139, AWWA C200 wall thickness 3/16"	4"	35
	AWWA C200 wall thickness 1/4"	48"	25
*Cast Iron	AWWA C151 or C115 Fittings-AWWA C110 or C153	48"	20
*Asbestos Cement	ASTM C296	36"	20
*Non-Reinforced Concrete	ASTM C14	48"	20
*Vitrified Clay Pipe with Rubber Gasket	ASTM C700	42"	20

*Acceptable pipe for dams 20 ft. or less in effective height only.

Joints between sections of pipe shall be designed to remain watertight after joint elongation caused by foundation consolidation. Joints shall be made watertight by the use of couplings, gaskets, caulking, or by welding. Connections of PVC plastic pipe to less flexible pipe or structures must be designed to prevent stress concentrations and possible pipe rupture.

Watertight couplings specified for corrugated steel and aluminum pipe shall conform to one of the following.

1. Annular corrugated metal sheet 2 feet wide wrapped around butting pipes with sheet ends lapping a minimum of 6 inches. The sheet will be secured by four circumferential steel rods with tank lugs. Prior to placement of the sheet, the contacted surface shall be coated with a thin layer of trowel grade bituminous mastic compound, or a rubber sheet gasket manufactured for this purpose shall be used.

2. Stamped or cut flanges continuously welded to each pipe and bolted on approximately 4-inch centers with gasket.

3. Pipe ends manufactured to receive a solid metal sleeve equipped with a round rubber gasket.

4. Others which are approved by the State Conservation Engineer.

Asbestos-cement, concrete and vitrified clay pipe shall be laid in a concrete bedding or cradle. Design of bedding or cradle shall be in accordance with the criteria contained in Technical Release 5. For ponds with effective heights of 10 ft. or less the bedding may be nonreinforced concrete, extending 1/3 of the pipe diameter up the sides of the pipe, 4" below the pipe, and be 4" wider than the outside diameter of the pipe.

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.

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.

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

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 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 3, less any reduction creditable to conduit discharge and detention storage.

The approving employee may waive the requirement for an emergency spillway on excavated ponds with drainage areas less than 10 acres, provided the embankment is constructed with side slopes no steeper than 3 horizontal to 1 vertical upstream and 5 horizontal to 1 vertical downstream. Procedures and Tables contained in the Engineering Field Manual for Conservation Practices, Chapter 11 for designing spillways with 3:1 sideslopes may be used to design spillways with combined slopes of 5:1.

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 earth. The side slopes shall be stable for the material in which the spillway is to be constructed. In earth or weathered rock the side slopes shall be no steeper than 2:1 and the combined inside and outside slopes shall be no less than 5:1. For dams having an effective height exceeding 20 ft., the emergency spillway shall have a bottom width of not less than 10 ft. and for all others the bottom width shall not be less than 8 ft. Emergency spillways will be constructed in undisturbed earth to the design flow elevation (H_p), at the control section.

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 (minimum 20 ft.). Procedures and Tables contained in the Engineering Field Manual for Conservation Practices for designing emergency spillways with 25 ft. level sections may be used to design spillways with 20 ft. level sections. 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. The minimum depth in the exit channel will be equal to or greater than the design H_p for the spillway.

Table 3
Minimum Spillway Capacity

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

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

The crest of the emergency spillway shall be 0.5 ft. above the crest of the principal spillway for ponds with drainage areas of 20 ac. or less. Ponds with drainage areas greater than 20 ac. shall have a minimum of 1.0 ft. difference between the principal spillway and emergency spillway crest elevations. However, when principal spillway flow is considered in design of the emergency spillway or when a principal design storm is required, then the crest of the emergency spillway shall be equal to or higher than the elevation required to create full pipe flow or the elevation established by routing the design storm, whichever is higher.

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 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.

Structural Emergency Spillways

If chutes or drops are used for principal spillways, combination spillways, 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 3, less any reduction creditable to conduit discharge and detention storage. The State Conservation Engineer must approve structural spillways.

Reservoir

Excavation and shaping required to permit the reservoir area to suitably serve the planned purpose shall be included in the construction plans. Reservoirs constructed or created specifically for fish production shall incorporate the requirements of the fish pond standards contained in the Technical Guide, and incorporation of these requirements should be considered for all ponds where recreation and fishing are secondary purposes.

The visual design of ponds shall be carefully considered in areas of high public visibility and those associated wih 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 left or added, for visual interest and to attract wildlife.

Side slopes of borrow excavations and excavations within the pool shall not be steeper than 2 horizontal to 1 vertical, except where the pond is to be managed for fishing or fish production. In this case the shoreline may be excavated on a maximum slope of 1 horizontal to 1 vertical to a maximum depth of 3 ft. (See Standard 399, Fishpond Management)

Excess material excavated from the pool of embankment ponds and excavation from excavated ponds shall be placed so that its weight will not endanger the stability of the pond sides 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.

Inlet Protection

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

378-14 POND

Operation and Maintenance

An operation and maintenance plan will be prepared for all ponds. The maintenance tips brochure for ponds may be used for most ponds, but will be supplemented to cover items not covered in the brochure, as necessary. The following items are to be considered in preparation of the Operation and Maintenance Plan:

1. Inspect regularly and repair:
    a. Principal spillway inlet, trash rack and antivortex device
    b. Principal spillway outlet
    c. Drain pipe, gates and/or valves
    d. Water supply pipes, valves and watering facilities
    e. Seepage drain outlets
    f. Fences, recreation facilities, safety facilities and measures installed for fish and wildlife enhancement
    g. Unstable wet areas below the pond

2. Vegetation should be kept healthy by liming, fertilizing and mowing periodically to control undesirable vegetation. Do not permit trees and brush to grow on the embankment.

3. Eroding areas on and around the pond should be revegetated or protected with mechanical measures such as riprap.

4. Gates, valves and other mechanical devices should be operated no less frequent than once a year to insure their continued operation. Lubrication as recommended by the manufacturer should be performed on a regular basis.

5. Pollution may be controlled by:
    a. diverting runoff from concentrated livestock areas, septic drain fields and other pollution sources
    b. stabilizing sediment sources in the drainage area
    c. regulating livestock use of water and adjacent land to prevent erosion and pollution from excrement.
    d. Removing trash and debris and providing trash can if the pond has high recreational use

6. Control of aquatic growth, growth of algae and fish species may be controlled by:*
    a. Use of mechanical equipment
    b. Chemical treatment
    c. deepening water at edge of pond
    d. periodic fertilization
    e. control of water depth and flow in the pond

*Refer to the standard for fish pond management for more detailed information.

7. Damage by muskrats can be controlled by trapping, hunting, or by discouraging burrowing with the use of linings.

8. Periodic cleanout of sediment may be required if planned for in the design or if sediment yield is greater than anticipated.

Plans and Specifications

Plans and specifications for installation of ponds shall be in keeping with this standard, and shall describe the requirements for application for the practice to achieve its intended purpose. Applicable West Virginia Engineering standards and specifications will apply to components of the system.

Ponds which have embankments with effective heights greater than 15 ft., could result in damage to roads or farm buildings should failure occur, or are multiple purpose structures, will have specifications prepared in conformance with NEH 20 or, the WV 700 series, as appropriate, and the guidelines listed in the construction specification guide of Standard 377, Earth embankments. Specifications for associated practices such as pipeline and tanks or troughs will be included as needed and specifications for items such as safety devices, recreation facilities, and fish and wildlife enhancement measures will be prepared as needed.

All other ponds will be constructed in conformance with the attached specification and the following guidelines:

1. The applicable specification (Table 2) for principal spillway pipe, drainpipe and water supply pipe will be shown on the drawings.

2. If riprap is used, the quality, size and gradation will be shown on the drawings.

3. Application rates for seeding and mulching materials will be shown on the drawings.

4. Details and dimensions of inlet and outlet structures, antiseep collars, seepage drains, riprap slope protection, safety measures, fences and fish and wildlife enhancement measures shall be shown on the drawings.

5. Construction specifications for pipeline and trough or tank will be included when livestock watering facilities are to be installed.

6. Specifications for items such as safety devices, recreation facilities, and fish & wildlife enhancement measures will be prepared as needed.

CONSTRUCTION SPECIFICATION
(Class III and IV Embankments)

PONDS

Foundation Preparation

The foundation area shall be cleared of trees, logs, stumps, roots, brush, boulders, sod, and rubbish. Topsoil having a high organic matter content shall be removed. 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 horizontal to 1 vertical. The foundation area will be thoroughly scarified before placement of the fill material. The surface will have moisture added or be compacted if necessary so the first layer of fill material can be compacted and bonded to the foundation.

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

Excess excavation material will be disposed of in a manner that its weight will not endanger the stability of the embankment or the pond sideslopes and so it will not be washed back into the pond. It will be used to widen required fills, disposed of adjacent to the pond or hauled away. When placed adjacent to the pond it 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. It will be shaped to blend visually with the landscape.

Principal Spillways, Drain Pipes and Watering Facilities

Pipe spillways, drain pipes and water supply pipes shall be firmly and uniformly bedded throughout their length, and shall be installed to the line and grade shown on the drawings. Inlet structures, outlet structures, antiseep collars, seepage drains, values and other fittings shall be installed as detailed on the drawings.

The type, applicable specification, and schedule, wall thickness or gage of pipe will be as shown on the drawings.

Antiseep collars or seepage drains, if required, will be constructed of materials and to the dimensions shown on the drawings. Sand for seepage drains will be fine concrete aggregate meeting the requirements of ASTM C33.

Water troughs and pipelines downstream of the embankment will be installed as shown on the drawings and as detailed in the specifications for pipeline and troughs or tanks.

Concrete used in construction of inlets, antiseep collars and troughs shall be ready-mixed concrete (3000 psi - 6 bags/c.y. mix.), pre-bagged commercially available concrete mix, or be hand mixed on-site. Cement will be Type I or IA meeting requirements of ASTM C150 and aggregates will meet the requirements of ASTM C33. Coarse aggregate will be Size No. 57 or No. 67 for ready-mix and hand mixed concrete. Hand mixed concrete shall be mixed at a ratio of 1 part cement, 2 parts sand, and 3 parts coarse aggregate. Pre-bagged concrete mix will be mixed according to the manufacturers' recommendation. Mixing water will be clean and free of substances that would effect the strength or durability of the concrete. Concrete will be mixed to a consistency that will allow consolidation in the forms, but not so wet that aggregates separate from the mortar (approximately 3"-6" slump).

Concrete will be mixed and placed in the forms in a timely manner so that it does not begin to set prior to placement, or cold joints are not formed between successive layers. Forms shall be mortartight and unyielding as concrete is placed.

Reinforcing steel shall be placed as shown on the drawings and held securely in place while concrete is placed.

Riprap for slope or pipe outlet protection, if required, will be commercially available limestone riprap or on-site field stone that had demonstrated its durability against weathering. Riprap size, gradation and details of installation will be as shown on the drawings.

Fill Placement

Foundation and cutoff trench areas shall be kept free of standing water when fill is being placed.

The embankment shall be constructed to the lines and grades shown on the drawings.

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

Selected backfill material shall be placed, in layers not exceeding 4" in thickness, around structures, pipe conduits, and antiseep collars at approximately the same rate on all sides to prevent damage from unequal loading, and hand compacted. Construction equipment shall not be permitted within 2 ft. of structures or conduits.

The placing and spreading of the fill material shall be started at the lowest point of the foundation and the fill shall be brought up in approximately horizontal layers. When it is necessary to use materials of varying texture and gradation, the more impervious material shall be placed in the upstream and center portions of the embankment. All fill materials shall be obtained from required excavations or designated borrow areas.

The fill shall be placed in layers not exceeding (8 inches) in thickness. Each layer shall be left with a rough surface prior to placement of subsequent layers. The fill shall be maintained so that surface drainage will occur in the upstream direction during placement.

The moisture content of fill material shall be adequate to permit the degree of compaction specified. The moisture content shall be sufficient to permit molding a firm ball when firmly squeezed in one's fist. The soil shall not be so wet that water runs out when squeezed nor so dry that the ball easily crumbles when slightly deformed. Water may need to be added if too dry.

Compaction shall be made by traversing the surface area of each layer with not less than four passes of a tamping roller exerting a pressure of approximately 200 psi or by a minimum of two passes with rubber-tired hauling equipment. One pass of the rubber-tired hauling equipment is complete when the entire lift surface has been traversed by a wheel.

Compaction of embankments with heights of 10 ft. or less, between the centerline low point and the emergency spillway crest elevations, may be accomplished by traversing the surface area of each layer with not less than four passes of the construction equipment, in lieu of a tamping roller or rubber tired hauling equipment.

Protection

A protective cover of vegetation shall be established on all exposed surfaces of the embankment, spillway, and borrow area where soil and climatic conditions permit. Lime and fertilizer will be spread at the rate shown on the drawings and will be disked into the soil to a depth of 4 inches to prepare a seedbed. Seed and mulch will be spread at the rate shown on the drawings. Where soil or climatic conditions preclude the use of vegetation and protection is needed, nonvegetative 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, as shown on the drawings, to protect the vegetation.

General

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 disturbed areas will be graded smooth and blend with the surrounding ground, prior to seeding operations.

Measures and construction methods that enhance fish and wildlife values shall be incorporated as shown on the drawings.

Appropriate safety measures, such as warning signs, rescue facilities, fencing, etc., will be installed as shown on the drawings.

Planning considerations for water quantity and quality

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.
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.

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 waters 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.