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, crop and orchard spraying, and other related uses, and to maintain or improve water quality.

SCOPE

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

1. Failure of the dam will not result in loss of life; in damage to homes, commercial or industrial buildings, main highways, or railroads; or in interruption of the use or service of public utilities.
2. The product of the storage times the effective height of the dam is less than 3,000. Storage is the volume, in acre-feet, in the reservoir below the elevation of the crest of the emergency spillway. The effective height of the dam is the difference in elevation, in feet, between the emergency spillway crest and the lowest point in the cross section taken along the centerline of the dam. If there is no emergency spillway, the top of the dam is the upper limit.
3. The effective height of the dam is 35 ft or less, and the dam is hazard class (a).

CONDITIONS WHERE PRACTICE APPLIES

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

Drainage area. The drainage area above the pond must be protected against erosion to the extent that expected sedimentation will not shorten the planned effective life of the structure. The drainage area shall be large enough so that surface runoff and groundwater flow will maintain an adequate supply of water in the pond. The quality shall be suitable for the water's intended use. Pond water shall be protected from contamination by barnyards, septic tanks, or other potential pollution sources.

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. Anticipated sediment yield from the watershed shall be considered in determining the storage volume of the pond and the inlet elevation of the principal spillway.

DESIGN CRITERIA FOR EMBANKMENT PONDS

Foundation cutoff. A core trench should be considered on all embankment ponds. A core trench shall be provided on all structures with a fill height greater than or equal to 12 ft. The core trench shall be excavated to a minimum depth of 4 ft below the existing ground level. If bedrock is encountered in the 4 ft, the core trench need only remove any weathered bedrock. The most impervious material available shall be used as backfill in the core trench. 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. The definition of total height of the dam or embankment in Table 1 is the difference in elevation between the designed top of dam (after settlement) and the low point on the centerline. 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 ponds with a permanent pool area of 2 acres or more, protection shall be provided across the earth fill at normal pool elevation (elevation of the inlet of the mechanical spillway) on the upstream side of the earth fill extending to the abutments. This protection may be: (1) a berm having a width of at least 5 ft, or (2) other suitable slope protection such as riprap.

The area on which a dam is to be placed shall consist of material that has sufficient bearing strength to support the dam without excessive consolidation.

Table 1. Minimum top width for dams

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

On structures with drop inlets, the riser shall be protected from damage by ice or floating debris by one of the following options: (1) a berm at least 5 ft wide or other suitable slope protection, such as rock riprap, shall be constructed across the earth fill at the normal pool elevation (elevation of the mechanical spillway) on the upstream side of the earth fill extending to the abutments; or (2) a semi-circular berm extending not less than 5 ft from the riser inlet shall be installed. A berm (full or semi-circular) should be considered with hood inlets for ice protection where the permanent pool level is maintained at the hood inlet elevation. The junction between the earth fill and abutments will normally carry runoff from berms and adjacent areas and shall be shaped and vegetated to minimize erosion.

Organic soils shall not be used for embankment materials unless approved by the State Conservation Engineer. If organic soils are used to build fills, the embankment should be covered with 4 to 6 in. of mineral soil whenever possible to prevent the fill from burning or decomposing rapidly.

Embankments comprised entirely of sandy soils shall not be used for fill heights in excess of 7 ft unless approved by the State Conservation Engineer. If it is necessary to use sandy soils, they will be evaluated on their permeability and piping characteristics. Frequently it is possible to mix some clay with the sandy soil; however, properly designed zoned fills are acceptable.

Borrow may be taken from the pool area provided a natural relatively impervious blanket of 1 foot for each 5 ft of water depth is maintained. Borrow pits upstream from an embankment will be located so that the minimum width between the toe of the embankment and the edge of an excavated borrow area will be equal to twice the maximum height of the dam. For drainage area less than 20 acres, borrow may be excavated from the pool adjacent to the fill, but not lower than the upstream toe of the fill. Generally borrow below a dam in the valley bottom is not recommended, but if necessary, shall be at least a distance of five times the height from the downstream toe.

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.

The minimum elevation of the top of the settled embankment shall be 1 foot 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.

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

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

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

The capacity of the pipe conduit shall be adequate to discharge long-duration, continuous, or frequent flows without flow through the emergency spillway(s). The diameter of the pipe shall not be less than 6 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.

(1) The pipe shall be capable of withstanding external loading without yielding, buckling, or cracking.

(2) Flexible pipe strength shall not be less than that necessary to support the design load with a maximum of 5 percent deflection.

(3) The inlets and outlets shall be structurally sound and made of materials compatible with those of the pipe.

(4) All pipe joints shall be made watertight by the use of couplings, gaskets, caulking, or by welding.

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

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

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

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

Practice standard 430-FF "*Irrigation Water Conveyance*" provides criteria for cathodic protection of welded steel pipe.

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

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

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

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

The drain shall be a minimum of 2 ft in thickness and extend vertically upward and horizontally at least three times the outside pipe diameter, and vertically downward at least 18 in. beneath the conduit invert, with these exceptions:

1. The vertical extension upward need be no higher than the maximum potential reservoir water level,

2. The horizontal extension need be no further than 5 ft beyond the sides and slopes of any excavation made to install the conduit.

3. The vertical extension downward may be terminated at the surface of bedrock when it occurs within the 18" distance. Additional control of general seepage through an upper zone of weathered bedrock may be needed.

The drain diaphragm shall be located immediately downstream of the cutoff trench, approximately parallel to the centerline of the dam, and downstream of the centerline of the dam if the cutoff is upstream of the centerline.

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 ASTM-D-1785 or ASTM-D-2241.

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. Drain fill shall be protected from surface erosion.

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

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

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

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

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

The minimum spillway capacities for class (A) dams having a product of storage times the effective height of the dam of less than 3000 and an effective height of 35 ft or less shall meet the requirements of Table 4.

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	0.135	----[3]

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

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

An emergency spillway must be provided for each dam, unless the principal spillway is large enough to pass the peak discharge from the routed design hydrograph and the trash that comes to it without overtopping the dam. The following are minimum criteria for acceptable use of a closed conduit principal spillway without an emergency spillway: (1) a conduit with a cross-sectional area of 3 ft^2 or more, (2) an inlet that will not clog, and (3) an elbow designed to facilitate the passage of trash.

The minimum capacity of a natural or constructed emergency spillway shall be that required to pass the peak flow expected from a design storm of the frequency and duration shown in Table 4, less any reduction creditable to conduit discharge and detention storage. Table 4 assumes an emergency spillway in good condition. A good spillway is one which will support vegetation (or is otherwise protected) and has exit slopes which lie within the ranges as defined in Minnesota Engineering Technical Note 1 or EFH, Exhibit 11-2, Tables 3A-3B. A poor emergency spillway is one which will likely sustain damage from an appreciable flow but will protect the principal spillway structure and embankment during the passage of a single design storm. Structures with a poor emergency spillway must increase the principal spillway design storm in Table 4 by one frequency level. (In other words, a site with a good emergency spillway may have a 10 year frequency design storm. If that same site has a poor emergency spillway, a 25-year design storm must be used.)

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

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

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

The allowable velocity to the control section shall not exceed the velocities shown in Table 5. For dams with an effective height greater than 20 ft and a drainage area greater than 20 acres, the exit channel velocity for peak discharge must not exceed Table 5 velocities in the reach where an exit channel failure might cause flow to impinge on the toe of the dam.

Table 4. Minimum spillway capacity

Drainage area	Effective height of dam[1]	Maximum Storage	Minimum principal spillway design storm[2] Frequency	Minimum principal spillway design storm[2] Minimum duration	Minimum emergency spillway design storm[2] Frequency	Minimum emergency spillway design storm[2] Minimum duration
acre	*ft*	*ac-ft*	*yr*	*hr*	*yr*	*hr*
20 or less	0-20	50	*	24	10	24
20 or less	20-35	50	2	24	25	24
20-80	0-20	50	5	24	25	24
20-80	20-35	50	5	24	50	24
80-250	0-20	50	10	24	25	24
80-250	20-35	50	10	24	50	24
All others	0-35	any	25	24	50	24

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

* A principal spillway is required on all embankment ponds except where the drainage area is under 20 acres AND there is no spring flow or base flow AND the emergency spillway is in good condition. A trickle tube is required if the site has no principal spillway.

Freeboard is the difference in elevation between the water surface in the vegetative spillway during the passage of the emergency spillway design storm and the top of settled fill. The minimum freeboard shall be 1.0 foot.

Spillways shall have a minimum length of level section upstream from the control section of 30 ft. The centerline of the approach channel upstream of the level section shall be tangent to the centerline of the level section. The shape of the level section shall have the same dimensions (side slope and bottom width) as the outlet section.

An abrupt change in grade may be constructed in lieu of a vertical curve section to achieve the intended purpose of a control section.

The alignment shall be as straight as possible throughout the length of the outlet section. No curvature shall be incorporated for a distance equal to at least one-half the maximum base width of the embankment. The outlet shall be (1) a nearly level channel or flood plain area; (2) a bluff type escarpment where outflow can spread uniformly over the escarpment slope.

Outlets where outflow will be concentrated due to gullies or small drainageways shall be avoided or modified to eliminate concentrations of flow.

Where the outlet has or will have seepage problems, appropriate measures shall be installed to maintain a stable outlet and promote good sod producing vegetation.

Seeding and mulching. An adequate cover of grass shall be established on the exposed surfaces of the embankment, borrow areas, and the emergency spillway. In some cases, temporary vegetation or mulching may be used until conditions are right for establishment of permanent vegetation. For seeding specifications, see Standard 342, "Critical Area Planting." For mulching specifications, see Standard 484, "Mulching."

Structural emergency 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 Engineering Field Handbook for Conservation Practices and the National Engineering Handbook-Section 5, Hydraulics; Section 11, Drop Spillways; and Section 14, Chute Spillways. The minimum capacity of a structural spillway shall be that required to pass the peak flow expected from a design storm of the frequency and duration shown in Table 4, less any reduction creditable to conduit discharge and detention storage.

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

The embankment may be shaped to blend with the natural topography. The edge of the pond may be shaped so that it is generally curvilinear rather than rectangular. Excavated material can be shaped so that the final form is smooth, flowing, and fitting to the adjacent landscape rather than angular geometric mounds. If feasible, islands may be added for visual interest and to attract wildlife.

TABLE 5. PERMISSIBLE VELOCITIES FOR VEGETATED SPILLWAYS*

Erosion Resistant Soils***

Permissible velocity in ft/sec**	Exit Channel slope 0 - 5 %	Exit Channel slope 5 - 10 %
Buffalo grass, Kentucky blue grass, Smooth bromegrass, Reed canarygrass	7	6
Sod-forming grass legume mixtures	5	4
Big bluestem Native grass mixtures	3.5	3.5

Easily Eroded Soils

Permissible velocity in ft/sec**	Exit Channel slope 0 - 5 %	Exit Channel slope 5 - 10 %
Buffalo grass, Kentucky blue grass, Smooth bromegrass, Reed canarygrass	5	4
Sod-forming grass legume mixtures	4	3
Big bluestem Native grass mixtures	2.5	2.5

* Refer to NRCS TP-61 or EFH Exhibit 11-2 (Table 1)

** Increase values 10% when the anticipated average use of the spillway is not more frequent than once in 50 years or 25 percent when the anticipated average use is not more frequent than once in 100 years.

*** Cohesive soils with a PI greater than 15.

DESIGN CRITERIA FOR EXCAVATED PONDS

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

Side slopes. Side slopes of excavated ponds shall be stable and shall 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.

Minimum size. Excavated ponds receiving their water supply from surface runoff must have a minimum dimension of 10 ft by 10 ft at a depth of 8 ft below the overflow level. Check pond capacity to insure that an adequate supply of water is available for livestock use (see section below). This minimum size requirement does not apply to ponds constructed for wildlife. The criteria in Standard 644, "Wildlife Wetland Habitat Management," apply for the minimum size of a wildlife structure. Excavated ponds receiving their water supply from ground water shall have a minimum dimension of 8 ft by 8 ft at a water depth of 4 ft. If the water supply is adequate, criteria on water capacities below do not apply to excavated ponds fed by ground water.

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

Seeding. All areas disturbed during construction are to be seeded to an erosion resistant mix specified in the construction documents.

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

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

1. Uniformly spread to a height that does not exceed 3 ft, with the top graded to a continuous slope away from the pond.
2. Uniformly placed or shaped reasonably well, with side slopes assuming a natural angle of repose. The excavated material will be placed at a distance equal to the depth of the pond but not less than 12 ft from the edge of the pond.
3. Shaped to a designed form that blends visually with the landscape.
4. Used for low embankment and leveling.
5. Hauled away.

OTHER CONSIDERATIONS

Water Capacity for all ponds. When used for stock watering purposes, the pond storage capacity should be based upon providing water requirements for livestock estimated on the following basis (Values should be increased for hot summer months.)

(1) Cow or horses -- 10 to 12 gallons daily.

(2) Heavy milk-producing cows -- 18 to 24 gallons daily.

(3) Hogs or sheep - 2.5 to 3 gallons daily.

(4) Poultry - 5 to 7 gallons daily per 100 chickens.

(5) Provide for a 180 day drought period.

(6) When the pond depends upon surface runoff, allow approximately 3 ft for seepage and evaporation.

When the primary purpose is for stock watering, the minimum surface area at normal water level shall be 0.15 acre. At least 0.04 acre surface area at normal water level (25 percent of surface area if practical) shall have a minimum depth of 8 ft. When the underlying material prevents excavation to the 8-foot depth, at least 0.08 acre surface area (50 percent if practicable) shall have a minimum depth of 6 ft.

If livestock are to water directly from the pond, an approach ramp must be constructed with a slope of 4:1 or 5:1. If the pond is fenced, the ramp shall be graveled, paved or otherwise prepared to provide solid footing and shall be at least 16 ft wide. Any permanent system used to pump water from a pond to a tank should be protected from damage by freezing. The intake should have a filter to prevent pipe clogging and the system must be large enough to meet the watering requirements.

Urban applications. Urban sites frequently are a higher risk than rural sites. Consideration should be given to public safety, utility locations, vandalism, and higher property values that may increase damages from a potential overtopping condition.

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 must be developed in accordance with the current Operations and Maintenance Manual.