NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

POND

(No.)

CODE 378

DEFINITION

A water impoundment made by constructing 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 the auxiliary spillway elevation is 3 feet 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 low-hazard ponds where:

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.

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. The effective height of the dam is the difference in elevation, in feet, between the auxiliary spillway crest and the lowest point in the cross section taken along the centerline of the dam. If there is no auxiliary spillway, the top of the dam is the upper limit.

The effective height of the dam is 35 feet or less.

General Criteria Applicable to All Ponds

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

The landowner is responsible for acquiring land rights from adjoining landowners for any permanent or temporary storage created by the planned structure. The landowner shall obtain permits to comply with applicable federal and state laws and regulations. See Table 7 for IDNR water storage and construction permit criteria.

The designer shall complete Form IA-ENG-40 for inventory dams and submit the form to the State Conservation Engineer upon completion of construction. The thresholds that have been established for dam and reservoir sizes to be included in the inventory of NRCS-assisted dams may be found in Table 8.

Ponds are potentially hazardous and precautions must be taken to prevent serious injury or loss of life. Protective guardrails, warning signs, fences, or lifesaving equipment shall be added as needed.

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 Critical Area Planting (342).

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 above the pond must be protected against erosion to the extent that expected sedimentation will not shorten the planned effective life of the structure. Design sediment storage capacity that is equal to the expected life of the structure or 35 years, whichever is greater, unless periodic sediment removal is provided for in the Operation and Maintenance Plan.

The drainage area shall be large enough so that surface runoff and groundwater will provide an adequate supply of water for the intended purpose unless an alternate water source exists to serve this purpose.

The quality shall be suitable for the water's intended use. Runoff water from barnyards, feedlots, septic tanks, barn drains, or other sources of contamination shall be diverted so as not to flow into ponds to be used for drinking water supply, livestock water supply, fish and wildlife, or recreation.

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.

It is generally recommended that the permanent pool volume not exceed the estimated annual runoff. Obtain estimated runoff values from the National Engineering Handbook (NEH) Part 650 (Engineering Field Handbook), Chapter 2, Estimating Runoff and Peak Discharge.

The minimum surface area of ponds to be used for fish production shall be 0.5 acre. The pond must provide at least 8 feet of water under at least 25% of the surface area at principal spillway elevation except in the northern 2 tiers of counties where the minimum depth under at least 25% of the surface area shall be 10 feet.

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. 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 to reduce seepage through the foundation. 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, but not less than 8 feet. Side slopes shall not be steeper than 1 ½ horizontal to 1 vertical.

Seepage control. Seepage control is to be included if (1) pervious layers are not intercepted by the cutoff, (2) seepage could create 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 filters and drains; (2) reservoir blanketing; or (3) a combination of these measures. See National Engineering Handbook (NEH) Part 650 (Engineering Field Handbook), Chapter 11, Ponds and Reservoirs, for foundation drainage requirements.

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. 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 feet in height, maintenance considerations or construction equipment limitations may require increased top widths from the minimum shown in Table 1.

Side Slopes. All slopes must be designed to be stable. Constructed embankment side slopes shall not be steeper than 3 horizontal to 1 vertical (3:1) on both the upstream and downstream sides, except for embankments built entirely of glacial till soil on foundations of glacial till soil, which may have side slopes not steeper than 2½:1. These general criteria shall apply unless a flatter slope ratio is indicated by slope stability analysis. Downstream or upstream berms can be used to help achieve stable embankment sections.

Borrow area in the pool within 6 vertical feet of the permanent water elevation shall have a minimum side slope of 2½:1. All other borrow areas below crest shall have a minimum side slope of 1½:1.

Table 1. Minimum top width for dams

Total height of embankment* (feet)	Top width (feet)
Less than 15.0	10
15.1 – 25.0	12
25.1 – 35.0	14
35.1 or more	See TR60

* Total height is the difference in elevation, in feet, between the design top of the dam and the lowest point in the cross section taken along the centerline of the dam.

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).

Rock riprap or other structural measures shall be used for dams where vegetation will not provide effective protection, for multiple-purpose dams, and for dams with fluctuating normal water levels. Rock riprap shall extend at least 1 foot above the maximum wave height and at least 3 feet below normal pool elevation.

A berm not less than 8 feet in width shall be provided at the normal pool elevation to dampen out wave action. It shall extend across the earthfill to the abutments. It need not be continuous across the face of the fill when the surface area of the pond is 2 acres or less but must extend around the inlet for a distance of not less than 10 feet. The berm may be omitted entirely when the surface area of the pond is 1 acre or less and the principal spillway diameter is less than 10 inches. The berm may be constructed as much as 6 inches above permanent pool level to provide for settlement.

A sloping berm designed in accordance with TR-56 may also be used.

When a downstream berm is needed on the downstream slope for slope stability, as an erosion control measure, or as a crossing, it shall be not less than 10 feet in width (measured on the horizontal projection). Downstream slopes may be flattened in lieu of berms. Berms may be built level or drain back towards the fill and laterally to safe outlets.

Freeboard. The minimum elevation of the top of the settled embankment shall be 1 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 feet for all dams having more than a 20-acre drainage area or more than 20 feet in overall 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 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. A mechanical spillway shall be provided for all ponds with drainage areas of 20 acres or more.

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 feet.

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 4 inches. See Table 2 for additional limits on pipe diameter. 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.

Table 2. Minimum Spillway Capacity for Ponds and Other Storage Type Structures

				Minimum Design Frequency (24-hour Duration Storm)[%]	
Drainage Area (acres)	Minimum Pipe Diameter (inches)	Effective Fill Height (feet)[#]	Storage (acre-feet)[#]	Principal Spillway (year)	Auxiliary Spillway (year)
0-20	4	0-20	Less than 50	------	10
0-20	4	20-35	Less than 50	2	25
20-80	6	0-20	Less than 50	5	25
20-80	6	20-35	Less than 50	5	50
80-250	10	0-20	Less than 50	10	25
80-250	10	20-35	Less than 50	10	50
All Others	15	0-35	All	25	50

[#] As defined under "CONDITIONS WHERE PRACTICE APPLIES."
[%] If the structure requires an IDNR permit, more restrictive criteria may apply. See IDNR Technical Bulletin 16, "Design Criteria and Guidelines for Iowa Dams."

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 unreinforced 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 thickness of flexible pipe shall be SDR 26, Schedule 40, Class 100, or 16 gage as appropriate for the particular pipe material. Pipe strength shall not be less than that of the grades indicated in Table 3 for plastic pipe and in Table 4 for corrugated aluminum and galvanized steel pipe. The maximum height of fill over any steel, aluminum, or plastic pipes must not exceed 25 feet.

Connections of flexible pipe to rigid pipe or other structures shall be designed to accommodate differential movements and stress concentrations. The inlets and outlets shall be structurally sound and made of materials compatible with those of the pipe.

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.

The outlet section shall be a minimum of 20 feet long with a minimum of 8 feet overhang downstream from the centerline of prop or from the intersection of the flow line of the pipe and design fill slope when no prop is used. The pipe shall project beyond the toe of the fill in all cases. The slope of the propped outlet should be within the limits shown in Table 5.

The invert of the pipe at the outlet end shall be a minimum of 1 foot above a constructed channel or gully bottom. In situations where sediment accumulation in outlet channels may be a problem the outlet shall be raised or a chute or slotted flume outlet used. A slotted flume may be used on corrugated metal pipe conduits.

Chute outlets should be used when downstream sedimentation is expected, downstream gully banks may be sloped at a later date, or outlet submergence may occur from downstream works of improvement. Chute outlets for concrete pipe conduits will be constructed of reinforced concrete and shall meet the requirements for outlets for chute spillways.

Chute outlets for monolithic conduits will meet the same criteria as outlined for chute spillways in Grade Stabilization Structure (410).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 resistivity 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.

Table 3. Acceptable PVC pipe for use in earthen dams*

Nominal Pipe Size (inches)	Pipe Material	Maximum Depth of Fill Over Pipe (feet)
4, 6, 8, 10, 12	ASTM D2241 SDR 26	13
4, 6, 8, 10, 12	ASTM D2241 SDR 21	17
4, 6, 8, 10, 12	ASTM D2241 SDR 17	24
10, 12	ASTM D1785 Schedule 40	8
6, 8	ASTM D1785 Schedule 40	13
4	ASTM D1785 Schedule 40	20
10,12	ASTM D1785 Schedule 80	20
6,8	ASTM D1785 Schedule 80	24
4	ASTM D1785 Schedule 80	25
4, 6, 8, 10, 12	AWWA C900 Class 100	13
4, 6, 8, 10, 12	AWWA C900 Class 150	18
4, 6, 8, 10, 12	AWWA C900 Class 200	25

*Class 12454-A, 12454-B, or 12454-C polyvinyl chloride pipe (ASTM D1784).

Table 4. Minimum gage for corrugated metal pipe (CMP)

	2 2/3 inch x 1/2 inch corrugations*									
Fill Height Above Pipe (feet)	Steel Pipe Nominal Diameter (in) of:						Aluminum Pipe# Nominal Diameter (in) of:			
	<21	24	30	36	42	48	<21	24	30	36
1-15	16	16	16	14	12	10	16	16	14	14
15-20	16	16	16	14	12	10	16	16	12	12
20-25	16	16	14	12	10	10	16	12	10	------$

3 inch x 1 inch corrugations%

Steel Pipe with Nominal Diameter (in) of:

	36	42	48	54	60	66	72	78	84	90	96
1-15	16	16	16	16	16	16	16	14	12	12	10
15-20	16	16	16	16	14	14	14	12	10	8	------$
20-25	16	16	14	12	10	8	8	8	------$	------$	------$

* Pipe with 6, 8, and 10 inch diameters has 1½ x ¼ inch corrugations.
\# Riveted or helical fabrication.
$ Not permitted.
% n = 0.027.

Table 5. Allowable slope of cantilever outlet

Diameter (in)	Minimum	Maximum
4-15	2%	20%
16-24	2%	12%
26-48	2%	7%
Over 48	2%	4%

Renewable Energy. For detailed criteria where the purpose is to develop renewable energy systems refer to interim conservation practice standard Renewable Energy Production (716).

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.

See NEH Part 650 (Engineering Field Handbook), Chapter 6, Structures, for additional criteria for cathodic protection of welded steel pipe.

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

- The effective height of dam is greater than 15 feet.
- The conduit is of smooth pipe larger than 8 inches in diameter.
- 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 diaphragm, unless it is determined that anti-seep collars will adequately serve the purpose.

A filter diaphragm is required for closed conduit structures when both of the following conditions exist:

1. The conduit has a diameter of 15 inches or more.

2. The maximum hydraulic head on the pipe is 6 feet or more. (Hydraulic head is measured from the highest water surface elevation of the auxiliary spillway routing to the 0.6d elevation at the outlet of the pipe.)

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 consist of sand meeting the requirements of ASTM C-33, for fine aggregate. If unusual soil conditions exist such that this material may not meet the required filter or capacity requirements, a special design analysis shall be made.

The filter diaphragm shall be a minimum of 2 feet thick and extend vertically upward and horizontally at least three times the outside pipe diameter, and vertically downward at least 18 inches beneath the conduit invert. The filter diaphragm shall be located immediately downstream of the cutoff trench, but downstream of the centerline of the dam if the cutoff is upstream of the centerline. The minimum earth cover for the filter shall be 3 feet.

The filter diaphragm shall outlet at downstream toe of the embankment using a drain backfill envelope that is continuous along the pipe to where it exits the embankment. Drain fill shall be protected from surface erosion.

Anti-seep Collars. When anti-seep collars are used in lieu of a 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 anti-seep collar(s) shall increase by at least 15 percent the seepage path along the pipe.

The number of anti-seep collars can be determined by the formula:

$$N = \frac{L}{7(V - D)}$$

Where: L = The length of pipe lying within the saturated zone in feet.

V = The vertical height of the anti-seep collar in feet.

D = The outside diameter of the principal spillway conduit or outside height of monolithic conduit in feet.

The length of pipe lying within the saturated zone (L) is interpreted as follows:

MLRA 107: The distance from the inlet or downstream face of the riser to the centerline of the embankment drainage system or to the downstream toe if no embankment drainage system is planned.

Remainder of State: The distance from the inlet or the downstream face of the riser to the downstream edge of the top plus 60% of the distance from the downstream edge of the top to the downstream toe.

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.

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 2, 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 a minimum distance of 30 feet. 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 of 1% to 10% unless a routing of the auxiliary spillway storm satisfies discharge and tractive stress requirements.

No curvature will be allowed in the exit channel upstream of a point opposite the toe of the main fill. Where necessary a dike will be constructed along the exit channel. The dike shall have a minimum top width of 8 feet, side slopes no steeper than 2½:1, and sufficient height throughout the length of the dike. The dike and exit channel shall extend a sufficient distance downstream to prevent spillway discharge from damaging the main fill. The maximum permissible velocities for auxiliary spillways can be found in Table 6.

Table 6. Permissible velocities for vegetated spillways

Vegetation	Permissible Velocity (feet/second)			
	Erosion Resistant Soils* Slope of Exit Channel		Easily Erodible Soils# Slope of Exit Channel	
	0 - 4.9%	5.0 – 9.9%	0 - 4.9%	5.0 – 9.9%
Smooth Bromegrass	8.75	7.5	6.25	5.0
Tall Fescue	8.75	7.5	6.25	5.0
Reed Canarygrass	8.75	7.5	6.25	5.0
Sod-forming grass-legume mix	6.25	5.0	5.0	3.75
Native grass mixtures	4.3	4.3	3.1	3.1

* Erodibility will be determined by the texture of the soil horizon that is exposed after construction. Erosion resistant soil textures are loam, sandy loam, loamy sand, clay loam, sandy clay loam, and clay.
# Easily erodible soil textures are silt, silt loam, fine sandy loam, loamy fine sand, silty clay loam, and silty clay.

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

Criteria for Excavated Ponds

Site Selection. Sufficient soil borings will be taken to determine if the soil is impervious enough to hold water for surface-fed ponds or to establish the presence of adequate groundwater for groundwater-fed ponds. If the soils are shallow and are underlain by gravel or sand the seepage rates may be excessive and another site should be selected.

Capacity and Size Requirements. If used for livestock water, the pit shall be large enough to supply the needs for the average number of livestock to be supplied or for a pit which is to distribute grazing; the practical limit would be the grazing potential of the pasture area.

The bottom width shall be 10 feet or more and the length 40 feet or more. The minimum bottom area shall be 500 square feet at the designed depth.

Runoff. Provisions shall be made for a pipe and auxiliary spillway, if needed, that will meet the capacity requirements of Table 2. Runoff flow patterns shall be considered 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 1½:1 nor flatter than 3:1 except where livestock water directly from the pond. If livestock will water directly from the pond, a watering ramp at least 10 feet wide shall be provided. The ramp shall extend to the anticipated low water elevation at a slope no steeper than 4 horizontal to 1 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. The material excavated from the pond shall be placed 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.

Fencing. Where an adjacent area is used for grazing or is open to livestock the pit and spoil areas shall be fenced. Where livestock are permitted to water directly from the pits the fencing will be placed in a manner that will permit livestock to utilize the approach ramp as a means of access to the water.

CONSIDERATIONS

Visual resource design. The visual design of ponds should 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.

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.

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 conservation practice standard 399, Fishpond Management.

Vegetation. Stockpiling topsoil for placement on disturbed areas can facilitate revegetation.

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 following list of Construction Specifications is intended as a guide to selecting the appropriate specifications for each specific project. The list includes most but may not contain all of the specifications that are needed for a specific project:

IA-1	Site Preparation
IA-3	Structure Removal
IA-5	Pollution Control
IA-6	Seeding and Mulching for Protective Cover
IA-11	Removal of Water
IA-21	Excavation
IA-23	Earthfill
IA-24	Drainfill
IA-26	Salvaging and Spreading Topsoil
IA-31	Concrete
IA-45	Plastic (PVC, PE) Pipe
IA-51	Corrugated Metal Pipe Conduits
IA-52	Steel Pipe Conduits
IA-81	Metal Fabrication and Installation
IA-83	Timber Fabrication and Installation
IA-92	Fences
IA-99	Cathodic Protection for Buried Metal Structures

OPERATION AND MAINTENANCE

An operation and maintenance plan shall be developed and reviewed with the landowner or individual responsible for operation and maintenance. The plan shall provide specific instructions for operating and maintaining the system to ensure that it functions properly. It shall also provide for periodic inspections and prompt repair or replacement of damaged components.

Table 7. Iowa DNR Storage and Construction Permit Criteria*

IDNR Approval Required for Dams in Rural Areas for any of the Following Instances	
Storage Permit (Iowa Administrative Code 567- 51.2)	a. Permanent Storage > 18 Acre-Feet
Construction Permit (Iowa Administrative Code 567- 71.3)	a. Total Storage at Top of Dam is ≥ 50 Acre-Feet with Auxiliary Spillway, or ≥ 25 Acre-Feet with No Auxiliary Spillway And Overall Height ≥ 5 Feet
	b. Permanent Storage > 18 Acre-Feet And Overall Height ≥ 5 Feet
	c. Drainage Area > 10 square miles
	d. Embankment is within 1 mile of an incorporated municipality and all of the following apply: Overall Height ≥ 10 Feet Total Storage at Top of Dam ≥ 10 Acre-Feet Discharge from dam flows through incorporated area

* Any structure that does not meet the criteria for 'Exempt' status, or does not fall under Regional Permit 33, requires an individual permit under Section 404 of the Federal Water Pollution Control Act which is administered by the U.S. Army Corps of Engineers. For both Section 404 and Regional Permit 33 use Joint Application Form 36.

Table 8. National Inventory of Dams Criteria#

NRCS form IA-ENG-40 shall be completed and submitted to the State Conservation Engineer when any of the following conditions is met: a. The dam is classified as Significant or High hazard. b. Overall height > 6 Feet, and storage capacity ≥ 50 Acre-Feet, or c. Overall height ≥ 25 Feet, and storage capacity ≥ 15 Acre-Feet

The National Inventory of Dams is in accordance with §520.21(f), National Engineering Manual (NEM) and is part of the NRCS program for dam safety.