E.16. Kentucky
RELATES TO: KRS 151.250
PURSUANT TO: KRS 151.125, 224.033(17), 224.045-(6)(b), 13.082
SUPERSEDES: DOW-Rg-2

NECESSITY AND FUNCTION: This regulation is necessary to establish minimum design criteria for dams and associated structures constructed in Kentucky.

Section 1. This regulation applies to all dams as defined by KRS 151.100 and to all other impounding obstructions which might create a hazard to life or property.

Section 2. Except as modified in this regulation, the procedures outlined by the latest edition of "Design of Small Dams" (Second Edition, 1973), available from the U.S. Government Printing Office and the Bureau of Reclamation, herein filed by reference, shall be the minimum criteria.

Section 3. The Division of Water Engineering Memorandum No. 5 outlined as follows: Section A. Definitions; Section B. Structure Classification; Section C. Hydrologic Criteria; Section D. Sediment Storage; Section E. Principal Spillways; Section F. Emergency Spillways; Section G. Earth Embankments; and Section E. Utilities Under Embankments; is hereby incorporated by reference and made a part of this regulation as if fully set out herein. Copies are available from the Division of Water upon request.

Section 4. Structure types not generally used in Kentucky, i.e., gravity, buttress, steel, timber, etc., will be considered on an individual basis and reviewed in accord with prevailing practices that are currently accepted by the engineering profession.

Section 5. In all cases the safety of the structure, the water and/or other material impounded therein, property and human life will be the principal governing factors. Under no circumstances will the proposed use of the structure and its contents, or the cost of providing an unquestionably safe structure be allowed to assume precedence over the possible hazard involved.

Section 6. Structures which are to be repaired or reconstructed must be made to conform to the criteria established by this regulation.

Section 7. Each of the following stated criteria indicates whether the limit is a maximum or minimum limit and is not to be construed as being satisfactory design criteria at all sites. Professional judgment, state laws and regulations, investigations, or analysis may dictate more conservative criteria.
Section 8. (1) Approval of all plans and specifications shall be divided into two (2) distinct parts:

(a) Issuance of a construction permit pursuant to KRS 151.250 shall constitute approval of the final engineering documents to allow construction to be started; and

(b) Final written approval by the department upon receipt of the "as-built" plans and specifications will constitute approval to impound.

(2) No approval to impound water and/or other material is implied or is in any way granted until the "as-built" plans and specifications have been approved, an on-site inspection has been made, and a written statement of approval issued. It is recommended that the owner and/or his engineer contact this division before initiation of final design for a pre-design conference.

Section 9. All plans and specifications submitted for consideration must bear the seal and signature of the responsible engineer as defined in KRS 322.010 (2), except officers and employees of the United States Government while engaged in engineering for the government. Each sheet of the drawings shall bear the seal and signature of the engineer or engineers responsible for its preparation.

Section 10. All structures, other-than Class A as defined in Engineering Memorandum No. 5 (2-1-75) shall have a complete sub-surface investigation and soil analysis submitted as an integral part of the drawings.

Section 11. (1) Elevation area capacity data and elevation discharge data must be submitted as a part of the plans for each structure. This elevation area capacity data shall give the area and capacities from the elevation of the lowest point in the impoundment area to at least the elevation at the top of the dam. When the configuration of the structure will not allow the elevation discharge relationship to be developed by methods accepted as standard by the engineering profession, the structure must provide the storage necessary to contain the entire storm runoff without probable damage to the structure or creating an unacceptable hazard to life or property.

(2) When this required basic information is furnished by the responsible design engineer, the Division of Water will upon request assist the engineering in preparing the floodroutings required by Engineering Memorandum No. 5.

(3) In the event that the elevation area capacity data is not furnished or the floodroutings show that insufficient floodwater storage has been provided, the plans will be returned to the design engineer without being approved.
Section 12. All information concerning elevations shall refer to mean sea level and the use of assumed elevations for any purpose is prohibited. Should an error in either the horizontal control or vertical control become known during construction, the necessary information to correct the distances and the elevations shall be referred to on the first sheet of the "as-built" drawings or referred to in the index. Clearly marked reference points and bench marks shall be maintained at the job site by the responsible engineer until final written approval is received.

Section 13. Unless waived in writing by the department, no structure shall be approved unless a positive means is provided to pass water through the structure in sufficient quantity to satisfy the needs of downstream users and to empty the reservoir within a reasonable length of time. Conditions considered in determining downstream water requirements and required minimum time to empty the impoundment shall be determined by the responsible engineer and referred to on the drawings.

Section 14. Construction supervision and inspection must be performed by or under the direction of the design engineer. Unless otherwise directed by the department the engineer shall submit monthly progress reports on forms to be supplied by the department. Copies of all testing reports shall be submitted with the progress reports.

Section 15. All "as-built" documents shall be submitted by the responsible engineer in the form of permanent type drawings of a standard and uniform size. Variations in size will be permitted for federal agencies in order that they may use their standard drawings. Drawings that do not conform to standard practices or drawings that are not easily legible will not be accepted.

Section 16. Because of the department's statutory duty to review federal projects for the Commonwealth under KRS 151.220, the United States Army Corps of Engineers is exempt from the provisions of this regulation and KRS 151.250.

ADOPTED: March 12, 1975
RECEIVED BY LRC: March 13, 1975 at 2:31 p.m.
RELATES TO: KRS 151.250
PURSUANT TO: KRS 151.125, 224.033(17), 224.045(6)(b), 13.082
SUPERSEDES: DOW-Rg-3

NECESSITY AND FUNCTION: This regulation is necessary to exempt certain dams, embankments, levees, dikes, bridges, fills, and other stream obstructions proposed in conjunction with surface and deep mining from the provisions of KRS Chapter 151 to avoid duplication of effort within the Department for Natural Resources and Environmental Protection.

Section 1. As a part of the routine processing of application for permits for surface mining and the surface effects of deep mining, the engineering staff of the Division of Permits, Bureau of Surface Mining Reclamation and Enforcement, reviews all designs for dams, embankments, levees, dikes, bridges, fills, and other stream obstructions proposed in conjunction with surface or deep mining and, whereas a substantial number of such dams, embankments, levees, dikes, bridges, fills, and other stream obstructions are of such a size, type, and location as to present no potential hazard to life and/or property; this regulation exempts from the provision of KRS 151.250 all such dams, etc., as described above, except those dams which come within the hazard classification contained in Division of Water Engineering Memorandum No. 5 (2-1-75), and those obstructions as described, which, in the professional judgment of the Division of Permits engineering staff, present a potential hazard to life and/or property. Copies of Engineering Memorandum No. 5 (2-1-75) are available upon request from the Division of Water.

Section 2. Certified, "as-built" engineering plans for all dams which impound or divert water and/or other material and which (i) are twenty-five (25) feet or more in height or (ii) have an impounding capacity of fifty (50) acre-feet or more at the lowest point on the top of the dam must be forwarded by the Division of Permits to the Division of Water for inclusion in the Dam Safety Program required by KRS 151.295(c). Height is measured from the natural bed of the stream or watercourse at the downstream toe of the barrier to the low point in the top of the dam.

ADOPTED March 12, 1975
RECEIVED BY LRC: March 13, 1975, at 2:31 p.m.
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>SECTION A - DEFINITIONS</td>
<td>6</td>
</tr>
<tr>
<td>SECTION B - STRUCTURE CLASSIFICATION</td>
<td>8</td>
</tr>
<tr>
<td>SECTION C - HYDROLOGIC CRITERIA</td>
<td>11</td>
</tr>
<tr>
<td>SECTION D - SEDIMENT STORAGE</td>
<td>15</td>
</tr>
<tr>
<td>SECTION E - PRINCIPAL SPILLWAYS</td>
<td>16</td>
</tr>
<tr>
<td>SECTION F - EMERGENCY SPILLWAYS</td>
<td>25</td>
</tr>
<tr>
<td>SECTION G - EARTH EMBANKMENTS</td>
<td>34</td>
</tr>
<tr>
<td>SECTION H - UTILITIES UNDER EMBANKMENTS</td>
<td>35</td>
</tr>
</tbody>
</table>
SECTION A - DEFINITIONS

A spillway is an open or closed channel, or both, used to convey water from a reservoir. It may contain gates, either manually or automatically controlled, to regulate discharge of water.

The principal spillway is the ungated spillway designed to convey the water from the retarding pool at release rates established for the structure.

The emergency spillway of a dam is the spillway designed to convey water in excess of that impounded for flood control or other beneficial purposes.

The retarding pool is the reservoir space allotted to the temporary impoundment of floodwater. Its upper limit is the elevation of the crest of the emergency spillway.

Retarding storage is the volume in the retarding pool.

The sediment pool is the reservoir space allotted to the accumulation of submerged sediment during the life of the structure.

The sediment storage is the volume allocated to total sediment accumulation.

The sediment pool elevation is the elevation of the surface the anticipated sediment accumulation at the dam.

An earth spillway is an unvegetated open channel spillway in earth materials.

A vegetated spillway is a vegetated open channel spillway in earth materials.

A ramp spillway is a vegetated spillway constructed on the downstream face of an earth dam.

A rock spillway is an open channel spillway in durable rock materials.

A control-section in an open channel spillway is that section where accelerated flow passes through critical depth.

The inlet channel of an emergency spillway is the channel upstream from the control section.
The **exit channel** of an emergency spillway is that portion of the channel downstream from the control section which conducts the flow safely to a point where it may be released without jeopardizing the integrity of the structure.

The **emergency spillway-hydrograph** is that hydrograph used to establish the minimum design dimensions of the emergency spillway.

The **freeboard hydrograph** is the hydrograph used to establish the minimum elevation of the top of the dam.

**Joint extensibility** is the length of a pipe joint measured from the center of the gasket to the point of flare of the bell ring or collar when the joint is engaged.

**Joint gap** is the longitudinal dimension between the end face of the spigot end of a pipe joint and the corresponding face of the bell end of the connecting pipe. It does not include the beveled portions designed for sealing compounds.

The **rotation capacity** of a pipe joint is the maximum angular deflection possible for the joint without binding or loss of watertightness.

The **maximum possible high water** is the maximum elevation of the water surface that might be attained either above or below the structure, which may be attributed to structure.

The **height of the embankment** is the distance in feet measured from the natural bed of the stream or watercourse at the downstream toe of the barrier to the low point in the top of the dam.
SECTION B - STRUCTURE CLASSIFICATIONS

<table>
<thead>
<tr>
<th>I. CLASS OF STRUCTURES</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Class (A) - Low Hazard</td>
<td>9</td>
</tr>
<tr>
<td>B. Class (B) - Moderate Hazard</td>
<td>9</td>
</tr>
<tr>
<td>C. Class (C) - High Hazard</td>
<td>9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>II. STRUCTURES IN SERIES</th>
<th></th>
</tr>
</thead>
</table>
SECTION B - STRUCTURE CLASSIFICATION

In determining structure classification, a number of factors must be considered. Consideration must be given to the damage that might occur to existing and future developments downstream resulting from a sudden breach of the earth embankment and the structures themselves. The effect of failure on public confidence is an important factor. State and local regulations and the responsibility of the involved public agencies must be recognized. The stability of the spillway materials, the physical characteristics of the site and valley downstream, and the relationship of the site to industrial and residential areas all have a bearing on the amount of potential damage in the event of a failure.

Structure classification is determined by the above conditions. It is not determined by the criteria selected for design.

1. CLASS OF STRUCTURES

The following broad classes of structures are established to permit the association of criteria with the damage that might result from a sudden major breach of the structure.

A. Class (A) - Low Hazard

This classification may be applied for structures located such that failure would cause loss of the structure itself but little or no additional damage to other property. Such structures will generally be located in rural or agricultural areas where failure may damage farm buildings other than residences, agricultural lands, or county roads.

B. Class (B) - Moderate Hazard

This classification may be applied for structures located such that failure may cause significant damage to property and project operation, but loss of human life is not envisioned. Such structures will generally be located in predominantly rural agricultural areas where failures may damage isolated homes, main highways or major railroads, or cause interruption of use or service of relatively important public utilities.

C. Class (C) - High Hazard

This classification must be applied for structures located such that failure may cause loss of life, or serious damage to houses, industrial or commercial buildings, important public utilities, main
highways or major railroads. This classification must be used if failure would cause probable loss of human life.

The responsible engineer shall determine the classification of the proposed structure after considering the characteristics of the valley below the site and probable future development. Establishment of minimum criteria does not preclude provisions for greater safety when deemed necessary in the judgment of the engineer. Considerations other than those mentioned in the above classifications may make it desirable to exceed the established minimum criteria. A statement of the classification established by the responsible engineer shall be clearly shown on the first sheet of the plans.

II. STRUCTURES IN SERIES

When structures are spaced so that the failure of an upper structure could endanger the safety of a lower structure, the possibility of a multiple failure must be considered assigning the structure classification of the upstream structure.

Additional safety can be provided in either structure by (1) increasing the retarding storage and/or (2) increasing the emergency spillway capacity.
## SECTION C - HYDROLOGIC CRITERIA

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. RUNOFF</td>
<td>12</td>
</tr>
<tr>
<td>A. Structure in Series</td>
<td>12</td>
</tr>
<tr>
<td>II. PRINCIPAL SPILLWAY</td>
<td>13</td>
</tr>
<tr>
<td>III. EMERGENCY SPILLWAY</td>
<td>13</td>
</tr>
<tr>
<td>IV. FREEBOARD</td>
<td>13</td>
</tr>
<tr>
<td>V. MINIMUM HYDROLOGIC CRITERIA</td>
<td>14</td>
</tr>
</tbody>
</table>
SECTION C - HYDROLOGIC CRITERIA

I. RUNOFF

Procedures for hydrologic design as contained in the USDA Soil Conservation Service National Engineering Handbook, Section 4 "Hydrology" will be accepted. Copies of this publication are available from the U. S. Government printing office.

The specific references for runoff determination are found in Chapter 10. All runoff volumes for design purposes will be based on Antecedent Moisture Condition II or greater. Chapter 21 contains hydrologic procedures for determining principal spillway capacities, retarding storage, and emergency spillway and freeboard hydrographs.

A. Structures in Series

For the design of a lower structure in a series, if the total drainage area above a lower structure exceeds 10 square miles and Section B-II of this memorandum applies, it is necessary to apply two sets of storms for development of both the emergency spillway and the freeboard hydrographs.

The first set of design storms will be selected for the development of the uncontrolled drainage area above a lower structure. The dimensions of the emergency spillway for a lower structure under this condition will be determined by reservoir routings of hydrographs developed for each storm.

The second set of design storms will be selected for the entire drainage area above the lower structure. Each design storm rainfall is determined by using this area in the areal adjustment of rainfall amounts. These design storm durations are determined by using the time of concentration of this area assuming no upper structures are in place. The design storm hydrographs will be routed through the emergency spillways of the upstream structures and the outflow routed to the lower structure and combined with the hydrograph for the uncontrolled area. The dimensions of the emergency spillway for a lower structure under this condition will also be determined by reservoir routings of the hydrographs developed for each storm.

The design storm imposing the most severe flow condition at the lower structure will be used.
II. PRINCIPAL SPILLWAY

The retarding storage and associated principal spillway discharge will be such that the emergency spillway will not operate more frequently than indicated in Table F-I, Section B, Emergency Spillways. The inflow hydrograph or the minimum runoff volume for developing the balance between principal spillway capacity and retarding storage will be determined by procedures in Chapter 21, Section 4, SCS National Engineering Handbook. In areas where streamflow records can be regionalized and transposed to ungaged watersheds (based on the volume-duration-probability analyses), the Division of Water will authorize the use of these data for developing the principal spillway capacity and retarding storage. When other streamflow data are used, sufficient documentation must be prepared to show how these values were determined.

In the determination of the retarding storage and the principal spillway capacity, it is assumed that the initial reservoir stage is at the crest of the principal spillway.

III. EMERGENCY SPILLWAY

The emergency spillway hydrograph will be routed through the reservoir starting with a water surface at the elevation of the principal spillway inlet or at the water surface elevation after 10 days of drawdown, whichever is higher. The 10-day drawdown will be computed from the maximum water surface elevation which would be attained during the passage of the minimum principal spillway design runoff for that class of structure.

IV. FREEBOARD

The freeboard hydrograph for class (A) and (B) structures will be routed through the reservoir starting at the same water surface elevation as for the emergency spillway hydrograph. The routing of the freeboard hydrograph for class (C) structures may be started at the crest of the principal spillway.
V. MINIMUM HYDROLOGIC CRITERIA

Minimum hydrologic criteria are established for the development of each hydrograph as follows:

Emergency Spillway Hydrograph

Class (A) \[ P_A = P_{100} \]
Class (B) \[ P_B = P_{100} + 0.12 \times (PMP - P_{100}) \]
Class (C) \[ P_C = P_{100} + 0.26 \times (PMP - P_{100}) \]

Freeboard Hydrograph

Class (A) \[ P_A = P_{100} + 0.12 \times (PMP - P_{100}) \]
Class (B) \[ P_B = P_{100} + 0.40 \times (PMP - P_{100}) \]
Class (C) \[ P_C = PMP \]

in which \( P \) denotes 6-hour design rainfall, \( P_{100} \) refers to 6-hour, 100-year precipitation, and \( PMP \) represents 6-hour Probable Maximum Precipitation.

The above values may be obtained from the "Rainfall Frequency Atlas of the United States for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years", Technical Paper No. 40, Weather Bureau, U. S. Department of Commerce, Washington, D. C., and "Two To Ten-Day Precipitation For Return Periods of 2 To 100 Years In Contiguous United States", Technical Paper No. 49, Weather Bureau, U. S. Department of Commerce, Washington, D. C. These values may also be found in Division of Water, Kentucky Department for Natural Resources and Environmental Protection, Engineering Memorandum No. 2, “Rainfall Frequency Values for Kentucky.”

When hydrographs are required for drainage areas with times of concentration in excess of 6 hours, the above must be modified to reflect the appropriate storm period.

The establishment of the above criteria does not eliminate the need for sound engineering judgment but only establishes the lowest limit of design considered acceptable.

It is the responsibility of the design engineer to classify the structure and to determine if the design requirements are in excess of the minimum.
SECTION D - SEDIMENT STORAGE

Where the primary purpose is floodwater retardation or water storage or combination thereof, reservoirs are normally designed on the basis of a 50 to 100-year useful life. In order to assure full effectiveness, capacity must be provided in the reservoir to offset depletion due to sediment accumulation for a period equal to its design life.
## SECTION E - PRINCIPAL SPILLWAYS

| I. | CAPACITY OF PRINCIPAL SPILLWAYS | 17 |
| II. | ELEVATION OF PRINCIPAL SPILLWAYS | 17 |
| III. | DESIGN OF PRINCIPAL SPILLWAYS | 18 |
| A. | Layout | 18 |
| B. | Conduits | 18 |
| 1. | Rigid Pipe | 18 |
| a. | Minimum inside Diameters on Yielding Foundations | 19 |
| b. | Minimum Inside Diameters on Rock Foundations | 20 |
| 2. | Corrugated Metal Pipe | 20 |
| C. | Joints | 21 |
| D. | Anti-Seep Collars | 22 |
| E. | Cantilever Outlets | 23 |
| F. | Trash Racks | 23 |
| G. | Anti-Vortex Device | 23 |
| H. | Drawdown Facilities | 24 |
SECTION E - PRINCIPAL SPILLWAYS

All component parts of the principal spillway except attached gates and trash racks will be of equal durability. The structural design criteria and detailing of such spillways will conform to recognized standards and codes of practice.

I. CAPACITY OF PRINCIPAL SPILLWAYS

The required capacity of the principal spillway depends on (1) the benefits that accrue to the reduction of the discharge rate, (2) damages that may result from prolonged storage in the retarding pool, (3) damages that may result from prolonged outflow, (4) the possibility of occurrence of significant runoff from two or more consecutive storm events within the time required to empty the retarding pool, and (5) limitations in water rights or other legal requirements.

It is desirable that the retarding pool be emptied in ten (10) days or less. It may be assumed that this requirement has been met if eighty (80) percent of the maximum volume of retarding storage has been evacuated in the ten (10) day period. The use of a longer period must be justified by an appraisal of the considerations listed above.

The discharge through gated outlets will not be considered in determining the emptying time of the retarding pool unless a specific reservoir operation plan has been approved and included in the plans.

II. ELEVATION OF PRINCIPAL SPILLWAYS

The crest of a single stage principal spillway will be placed at the elevation of the 50-year sediment pool except where a higher elevation is justified. For a two stage principal spillway, the crest of the lower inlet will be set at the same elevation as for a single stage structure. When a period greater than 50 years has been used for evaluation, it is recognized that structural changes may be necessary to make the structure function effectively during the latter part of its life.

For dry dams, the riser will be designed to permit design discharge at the 50-year sediment pool elevation with provisions for discharging water at lower elevations to satisfy the functional requirements of the structure. Flood routings must start at or above the anticipated elevation of the 50-year sediment pool.

When water is stored for beneficial use, the elevation of the lowest ungated inlet of the principal spillway will be determined by the volume, area, or depth of water required for the planned purpose or purposes in addition to the anticipated sediment storage during the design life.
III. DESIGN OF PRINCIPAL SPILLWAYS

A. Layout

The barrel of drop inlets should be straight in alignment when viewed in plan. Any required changes in alignment will be accomplished by angle changes at joints which do not exceed five degrees or by special elbows having a radius equal to or greater than the diameter or width of the conduit. Thrust blocks of adequate strength will be provided where special pipe elbows are used. They will be designed to distribute the thrust, due to change in direction, for the maximum possible discharge.

Drop inlet barrels will be installed with sufficient camber to insure free drainage to the outlet of all parts of the barrel at the time of construction and under the maximum anticipated foundation consolidation.

B. Conduits

All conduits under an earth embankment must support the external loads imposed with an adequate factor of safety. They must withstand the internal hydraulic pressures without leakage under full external load and settlement. They must convey water at the design velocity without damage to the interior surface of the conduit.

Principal spillway conduits under earth dams must be designed to support fill heights greater than the original constructed height where there is a reasonable possibility that it may become desirable to raise the embankment height at a later date to incorporate additional storage.

Principal spillway conduits are to be of reinforced concrete pipe, cast-in-place reinforced concrete, or ductile iron pipe, unless corrugated steel or welded steel pipe is used in accordance with subsection III-B-2, which follows:

1. Rigid Pipe

Rigid drop inlet barrels will be designed as positive projecting conduits. For reinforced Concrete Water Pipe Steel Cylinder Type, Prestressed, meeting specification AWWA C-301, the 3-edge bearing strength at the first 0.001 inch crack will be used in the design analysis with a factor of safety of at least one.

For reinforced Concrete Water Pipe - Steel Cylinder Type - Not Prestressed meeting specification AWWA C-300, for Reinforced Concrete Water Pipe - Non-cylinder Type - Not Prestressed meeting specification AWWA C-302, and other types of reinforced concrete pipe, the
3-edge bearing strength at the first 0.01 inch crack will be used in the design analysis with a factor of safety of at least 1.33.

Ductile Iron Pipe may be used as a principal spillway conduit under certain conditions. Fill heights and foundation conditions require special considerations such that each use will be checked on an individual basis. Cradling or encasement in concrete may be required in most instances.

Elliptical or other systems of reinforcement requiring special orientation of pipe sections are not permitted in pipe drop inlet barrels.

Reinforced concrete pipe, with or without cradles, will be designed to support at least 12 feet of earth fill above the pipe at all points along the conduit.

These safety factors are for uniform conditions. They should be increased if the strength and compressibility of the foundation are not reasonably uniform.


Class (A) dams: The minimum diameter of the principal spillway barrel will be 30 inches except:

(1) Where a joint extension safety margin of 1.5 inches is used, in which case the minimum diameter is to be 18 inches for fill heights up to 50 feet and 24 inches for greater heights.

(2) Where the drop inlet is designed hydraulically in such a way that the flow in the barrel under all possible conditions of discharge and foundation consolidation is positively known to be open channel flow with the water surface in the conduit subject to atmospheric pressure only, in which case the minimum diameter will be 18 inches.

(3) Where corrugated metal pipe is used the principal spillway must be designed in accordance with conditions presented in Section III-B-2 below.

Class (B) dams: The minimum diameter of the principal spillway barrel will be 30 inches, except where a joint extension safety margin of 1.5 inches is used, in which case the minimum diameter will be 24 inches.

Class (C) dams: The minimum diameter of the principal spillway barrel will be 30 inches.

b. Minimum Inside Diameter on Rock Foundations

INFORMATIONAL COPY
Reprinted June, 1999
Class (A), (B), and (C) dams: The minimum diameter of the barrel of reinforced-concrete pressure pipe drop inlets for class (A) dams is to be 18 inches for heights up to 50 feet and 24 inches for heights greater than 50 feet, and 24 inches for all class (B) and (C) dams. The barrel and cradle or bedding are to rest directly on firm bedrock thick enough so that there is essentially no foundation consolidation under the barrel. Under these conditions the cradle under the pipe need not be articulated.

2. Corrugated Metal Pipe and Welded Steel Pipe

Principal spillways of corrugated metal pipe or welded steel pipe may be used for class (A) dams under the following conditions, all of which must be met:

a. The minimum diameter of the barrel will be 18 inches.

b. The height of fill over the pipe will be less than 25 feet.

c. Corrugated steel pipe is to be close riveted, asbestos treated, and asphalt coated, with watertight connecting bands. The minimum gage is to be that specified for 35 feet of fill over the pipe.

d. Welded steel pipe conduits are to conform to ASTM specifications A53, A120, A135, A139, or A134 and are be structurally designed as rigid pipe. A joint extension safety margin of 1.5 inches is to be provided for conduits on yielding foundations. Welded pipe is to be protected by an approved exterior coating.

e. Joints between lengths of corrugated steel or welded steel pipe, other than welded joints, are to electrically bridged on the outside of the pipe with insulated copper wire, #6 AWG or larger, securely attach to uncoated pipe metal at both sides of the joint. The requirement applies whether or not the cathodic protection is completed by the installation of anodes, etc. The wire should have a tough, waterproof insulation designed for direct burial, with a rating of at least 600 volts. Bare wire and exposed pipe metal at the points of connection are to be thoroughly coated with a coating equivalent the original pipe coating to prevent the entry of moisture.

f. Soil investigations for resistivity and pH of the subgrade and backfill materials to be adjacent to the conduit are to be made if corrugated steel or welded steel pipe is to be used. The resistivity measurements are to be made on saturated samples.
Department for Natural Resources and Environmental Protection  
Division of Water  
Engineering Memorandum No. 5

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g. Cathodic protection is to be provided for welded steel pipe conduits according to approved engineering criteria.

h. Cathodic protection meeting the above requirements is to be provided for corrugated steel pipe in soil whose resistivity in a saturated condition is less than 4000 ohms/cm³ or whose pH is lower than 5.0.

i. If cathodic protection for corrugated steel or welded steel pipe is not required according to the above criteria and is not installed during construction of the dam, pipe-to-soil potentials are to be measured within the first two (2) years after construction when the soil around the conduit is estimated to be at its normal post-construction moisture content, and cathodic protection is to be installed if such measurements indicate it is needed.

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C. JOINTS

Conduit joints will be designed and constructed to remain water tight under maximum anticipated hydrostatic head and maximum probable conditions of joint opening including the effects of joint rotation and a margin of safety where required.

The required joint extensibility is equal to the unit horizontal strain in the earth adjacent to the barrel, multiplied by the length (in inches) of the section of barrel between joints, plus the extension (in inches) due to calculated joint rotation, plus a margin of safety if required. A margin of safety of 0.5 inch is recommended. The required joint extensibility, plus the maximum permissible joint gap equals the required joint length.

The calculation of the required joint extensibility for any particular dam and spillway depends, among other things, on the evaluation of the maximum potential foundation consolidation under the spillway barrel. For Classes (B) and (C) dams, the consolidation will be estimated from adequate foundation borings and samples, soil mechanics laboratory tests and engineering analysis.

For those Class (A) dams where undisturbed foundation samples are not taken for other purposes, approximate procedures based on soil classification and experience will be used for estimating foundation consolidation. When AWWA C-302 or other types of reinforced concrete pipe are used, they will have rubber to steel joints.

Only joints incorporating a round rubber gasket set in a positive groove which will prevent its displacement from either internal or external pressure under the maximum designed joint extensibility will be used on precast concrete pipe drop inlet barrels.
Articulation of the barrel will be provided at each joint in the barrel and at the junction of the barrel and the inlet (riser). Concrete bedding for pipe drop inlets need not be articulated: cradles will be articulated when on yielding foundations.

D. Anti-Seep Collars

All conduits through earth embankments, foundations, and abutments will be provided with anti-seep collars.

The minimum number of anti-seep collars will be determined by the size of collars and the length of that portion of the conduit which lies in the saturated zone of earth embankment.

The following criteria will be used to determine the size and number of anti-seep collars.

Let $V =$ the vertical projection and minimum horizontal projection of the anti-seep collar in feet.

$L =$ Length in feet of that portion of the barrel of a drop inlet or culvert lying within the zone of saturation, measured from the downstream side of the riser to the toe drain, or point where phreatic line intersects the conduit.

$n =$ Number of anti-seep collars.

The length of the line of seepage is defined as the distance along the line of contact between the earth embankment and the barrel and the anti-seep collars from the upstream end of the barrel to the point of intersection of the barrel and the phreatic line. The ratio of the length of the line of seepage $(L + 2nV)$ to $L$ will not be less than 1.15.

Anti-seep collars should be equally spaced, except where necessary to avoid pipe joints, along that portion of the barrel within the saturated zone at distances of not more than 25 feet.

In the absence of positive evidence to the contrary (for purposes of computing anti-seep collar requirements) the location of the phreatic line in the earth dam embankment will be estimated on the assumption that the foundation of the embankment is impervious or that it is fully saturated.

E. Cantilever - Outlets

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22
The invert of cantilever outlets of pipe drop inlets or culverts at its lower end will be at least one foot above the tailwater elevation of the downstream channel at maximum discharge.

Cantilever outlets will be supported on bents or piers and will extend a minimum of eight feet beyond the bents or piers. The bents will be located downstream from the intersection of the downstream slope of the earth dam embankment with the grade line of the channel below the dam. They will extend below the lowest elevation anticipated in the scour hole.

In determining the depth of the stilling basin, full consideration must be given to the total energy to be dissipated. The stilling basin will be excavated when soil conditions at the downstream end of the cantilever outlet indicate that a stilling basin will not be readily formed without extensive erosion of channel banks or the embankment.

Adequate safeguards must be taken to insure that the seepage forces into the stilling basin will not result in a piping failure.

F. Trash Racks

Trash racks will be designed and built to provide positive protection against clogging of the spillway at any point. The average velocity of flow through a clean trash rack will not exceed two feet per second with the water elevation in the reservoir five feet above the top of the trash rack or at the crest of the emergency spillway whichever is lower. Velocity will be computed on the basis of the net area of opening through the rack.

For dry dams, a trash rack may be used in lieu of a ported concrete riser. The principal spillway trash rack will extend sufficiently above the anticipated sediment elevation at the inlet to provide full design flow through the spillway with velocities through the net area of the trash rack above the sediment elevation not in excess of two feet per second when the water surface in the reservoir is five feet above the top of the trash rack.

G. Anti-Vortex Device

All closed conduit principal spillways designed for pressure flow will have an adequate anti-vortex device.
H. Drawdown Facilities

The necessary drawdown facility for any dam may be made an integral part of the principal spillway structure if the principal spillway configuration warrants, but in no case will the drawdown facility be allowed to be valved on the downstream side of the embankment. This precludes in any case a wet line under pressure through the embankment.

This above stated requirement will be waived in the case of a water supply line through the dam but provision must be made for a positive shutoff on the upstream side of the structure.
SECTION F - EMERGENCY SPILLWAYS

I. SPILLWAY REQUIREMENTS 26

A. Capacity of Emergency Spillways 26

B. Elevation of the Crest of the Emergency Spillway 26

C. Hydraulic Design 27

II. VEGETATED AND EARTH EMERGENCY SPILLWAYS 27

A. Layout 28

   1. Special Precautions for Class C Structures 29

B. Frequency of Use of Earth and Vegetated Emergency Spillways 29

C. Permissible Velocity in Vegetated or Earth Emergency Spillways 30

   1. Vegetated Emergency Spillways 31

      a. Ramp Spillways 31

   2. Earth Emergency Spillways 32

III. ROCK EMERGENCY SPILLWAYS 33

IV. STRUCTURAL EMERGENCY SPILLWAYS 33

V. WATER SURFACE PROFILE 33
Emergency spillways are provided to convey large flows safely past an earth embankment. They are usually open channels excavated in earth or rock or constructed of compacted embankment or reinforced concrete.

An emergency spillway must be provided for each structure, unless the principal spillway is large enough to pass the routed freeboard hydrograph discharge and the trash that comes to it. A conduit type principal spillway having a barrel with a cross-sectional area of 36 square feet or more, an inlet which will not clog, and an elbow designed to facilitate the passage of trash, is a minimum size and design that may be utilized without an emergency spillway. If a principal spillway of this type and size is not provided, danger from clogging requires the use of an emergency spillway regardless of the volume of storage provided.

A single uncontrolled open channel spillway may be used for all purposes provided it is designed to accommodate all discharges, including the freeboard storm, without damage to the structure. However, a positive means to drain the lake must also be provided unless waived in writing by the Director.

I. SPILLWAY REQUIREMENTS

A. Capacity of Emergency Spillways

Emergency spillways will be proportioned so that they will pass the emergency spillway hydrograph at the safe velocity determined for the site. They will have sufficient capacity to pass the freeboard hydrograph with the water surface in the reservoir at or below the elevation of the settled height of the dam. When the principal spillway is of the size and design that requires the use of an emergency spillway, the capacity of the emergency spillway will not be less than that determined from

\[ Q = 230 \times A^{0.5} \]

where \( Q \) is the spillway capacity in cubic feet per second and \( A \) is the drainage area in square miles but in no case shall a \( Q \) of less than 200 cfs be used.

B. Elevation of the Crest of the Emergency Spillway

The minimum crest elevation of the emergency spillway depends on the frequency of operation selected for the specific site. The minimum retarding storage volume and the associated...
principal spillway discharge will be such that the emergency spillway discharge will not occur during the routing of the runoff from any duration storm of the selected frequency.

C. Hydraulic Design

The relationship between the water surface elevation in the reservoir and the discharge through the emergency spillway will be evaluated by computing the head losses in the inlet channel upstream of the control section, or if a control section is not used, by computing the water surface profile through the full length of the spillway.

Manning's formula will be used to evaluate friction losses and determine velocities. Policy on the selection of the "n" values is given in the discussion of the various types of emergency spillways.

II. VEGETATED AND EARTH EMERGENCY SPILLWAYS

Vegetated and earth emergency spillways are open channels and usually consist of an inlet channel, a control section, and an exit channel (see Section A - Definitions). Subcritical flow exists in the inlet channel and the flow is normally supercritical in the exit channel.

Vegetated emergency spillways are usually trapezoidal in the cross-section and are protected from damaging erosion by a grass cover. They are adapted to sites where a vigorous grass growth can be sustained by normal maintenance without irrigation.

Earth spillways are used in those areas where vegetative growth cannot be maintained. They are similar to vegetated spillways but are designed for lower permissible velocities and less frequent use. Normally they will require more maintenance after a flow occurs.

Earth and vegetated emergency spillways are designed on the basis that some erosion or scour may be permissible if its occurrence is infrequent, if maintenance facilities are provided, and if damage from a severe storm, as represented by the freeboard inflow hydrograph, will not endanger the structure.

A Manning's "n" of 0.040 will be used for determining the velocity and capacity in vegetated spillways. Permissible velocities in earth spillways will be based on an “n” value of 0.020 but the capacity of earth spillways will be based on an appraisal of the roughness condition at the site.
A. Layout

Emergency spillways should be located away from the dam site whenever possible. Topographic saddles generally make good sites.

The layout and profile of vegetated or earth spillways should provide a maximum bulk of material to provide safety against breaching of the spillway during the passage of the freeboard hydrograph. This can be accomplished by the proper selection of the location and layout of the spillway. A long, non-deepened inlet section will provide more bulk but has the disadvantage of requiring a higher stage in the reservoir for any given discharge. The exit channel should be as long as reasonably practical with just sufficient slope to meet hydraulic design requirements. The characteristics and layering of the materials on which the spillway is built must be considered in estimating the volume required to prevent breaching.

The inlet channel will be level for a minimum distance of 30 feet upstream from the control section. This level part of the inlet channel will be the same width as the exit channel, and its centerline will be straight and coincident with the centerline of the exit channel. A curved centerline is permissible in the inlet channel upstream from the level section, but it must be tangent to the centerline of the level section.

The centerline of the exit channel will be straight and perpendicular to the control section for a distance equal to at least one-half of the maximum base width of the dam. Curvature may be introduced below this point if it is certain that the flowing water will not impinge on the dam should the channel fail at the curve.

When a control section is utilized, the grade of the exit channel should be sufficient to insure supercritical flow for all discharges equal to or greater than 25 percent of the maximum discharge through the emergency spillway during the passage of the emergency spillway hydrograph. However, the slope in the exit channel need not exceed 4 percent (s=0.04 ft/ft) to meet this requirement.

The spillway discharge may be conducted by an exit channel to a point some distance above the stable grade of the natural stream channel. When this is done, the discharge is allowed to spread naturally over the existing topography and find its way to the channel downstream. This layout involves no consideration of velocities beyond the exit channel and during spillway discharge there may be considerable erosion on those reaches not designed on a permissible velocity basis.

Another approach is to construct a channel from the end of the exit channel to stable grade below. In this case, the lower constructed channel may be designed with higher velocities than are permissible in the exit channel proper. This assumes that erosion in the lower, well defined,
improved channel may be less damaging than that occurring where the discharge is permitted to meander over the natural relief in reaching stable grade.

In both layouts erosion will occur wherever the permissible velocities are exceeded and maintenance will be required to protect the integrity of the spillway.

1. Special Precautions for Class (C) Structures

Special consideration must be given to the layout of spillways on human hazard structures to assure that the spillway will not breach under the most extreme conditions of flow. The length of the exit channel should be increased to the maximum extent possible so that the area most subject to erosion is at a considerable distance from the dam. Within the limitations of the site, the profile of the spillway will be such that a maximum bulk of material is provided.

It is preferable that the flow be confined without the use of levees, but when they are necessary they will be high enough so that they will not be overtopped during the passage of the freeboard hydrograph. Levees will be constructed of erosion resistant materials and will be compacted to the degree necessary to develop this resistance. They will have a toe width not less than 12 feet and, if not protected with riprap, have side slopes not steeper than 3 horizontal to 1 vertical. When constructed on foundations subject to piping or undermining, they will be keyed into the foundation with a compacted core having a width not less than the top width of the levee and sufficient depth to reach sound material, or at least equal to the height of the levee.

Where the bulk or quality of the material in the spillway may be questionable, it may be desirable to provide a crest control structure at the control section. The purpose of this structure is to stabilize the crest of the emergency spillway for at least the period equal to the passage of the freeboard hydrograph. It is subject to eventual failure if the exit channel is not properly maintained.

Consideration should also be given to the reduction of the duration of flow through the emergency spillway by raising the elevation of the crest of the emergency spillway, thereby increasing the volume of storage in the retarding pool. An alternate or complementary procedure is to increase the capacity of the principal spillway by means of a two stage inlet of sufficient size to have an appreciable effect on the outflow hydrograph of the reservoir.

B. Frequency of Use of Earth and Vegetated Emergency Spillways

Table F-I gives the permissible frequency of use of earth and vegetated emergency spillways. For earth spillways, it refers to sites where peak flow of short duration may be expected, and where erosion resistant soils and moderate slopes exist. When vegetated spillways are used,
the sites must have these same characteristics, and in addition, conditions must be such that vigorous vegetation can be maintained without irrigation.

### TABLE F-1
ALLOWABLE FREQUENCY OF USE OF EMERGENCY SPILLWAYS

<table>
<thead>
<tr>
<th>Class of Structure</th>
<th>Earth Once In</th>
<th>Vegetated Once In</th>
<th>Rock Once In</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A)</td>
<td>50 years</td>
<td>25 years</td>
<td>10 years</td>
</tr>
<tr>
<td>(B)</td>
<td>100 years</td>
<td>50 years</td>
<td>25 years</td>
</tr>
<tr>
<td>(C)</td>
<td>100 years</td>
<td>100 years</td>
<td>50 years</td>
</tr>
</tbody>
</table>

When conditions are less favorable, spillways must be designed for less frequent use by (1) raising the elevation of their crest, (2) providing a second stage of greater capacity to the principal spillway, or (3) increasing the capacity of the principal spillway.

The maintenance required for the emergency spillway will be increased as the flow frequency and duration increases. Good design requires balancing the spillway maintenance cost against the increased cost of modifying the other elements of the dam to reduce the flow frequency.

### C. Permissible Velocity in Vegetated Earth Emergency Spillways

The maximum velocity limitations given below for vegetated or earth emergency spillways apply to the exit channel. They must not be exceeded from the control section to a point where (1) the distance from the control section is at least equal to one-half the maximum base width of the embankment and (2) a channel failure might cause the flow to impinge on the toe of the dam. The velocity limitations are based on the capacity required by routing the emergency spillway hydrograph and the assumption that uniform flow conditions exist in the exit channel. When the spillway is of the minimum capacity as determined by $Q=230 \cdot A^{0.5}$, the velocity limitation will only apply to the lesser flow that would be developed by routing the emergency spillway hydrograph.

1. **Vegetated Emergency Spillways**
When the anticipated average use of a vegetated emergency spillway is more frequent than once in 50 years, the maximum permissible velocity will be in accordance with the values given in Table F-II. The values may be increased 10 percent when the anticipated average use is not more frequent than once in 50 years or 25 percent when the anticipated average use is not more than once in 100 years.

The values given will be the upper limit for all grasses. Values for grasses or grass mixtures will be determined by comparison with the values shown, with due consideration given to the growth characteristics and density attained in the local area by the species under consideration.

Where bona fide studies or investigations have been made to determine the permissible velocity for a specific soil, and site, these values may be used in lieu of those shown in Table F-II.

**TABLE F-II**

PERMISSIBLE VELOCITIES FOR VEGETATED ARTS SPILLWAYS

<table>
<thead>
<tr>
<th>Grasses or Grass Mixtures</th>
<th>Soil Type</th>
<th>Slope</th>
<th>Permissible Velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Erosion Resistant</td>
<td>0 - 5%</td>
<td>8.0 fps</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 - 10%</td>
<td>7.0 fps</td>
</tr>
<tr>
<td></td>
<td>Easily Eroded</td>
<td>0 - 5%</td>
<td>6.0 fps</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 - 10%</td>
<td>5.0 fps</td>
</tr>
</tbody>
</table>

a. **Ramp Spillways**

The use of ramp spillways is prohibited.
2. **Earth Emergency Spillway**

The permissible velocity in earth spillways will be chosen after due consideration of the soils involved, the frequency of use of the spillway and other pertinent factors. Table F-III is taken from Fortier and Scobey's study, “Permissible Canal Velocities After Aging”, and may be helpful in determining this velocity. The values given for non-cohesive soils are quite applicable and should not be exceeded unless bona fide studies have demonstrated that higher velocities are permissible. The table is not strictly applicable for cohesive soils since it applies to canal beds that are seasoned (perhaps permitting higher velocities) and subject to continuous flow and under conditions where erosion damage cannot be tolerated (requiring lower velocities).

**TABLE F-III**

**PERMISSIBLE CANAL VELOCITIES AFTER AGING***

<table>
<thead>
<tr>
<th>Original Material Excavated</th>
<th>Feet/Second</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine sand, non-colloidal</td>
<td>1.50**</td>
</tr>
<tr>
<td>Sandy loam, non-colloidal</td>
<td>1.75</td>
</tr>
<tr>
<td>Silt loam, non-colloidal</td>
<td>2.00</td>
</tr>
<tr>
<td>Alluvial silts, non-colloidal</td>
<td>2.00</td>
</tr>
<tr>
<td>Ordinary firm loam</td>
<td>2.50</td>
</tr>
<tr>
<td>Volcanic ash</td>
<td>2.50</td>
</tr>
<tr>
<td>Fine gravel</td>
<td>2.50</td>
</tr>
<tr>
<td>Stiff clay, very colloidal</td>
<td>3.75</td>
</tr>
<tr>
<td>Graded, loam to cobbles, non-colloidal</td>
<td>3.75</td>
</tr>
<tr>
<td>Alluvial silts, colloidal</td>
<td>3.75</td>
</tr>
<tr>
<td>Graded silt to cobbles, colloidal</td>
<td>4.00</td>
</tr>
<tr>
<td>Coarse gravel, non-colloidal</td>
<td>4.00</td>
</tr>
<tr>
<td>Cobbles and shingles</td>
<td>5.00</td>
</tr>
<tr>
<td>Shale and hardpans</td>
<td>6.00</td>
</tr>
</tbody>
</table>

* Recommended in 1926 by Special Committee on Irrigation Research, American Society of Civil Engineers.

** Values shown apply to clear water, no detritus.

On easily erodible soils, consideration should be given to the use of mechanical control on the spillway crest to maintain the elevation and position of the control section.

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32
III. ROCK EMERGENCY SPILLWAYS

Some of the principles used for the layout of earth emergency spillways are applicable to rock emergency spillways. Allowable average frequency of use and permissible velocities must be ascertained for the specific site based on a knowledge of the hardness, condition, durability, and structure of the rock formation. An individual appraisal is necessary to determine the proper roughness coefficient, “n”. In the absence of a complete investigation and a written recommendation to design the spillway as a rock spillway, the material shall be considered earth. A note showing the engineer's recommendation and bearing his seal and signature shall be a part of the plans. Table F-I gives the permissible frequency of use of rock emergency spillways.

IV. STRUCTURAL EMERGENCY SPILLWAYS

Chutes or drops, when used for emergency spillways, will be designed in accordance with the principles set forth in SCS National Engineering Handbook, Section 5, "Hydraulics", Section 11, "Drop Spillways", and Section 14, "Chute Spillways".

All structural concrete shall be designed by a registered professional engineer and shall conform to the latest accepted design codes.

V. WATER SURFACE PROFILE

The design engineer shall compute a complete water surface profile for both the emergency spillway storm and freeboard storm, to include an energy grade line, between the upstream and downstream normal flow depths. This profile shall be a part of the plans and be of such detail as to delineate the required information.
SECTION G - EARTH EMBANKMENTS

I. HEIGHT

The earth embankment will be high enough to prevent overtopping with the most severe of the following conditions: (1) the passage of the freeboard hydrograph or (2) the passage of the emergency spillway hydrograph, plus the necessary freeboard required by the site for frost conditions or wave action.

II. TOP WIDTH

The top width of earth embankments will not be less than the value given by the following equation:

\[ W = \frac{H + 35}{5} \]

where \( H \) = Height of embankment in feet.
\( W \) = Minimum top width of embankment in feet.

III. WAVE EROSION PROTECTION

The earth embankment will be riprapped or other wave protection provided over the full range in stage between the lowest drawdown elevation and at least a few feet above the full normal pond elevation.
SECTION H - UTILITIES UNDER EMBANKMENTS

Existing pipelines, cables and conduits of a wide variety of sizes, materials and functions are frequently encountered at dam sites. These conduits usually are located at shallow depth in flood plain. They constitute a hazard to the safety of the dam and must be (1) relocated away from the site or (2) reconstructed or modified to provide the durability, strength and flexibility equal in all respects to the principal spillway designed for the site.

Every reasonable effort should be made to have such conduits, cables, and pipelines removed from the site. Most utilities and industries will want their facility removed from the site for easy maintenance. Only as a last resort and under the limitations imposed will conduits be permitted to remain under an earth dam embankment.

Conduits permitted to remain under any part of the embankment below the crest of the emergency spillway must be (1) provided with anti-seep collars when the location of the pipe creates a piping potential, (2) properly articulated on all yielding foundations, (3) encased in concrete or otherwise treated to insure durability and strength equal to that of the principal spillway, and (4) made absolutely watertight against leakage either into or out of the pipe.

Enclosure of the conduit, cable or pipeline within another conduit which meets the requirements of this section and which is positively sealed at the upstream end to prevent seepage into the enclosing conduit is acceptable. Such an enclosing conduit will extend the full distance through which the conduit being enclosed is beneath the embankment.

RELATES TO: KRS 151.250

STATUTORY AUTHORITY: KRS 151.125, 224.01-110(6)(b), 224.10-100(17)

NECESSITY, FUNCTION, AND CONFORMITY: This administrative regulation is necessary to establish minimum design criteria for dams and associated structures constructed in Kentucky.

Section 1. This administrative regulation applies to all dams as defined by KRS 151.100 and to all other impounding obstructions which might create a hazard to life or property.

Section 2. Except as modified in this administrative regulation, the procedures outlined by the latest edition of “Design of Small Dams” (Second Edition, 1973), available from the U.S. Government Printing Office and the Department of Reclamation, herein filed by reference, shall be the minimum criteria.

Section 3. The Division of Water Engineering Memorandum No. 5 (2-1-75) outlined as follows: Section A. Definitions; Section B. Structure Classification; Section C. Hydrologic Criteria; Section D. Sediment Storage; Section E. Principal Spillways; Section F. Emergency Spillways; Section G. Earth Embankments; and Section H. Utilities Under Embankments; is hereby incorporated by reference and made a part of this administrative regulation as if fully set out herein. Copies are available from the Division of Water upon request.

Section 4. Structure types not generally used in Kentucky, i.e. gravity, buttress, steel, timber, etc., will be considered on an individual basis and reviewed in accord with prevailing practices that are currently accepted by the engineering profession.

Section 5. In all cases the safety of the structure, the water and/or other material impounded therein, property and human life will be the principal governing factors. Under no circumstances will the proposed use of the structure and its contents, or the cost of providing an unquestionably safe structure be allowed to assume precedence over the possible hazard involved.

Section 6. Structures which are to be repaired or reconstructed must be made to conform to the criteria established by this administrative regulation.

Section 7. Each of the following stated criteria indicates whether the limit is a maximum or minimum limit and is not to be construed as being satisfactory design criteria at all sites. Professional judgment, state laws and administrative regulations, investigations, or analysis may dictate more conservative criteria.

Section 8. (1) Approval of all plans and specifications shall be divided into two (2) distinct parts:
   (a) Issuance of a construction permit pursuant to KRS 151.250 shall constitute approval of the final engineering documents to allow construction to be started; and
   (b) Final written approval by the cabinet upon receipt of the “as-built” plans and specifications will constitute approval to impound.

   (2) No approval to impound water and/or other material is implied or is in any way granted until the “as-built” plans and specifications have been approved, an on-site inspection has been made, and a written statement of approval issued. It is recommended that the owner and/or his engineer contact this division before initiation of final design for a predesign conference.

Section 9. All plans and specifications submitted for consideration must bear the seal and signature of the responsible engineer as defined in KRS 322.010(2), except officers and employees of the United States Government while engaged in engineering for the government. Each sheet of the drawings shall bear the seal and signature of the engineer or engineers responsible for its preparation.

Section 10. All structures, other than Class A as defined in Engineering Memorandum No. 5 (2-1-75) shall have a complete subsurface investigation and soil analysis submitted as an integral part of the drawings.

Section 11. (1) Elevation area capacity data and elevation discharge data must be submitted as a part of the plans for each structure. This elevation area capacity data shall give the area and capacities from the elevation of the lowest point in the impoundment area to at least the
elevation at the top of the dam. When the configuration of the structure will not allow the elevation discharge relationship to be developed by methods accepted as standard by the engineering profession, the structure must provide the storage necessary to contain the entire storm run-off without probable damage to the structure or creating an unacceptable hazard to life or property.

(2) When this required basic information is furnished by the responsible design engineer, the Division of Water will upon request assist the engineer in preparing the flood routings required by Engineering Memorandum No. 5 (2-1-75).

(3) In the event that the elevation area capacity data is not furnished or the flood routings show that insufficient floodwater storage has been provided, the plans will be returned to the design engineer without being approved.

Section 12. All information concerning elevations shall refer to mean sea level and the use of assumed elevations for any purpose is prohibited. Should an error in either the horizontal control or vertical control become known during construction, the necessary information to correct the distances and the elevations shall be referred to on the first sheet of the "as-built" drawing or referred to in the index. Clearly marked reference points and bench marks shall be maintained at the job site by the responsible engineer until final written approval is received.

Section 13. Unless waived in writing by the cabinet, no structure shall be approved unless a positive means is provided to pass water through the structure in sufficient quantity to satisfy the needs of downstream users and to empty the reservoir within a reasonable length of time. Conditions considered in determining downstream water requirements and required minimum time to empty the impoundment shall be determined by the responsible engineer and referred to on the drawings.

Section 14. Construction supervision and inspection must be performed by or under the direction of the design engineer. Unless otherwise directed by the cabinet the engineer shall submit monthly progress reports on forms to be supplied by the cabinet. Copies of all testing reports shall be submitted with the progress reports.

Section 15. All "as-built" documents shall be submitted by the responsible engineer in the form of permanent type drawings of a standard and uniform size. Variations in size will be permitted for federal agencies in order that they may use their standard drawings. Drawings that do not conform to standard practices or drawings that are not easily legible will not be accepted.

Section 16. Because of the cabinet's statutory duty to review federal projects for the Commonwealth under KRS 151.220, the United States Army Corps of Engineers is exempt from the provisions of this administrative regulation and KRS 151.250. (DOW-Rg-2; 1 Ky.R. 759; eff. 6-11-75.)
E.17. Louisiana
DAM SAFETY RULES AND REGULATIONS

Louisiana Department of Transportation and Development
TABLE OF CONTENTS

DAM SAFETY RULES AND REGULATIONS

Preface.............................................................................................................................................5
History ............................................................................................................................................5
Purpose ...........................................................................................................................................6
Applicability ..................................................................................................................................6
Permitting.......................................................................................................................................7
Submittals.......................................................................................................................................8
Design............................................................................................................................................8
Construction ................................................................................................................................13
Maintenance and Operation......................................................................................................13
Inspections ...................................................................................................................................14
Enforcement.................................................................................................................................14
Existing Structures .....................................................................................................................14
Emergency Preparedness Plans ..............................................................................................15
References ....................................................................................................................................15
### APPENDICES

<table>
<thead>
<tr>
<th>APPENDIX</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPENDIX A</td>
<td>Letters, Forms, Public Notice and Permits</td>
</tr>
<tr>
<td>APPENDIX B</td>
<td>Recommended Glossary</td>
</tr>
<tr>
<td>APPENDIX C</td>
<td>Figures 1 and 2</td>
</tr>
<tr>
<td></td>
<td>Figure 1 - Structures that are required to have an approved permit under the</td>
</tr>
<tr>
<td></td>
<td>State Dam Safety Program</td>
</tr>
<tr>
<td></td>
<td>Figure 2 - Structures that must be submitted to the Director, Public Works</td>
</tr>
<tr>
<td></td>
<td>and Flood Control Directorate, for review under the State Dam Safety Program</td>
</tr>
<tr>
<td>APPENDIX D</td>
<td>Form letter from owner of dam</td>
</tr>
<tr>
<td>APPENDIX E</td>
<td>Procedural Sequence</td>
</tr>
<tr>
<td>APPENDIX F</td>
<td>Minimum Hydrologic and Hydraulic Submittals</td>
</tr>
<tr>
<td></td>
<td>to establish Impact Classification and Inflow Design Flood (IDF)</td>
</tr>
<tr>
<td>APPENDIX G</td>
<td>Minimum Required Submittals</td>
</tr>
</tbody>
</table>
AKNOWLEDGEMENTS

The adopted rules and regulations were compiled after reviewing the works of various state and federal agencies and many professional organizations.

Special recognition is made to the following:

State of Oklahoma
State of Texas
State of Arizona
All other States submitting information for our review.
Department of the Army Corps of Engineers
Federal Emergency Management Agency
National Research Council
Committee on the Safety of Existing Dams
United States Committee of Large Dams
Association of State Dam Safety Officials
PREFACE

The Public Works and Flood Control Directorate of the Department of Transportation and Development serves as the Water Resources agency for the State of Louisiana, providing engineering and technical support for the orderly planning and development of programs and projects related to flood control, drainage, irrigation, water diversions, reservoirs, navigation, port development, hurricane protection, coastal engineering, and management and development of water resources.

Act No. 733 of the 1981 Legislature provides for a Dam Safety and Regulatory Program. The Public Works and Flood Control Directorate is charged with the responsibility for administering the program. The program is operated by the DOTD's Water Resources Design and Development Section, with administrative and enforcement authority vested in the Director of the Public Works and Flood Control Directorate.

HISTORY

More than 100 large dams in the United States have failed since 1930. The Baldwin Hills Reservoir near Los Angeles, the Teton Dam in Idaho, and the Barnes Lake Dam in Georgia are some of the better known failures. Dam disasters in the early 1970's, resulting in approximately 355 deaths and extensive property damage, led to the passage of the 1972 National Dam Inspection Act (Public Law 92-367, August 8, 1972). The Secretary of the Army, through the U.S. Army Corps of Engineers, was directed to inspect the majority of the nation's dams for protection of life and property. Yet, through November of 1976 no inspections had been conducted and the Corps recommended to Congress a program which emphasized voluntary state actions to inspect and regulate the 43,000 non-federal dams covered by the act. But, without federal assistance, many states could not conduct such a program.

In the summer of 1977, Congress appropriated $15 million, later increased to $18 million, for inspection of non-federal dams. In December of 1977, following the Barnes Lake Dam disaster which killed 39 persons, the president announced a federal program to inspect non-federal dams under the authority of the 1972 Act. The program's goal was to inspect approximately 9,000 non-federal, highly hazardous dams, at a cost of approximately $93 million. The president indicated that the federally-funded program could not be a substitute for effective dam safety action at the state level, and the program was intended to stimulate the states to action.

The Public Works and Flood Control Directorate was designated as Louisiana's representative in the program. A total of 343 dams were inventoried, of which 6 were classified as highly hazardous to downstream populations. In some instances, remedial measures were recommended to the dam owner for the protection of public safety. But, because Louisiana had no law relating to dam safety, the recommended measures could not be enforced.

With the passage of Act No. 733 of the 1981 Regular Session (L A. R.S. 38:21-28),
Louisiana acknowledged its responsibility of insuring the valuable resource of dams to their surrounding communities and also to protecting the life and property of the communities located downstream of dams, placing Louisiana in proper posture with the nationwide effort for dam safety.

**PURPOSE**

Simply stated, the purpose of Act No. 733 (LA. R.S. 38:21-28) is to recognize the inherent dangers posed by impoundments of significant volumes of water, and to require that owners of structures which impound water (or other liquids) assume the responsibility for that danger by ensuring that such structures are designed, constructed, and maintained so as to minimize the risk to life and property. Regardless of the circumstances of failure, the owner is ultimately responsible for loss of life and property damages that may occur from the failure of his dam.

The Department of Transportation and Development, Public Works and Flood Control Directorate, is charged with the responsibility for developing and enforcing a regulatory program to ensure that public safety and welfare is not compromised by the presence of dams or other impoundment facilities. The DOTD Dam Safety Program defines the minimum standards for the design, construction, operation, and maintenance of dams in the state of Louisiana, and DOTD has the responsibility and the authority to enforce the standards of the program. This manual documents the minimum standards for design, construction, operation and maintenance of dams and impoundment structures and the policies for the enforcement of those standards.

**APPLICABILITY**

The regulations of this program will govern the construction, enlargement, alteration or repair, maintenance and operation of all dams as defined by Act No. 733 (LA. R.S. 38:21-28) of the 1981 Regular Session of the Louisiana Legislature. The terms "dam" and "impoundment structure" are used interchangeably and shall mean the embankment, spillway(s), outlet works and other attendant parts. Included are all artificial barriers together with all appurtenant works which impound or divert water or any other liquid and which are:

1. Twenty-five feet or more in height and have an impounding capacity at maximum storage greater than fifteen acre-feet,
   or
2. Have an impounding capacity at maximum storage of fifty acre-feet or more and are greater than six feet in height (see Figure 1, Appendix C).
All barriers which are six feet or more in height with maximum storage capacities of fifteen acre-feet or more must be submitted to DOTD for review (see Figure 2, Appendix C). The height of a dam is measured from the natural bed of the stream or watercourse at the downstream toe of the barrier, or if it is not across a stream or watercourse, the height from the lowest elevation of the outside limit of the barrier, to the top of the dam. The capacity at maximum storage is the volume in the reservoir in acre-feet when the water level in the reservoir is at top of dam elevation.

PERMITTING

APPLICATION FOR PERMIT -- A permit from the DOTD will be required prior to constructing any new impoundment structure or commencing any structural modifications to existing impoundment structures (see Appendix A). Permit forms may be obtained from the Director, Public Works and Flood Control Directorate, Louisiana Department of Transportation and Development, P.O. Box 94245, Baton Rouge, Louisiana, 70804-9245. The permitting process is designed to ensure that new structures and modifications to existing structures are designed and constructed in accordance with the requirements documented herein.

NATURAL RESOURCES CONSERVATION SERVICE -- The approval process may be abbreviated if dams meet the requirements of Pond Standard 378 of the Natural Resources Conservation Service National Handbook for Conservation Practices and the Natural Resources Conservation Service's engineering staff provides the design, layout, and construction inspection. In this case, the Natural Resources Conservation Service will certify that the dam design and construction meets the requirements of Pond Standard 378 and they will provide DOTD with the Pond Data Sheet, a map showing the location of the pond, and a letter signed by the owner of the dam (see Appendix D). The Natural Resources Conservation Service will agree to periodically inspect the structure to ensure that Pond Standard 378 is being maintained, and to inform the DOTD if the structure ever falls below Pond Standard 378. NOTE: Natural Resources Conservation Service formerly the "Soil Conservation Service".

PUBLIC HEARINGS -- After an application has been filed and accepted, the public in the affected locale will be notified by publication in the local news publication. The Director of Public Works and Flood Control will prepare a notice, assigning a date and place for a public hearing of the application. The notice will contain information describing the application and the name and address of the applicant (see Appendix A). It will be the applicant's responsibility to have the notice published once a week for two consecutive weeks in the official journal of the parish in which the project will be constructed, and shall
provide notarized proof of publication on or before the hearing date. The applicant will bear the cost of the publication. The DOTD will conduct the public hearing, and the applicant will be required to attend to describe the nature and purpose of the proposed project and to answer questions.

**ISSUANCE OF A PERMIT** – An "Impoundment Permit/Certificate of Completion" shall be issued for all dams, both existing and new construction. The "Impoundment Permit/Certificate of Completion" is not transferable. The owner of a dam must notify the DOTD 30 days prior to transferring ownership of the dam, and must return the "Impoundment Permit/Certificate of Completion" to the DOTD.

**FAILURE TO OBTAIN APPROVAL** -- If, prior to beginning construction, the owner fails to obtain approval, the owner will be cited and fined under the statutory authority of Louisiana Revised Statute, Title 38, Section 28. Also, the lake may be ordered to be drained until all approvals have been obtained.

**SUBMITTALS**

All designs for work to be permitted under the program will be submitted for review and approval with all necessary supportive documentation (See Appendix G). Normally, it is expected that an owner or prospective owner will establish contact with the DOTD to apply for a permit to construct or modify a dam. An example of a letter notifying the DOTD of intent to construct or modify a dam is provided in Appendix A. In some cases, however, structures are built and water is impounded without the knowledge or approval of the DOTD. When such structures are discovered, the owners will be contacted by the DOTD and required to furnish documentation that their structure meets the safety requirements of the program. In either case, the applicant will be guided by the Water Resources Design and Development Section throughout the review and approval process. The documentation required will be formal engineering designs and calculations, supported by sufficient field information, and certified by a professional civil engineer registered to practice in Louisiana. Because each step in the design of a dam is dependant upon the quality of the design judgements made in the previous steps, the applicant is advised to coordinate each of the three formal design stages, identified in the next section, with the DOTD review team prior to proceeding to the next step.

After general designs have been approved, the applicant may proceed with plans and specifications, which will also require approval before construction can begin. Plans and specifications will be of professional engineering detail and quality and will include all information and directions necessary to construct the dam in accordance with the design intent.

**DESIGN**
The proper design of a dam involves a complex combination of engineering applications. It is not within the scope or intent of this document, nor will it be the practice of the staff of DOTD, to instruct in the detailed procedures for the design of a dam. All dams and impoundment structures to be permitted under this program will be designed by a professional civil engineer(s), registered by the Louisiana State Board of Registration for Professional Engineers and Land Surveyors. The registered civil engineer will certify the designs and plans by professional seal. Designs must conform to nationally recognized standards, further explained in the following paragraphs and in the reference material. The completed design package will state the intended design life of the structure, and will include the operations and maintenance procedures necessary to ensure that the structure will function as designed for its stated design life.

Failure of an impoundment structure and the instantaneous release of large volumes of water is referred to as a dam breach and is the primary risk associated with dams, and is the fundamental reason for the state to assume regulatory authority over dams through the Dam Safety Program. Breaching may occur during fair weather due to the cumulative effects of erosion or seepage, or it may occur as a result of stresses caused by excess water produced during a storm event. The hydraulic and hydrologic (H&H) design will determine which of the two scenarios poses the greater hazard, the volume of water which is likely to be released, and the rate of flow.

It is the H&H design which determines the volumes and flow rates with which the impoundment structure(s) must contend. The geotechnical and structural designs must ensure that the impoundment structure(s) can safely accommodate the hydraulic forces imposed by the conditions predicted by the H&H design. Following are the sequential steps which are necessary in any dam/impoundment structure design, and each step must be documented with design calculations and all supporting data, certified by a Registered Professional Civil Engineer:

I. Hydrology and Hydraulics (H&H) Design
   A. Impact (Hazard) Classification
   B. Determination of controlling design condition and associated storm runoff.
   C. Setting of spillway and stilling basin widths and elevations, top of embankment elevation, and normal pool stage.

II. Structural and Geotechnical Design of Embankment, Spillways, and Drawdown Structures.

III. Development and Documentation of Operations and Maintenance Procedures.

Note: For the purpose the Dam Safety Program, the “Emergency Spillway” shall be defined as being overtopped by the 100 year storm or greater and the “Principal Spillway” shall be defined as being overtopped by a storm less than the 100 year storm.

HYDROLOGY AND HYDRAULICS (H&H) DESIGN -- Before the structural design of the dam can begin, the requirements of hydraulic capacity must be determined. The height of the dam, the amount of freeboard above normal pool elevation, the size and
capacity of the principle and emergency spillways, must all be designed to balance the hydrological and hydraulic properties of the location of the reservoir. A properly designed drawdown structure, capable of reducing the stage of the reservoir at a suitable rate in the event of emergency, must also be designed to meet the capacity requirements of the site.

The H&H design begins with the Impact Classification (also referred to as Hazard Classification in some texts) of the dam (See Appendix F). The Impact Classification is determined by an evaluation of the probable maximum impacts of a dam breach. Low impact structures are those for which, because of size and/or location, little or no significant damage to life or property is likely to result from a failure of the structure. Significant impact structures are those which could cause appreciable damage to property or could pose possible threat to human life in the event of failure. High impact structures are those for which failure would cause excessive property damage or make loss of human life likely.

Note: The inflow design flood (IDF) is determined by the various Hydrograph Methods after the precipitation amount is developed. The major source of precipitation data is the National Weather Service (NWS). The DOTD has final authority for approval of the method to be utilized to determine the IDF.

<table>
<thead>
<tr>
<th>IMPACT CATEGORY</th>
<th>POTENTIAL LOSS OF LIFE</th>
<th>POTENTIAL ECONOMIC LOSS</th>
<th>MINIMUM INFLOW DESIGN (IDF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW</td>
<td>NOT LIKELY</td>
<td>MINIMAL</td>
<td>50-Yr. Freq.</td>
</tr>
<tr>
<td>SIGNIFICANT</td>
<td>POSSIBLE</td>
<td>APPRECIABLE</td>
<td>100-Yr. Freq.</td>
</tr>
<tr>
<td>HIGH</td>
<td>LIKELY</td>
<td>EXCESSIVE</td>
<td>1/2 PMF</td>
</tr>
</tbody>
</table>

Further guidance in assessing the potential hazards and associated impact classification for dams may be found in Reference 1. It is the responsibility of the owner/applicant to establish impact classification, and all dams will be considered to be of High Impact potential until demonstrated to be otherwise by a documented analysis provided by the applicant. The proposed impact classification must be supported by sufficient analysis and documentation, and DOTD will have final authority for assigning Impact Classification.

Having established the Impact Classification for the structure, the next step is to establish the magnitude of the meteorological event on which the entire design is to be based. Dams must be designed to be able to safely withstand the passage of a flood of design magnitude. The Inflow Design Flood (IDF) is the largest storm event to be considered in the design of the structure, and the magnitude of the storm event for which
the IDF is computed is related to the Impact Classification. The values shown for IDF in Table I are minimums, and the actual storm event to be used as the IDF will be determined by a site specific analysis. For low impact structures, the primary consideration is the protection against loss of the dam and its benefits in the event of failure, while for significant and high impact structures, adequate protection of life and property must be assured.

For dams classified as high impact, the IDF is defined as the flood event above which a breach of the dam does not increase hazard to downstream interests. The upper limit of the IDF for high impact structures is the Probable Maximum Flood (PMF), which is the flood which may be expected from the most severe combination of critical meteorological and hydrological conditions which are reasonably possible. While the PMF is the upper limit for the IDF, the IDF for high impact dams may be an event of smaller magnitude, depending upon an incremental hazard assessment, which is a routing of floods of increasingly larger magnitude through the structure and downstream channel reaches, comparing conditions with and without a dam failure, until a flood magnitude is reached for which the dam failure condition does not appreciably increase the hazard potential.

Dams classified as having significant impacts may or may not require a formal incremental hazard evaluation, depending upon the extent of existing and potential downstream development, the size of the reservoir, and the type and use of the dam. The upper limit of the IDF for significant impact structures is the PMF.

For dams with low impact classification, the incremental hazard evaluation is not required, and the IDF can be based upon factors related to loss of service of the dam, potential maintenance costs, etc., but with the 50-Yr. frequency storm being the minimum design event. The Water Resources Design and Development Section should be a partner in establishing the IDF, and designs should not proceed until agreement has been reached between the DOTD and the owner's engineer on the choice of the IDF. Establishing the IDF is the foundation for the entire design process, since the dam must be designed to safely pass and/or contain the IDF. A guideline for performing the incremental hazard evaluation necessary to establish the IDF is provided in Reference 1.

How the IDF is to be safely passed by the dam structure and the stability of the dam against the long-term effects of hydrostatic forces is the subject of the balance of the design effort, including the general configuration of the dam; length, elevation, and composition of principal and emergency spillways; freeboard above normal pool elevation; erosion protection; and stability design. The most practical way of assuring the integrity of the dam during an IDF is to provide a concrete spillway which is capable of carrying the peak flow of the storm. Principal spillways are normally sized to carry flows from all but the largest of storms, with emergency spillways, which are not normally armored, functioning only during
major storm events. If the peak flow from the IDF can be contained within the principal and emergency spillways, the stability of the dam is not likely to be threatened by the erosive action of water flowing over the embankment. The designer may wish to balance the relative economy of providing spillway capacity versus storage capacity above normal pool stage. But, if design calculations indicate that the embankment will be overtopped by the IDF, provisions must be included in the design to prevent the embankment from failing under the erosive forces of the overtopping flows.

GEOTECHNICAL DESIGN -- It is essential to the stability of the structure that the material used in the impoundment structure, as well as the foundation and adjoining earth have the necessary structural properties to withstand the hydrostatic forces required by the design, that potential for destructive seepage is identified and appropriately dealt with, and that the surfaces of the structure are adequately protected from surface erosion.

Field investigations shall be adequate to define the soils and ground water conditions with respect to stability and seepage control. Stability analysis should consider after-construction conditions, based on the undrained shear strength parameters determined by laboratory tests. Long-term steady seepage, partial pool, and rapid drawdown analyses should also be performed, using shear properties appropriate to the subject materials and minimum safety factors shown in Table II.

| TABLE II |
| FACTOR OF SAFETY |
| FOR STABILITY ANALYSIS |
| ANALYSIS CONDITION | FACTOR OF SAFETY |
| Rapid Drawdown | 1.25 |
| Partial Pool | 1.40 |
| Steady Seepage | 1.40 |
| After Construction | 1.30 |
| Earthquake | 1.15 |
STRUCTURAL DESIGN -- Structural Designs are to be prepared in accordance with generally accepted structural engineering practices such as those of the American Concrete Institute, the American Institute of Steel Construction and the American Institute of Timber Construction. Components of the spillway or other appurtenant structures shall be designed to resist the most critical loading combination of dead loads plus live loads that may occur during its construction or design life. Some of the loads which must be considered in the design are: buoyancy forces, sliding forces, hydrostatic uplift forces, bearing forces, overturning forces, water drag forces, wing drag forces, gate-lifting and closing forces, soil and water pressure forces, impact forces, uniform and point live load forces, etc. The minimum factors of safety for buoyancy and sliding shall be 1.5 and 2.0, respectively. The overturning analysis must indicate that the resultant force falls within the center 1/3 of the base. The minimum factor of safety for pile design shall be 2.0.

CONSTRUCTION

It will be the owner's responsibility to ensure by the presence of professional construction supervision personnel that the structure is built in strict compliance with the approved designs and specifications. Adequate records shall be maintained to document that all materials and construction procedures meet or exceed those specified. The owner shall report on the construction to the DOTD. The work of construction, enlargement, alteration, repair or removal of a dam or reservoir for which approved application, designs, plans and specifications are required shall be under the responsible charge of a registered civil engineer. Upon completion of the work and prior to the impoundment of water, the engineer shall certify that all work has been done in compliance with the approved plans and specifications (Appendix A).

During construction, periodic inspections may be made by representatives of DOTD. The owner will be required to provide such works or tests as may be needed to disclose sufficient information to enable DOTD to determine that conformity with approved plans and specifications is being maintained. Inspections made by DOTD are "limited inspections" and do not relieve the owner or the owner's engineer from their responsibilities for conformance to accepted designs and procedures.

MAINTENANCE AND OPERATION

Once in service, the integrity of the impoundment structure must be sustained by regular maintenance, in accordance with the approved Operations and Maintenance document provided by the designer. The Operations and Maintenance Manual should contain forms and schedules for records and documentation of inspections, maintenance procedures, and repairs. The owner will be responsible for certifying, through properly documented records, to the DOTD that the required periodic inspections have been made, for correcting any deficiencies revealed during such inspections, and for maintaining
records of all operations and maintenance activities, as well as of original construction and any subsequent modifications.

An Emergency Preparedness Plan is required for all dams and reservoirs. The plan shall comply with the guidelines of the current issue of Louisiana's "Emergency Action Plan Guidelines", available from the DOTD's Director of Public Works and Flood Control. The Emergency Preparedness Plan will be a condition of the permit for the project, and it will be the owner's responsibility to implement the provisions of the plan in the event of emergency.

**INSPECTIONS**

The DOTD will periodically inspect every dam in the jurisdiction of the program. The purpose of the DOTD inspections is to ascertain whether the structure is being properly maintained in accordance with the approved Operations and Maintenance procedures. DOTD inspections are limited inspections and do not relieve the owner of responsibility to perform and document periodic inspections. If an inspection by DOTD reveals that a dam is unsafe or in danger of becoming unsafe, the DOTD, through the Director of Public Works and Flood Control, shall direct the owner to take whatever action is necessary to restore the dam to its design condition.

The owner has the primary responsibility for insuring the safe condition of the structure by regular maintenance and periodic inspection. The owner is required to immediately inform the Director of Public Works and Flood Control of any unusual circumstances or occurrences which may affect the condition or safety of the reservoir. Also, the Director will be notified prior to any planned draw downs of the reservoir.

**ENFORCEMENT**

If any dam or impoundment structure is determined to be unsafe, the Director of Public Works and Flood Control for the Department of Transportation and Development, pursuant to La R.S. 38:21-28, shall direct any such repairs or remediations for a dam or impoundment structure as he deems necessary to ensure that life and property is not unduly threatened by the impoundment. Such remedial action may include (1) directing that the water level behind the structure be lowered to a safe level, or (2) that the impoundment be completely drained until all necessary corrections to the structure have been made.

**EXISTING STRUCTURES**

All dams constructed or under construction prior to the promulgation of these rules will be reviewed to assess their disposition under the program regulations. Each dam is unique and must be judged on the basis of its own particular set of circumstances. Based on the circumstances of each individual case, a judgement will be made of what modifications or repairs are necessary to meet program standards. It is the intent of the program to eventually have every dam upgraded to meet program standards. DOTD will be the sole judge of whether an existing deficiency creates an unacceptable risk to the
general public. While it is not the intent of this program to lower the standards for existing dams, DOTD recognizes that it is not practical to force all dam owners to immediately retrofit their structures to meet new minimum Inflow Design Flood standards.

An "Impoundment Permit" is required for existing dams and will be issued after reviewing all historical data (designs, plans, specifications, operation and maintenance records, etc.) and performing a technical inspection (or inspections) to adequately assess the safety of the dam. The owner shall provide all historical data, if available.

EMERGENCY PREPAREDNESS PLAN

An Emergency Preparedness Plan is required for all dams and reservoirs both existing and new construction (See page 21, "Existing Structures"). The plan will comply with the guidelines of the current issue of Louisiana's "Emergency Action Plan Guidelines", available from the Director of Public Works and Flood Control, and shall be submitted as a necessary component of the Maintenance and Operating Procedures as a condition of the permitting process. It is the owner's responsibility that the provisions of the Emergency Action Plan are implemented in the event of an emergency situation.

A breach analysis is required to develop the emergency preparedness plan. The breach analysis will establish the magnitude of the inundated area (inundation map), peak flood elevations and arrival times of the peak flood elevations at critical locations. The worst case scenario breaching event will be somewhere between the "sunny day" breach and that event above which a breach of the dam does not increase hazard to downstream interests. If the dam owner wants to perform only one breach analysis instead of doing incremental analyses to find the worst case scenario breaching event, he can perform a breach analysis where the tail water is at the average annual elevation and the reservoir is at maximum design surcharge.

REFERENCES


Baton Rouge, Louisiana; telephone (504) 767-9131.
APPENDIX A
LETTERS, FORMS, PUBLIC NOTICE AND PERMITS

LETTER OF INTENT

Purpose: To notify the Louisiana State Dam Safety Program of the applicant's intent to construct, enlarge, alter, repair or remove a dam within the state.

Address To: Louisiana State Dam Safety Program
            Louisiana Department of Transportation and Development
            Public Works and Flood Control Directorate
            Post Office Box 94245
            Baton Rouge, Louisiana 70804-9245

Contents: 1) Name of proposed or existing dam

            2) Purpose of dam

            3) Owner's:
               Name
               Address
               Telephone

            4) Location of dam (section, township, range, parish)

            5) Brief description of proposed dam construction, enlargement, alteration, repair or removal

               *6) Height of Dam (height in feet from top of dam to lowest point at downstream toe of dam)

               *7) Reservoir Capacity (volume in acre-feet with water at top of dam)

*NOTE: Items 6 and 7 can be approximated at this time.
Letters of No Objection and Other Permits

The applicant must forward copies of the pre-application to the appropriate state, federal and local agencies to obtain letters of no objection and/or permits as required by these agencies. Copies of the letters of no objection and permits must be submitted to the Louisiana State Dam Safety Program as part of the applicant's application under this program.

Pursuant to the rules and regulations of the State Dam Safety Program as established by Act No. 733 of the 1981 Regular Session, interested parties are hereby notified that a "Letter of Intent" and a "Pre-Application for Construction of Dam" have been received by the Director, Public Works and Flood Control Directorate, Department of Transportation and Development to construct the proposed Dam and Reservoir Pre-Application Number PA located in Section , Township) , Range , Parish.

Applicant:

(Name)

(Address)

(Phone)

Purpose and Brief Description of Dam:

All interested parties are hereby notified that a public hearing on the application will be held at p.m. on at . Any interested party shall have the right to request a public hearing on the application. Requests for public hearings must be in writing and must be submitted no later than the close of the public hearing on . Letters must state, with particularity, the reasons for holding a public hearing, applicant's name and Pre-application number. Upon receiving a written request for a hearing within the time limits set forth in
this notice, the Director, Public Works and Flood Control Directorate, shall set a date, time and place for conducting a hearing on the application. During the hearings, any interested party shall have the right to protest the application and to appear and present evidence and testimony in support of such protest.

**Letter for Approval of Construction**

Purpose: To notify the applicant of the "Approval for Construction" of his "Application for Construction of Dam".

Address To: Applicant with copy to applicant's consulting engineering firm.
**Letter of “Notice of Completion and As-Built Drawing”**

**Purpose:** To notify the Louisiana State Dam Safety Program that the construction of the subject project is complete and to certify that said construction was done in accordance with the approved designs, plans, drawings and specifications.

**From:** Applicant's Consulting Engineering Firm (letter must be signed and sealed by a Registered Professional Civil Engineer licensed in the State of Louisiana).

**Address To:** Louisiana State Dam Safety Program  
Louisiana Department of Transportation and Development  
Public Works and Flood Control Directorate  
Post Office Box 94245  
Baton Rouge, Louisiana 70804-9245

**Note:** As-Built Drawings must be received by the Director, Public Works and Flood Control Directorate, within 30 days after completion.

**Private Impoundment Permit**  
(Certificate of Completion)

**Purpose:** Authorizes the Owner of a Dam and Reservoir to impound water at his facility. Certifies that the applicant has met all requirements under the State Dam Safety Program (see sample next page).
ABUTMENTS - Those portions of the valley sides which underlie and support the dam structure, and are usually also considered to include the valley sides immediately upstream and downstream from the dam.

AUXILIARY OR EMERGENCY SPILLWAYS - A secondary spillway designed to operate only during unusually large storm events. Louisiana's dam safety program defines "unusually large storm events" as being equal to the 100 year storm event or larger.

BAFFLE BLOCKS - Baffle blocks are blocks constructed in a stilling basin to dissipate the energy of fast flowing water.

BERM - The berm of the dam is a horizontal step in a sloping profile. The berm is usually constructed with a slight slope for drainage purposes. The berm is often referred to as a seepage or stability berm.

BLANKET DRAIN - The blanket drain is a horizontal pervious zone located downstream of the impervious core. This zone is often referred to as a sand blanket.

BREACH - An eroded opening through a dam that drains the reservoir. A controlled breach is an intentionally constructed opening. An uncontrolled breach is an unintentional opening that allows uncontrolled discharge from the reservoir.

CHIMNEY DRAIN - The chimney drain is a vertical pervious zone located just downstream of the impervious core. The chimney drain is usually constructed with a sand material.

COFFERDAM - A temporary structure enclosing all or part of the construction area so that the construction can proceed in the dry.

CONDUIT - A conduit is a closed channel to convey discharges through or under a dam. The conduit can be a reinforced concrete pipe, a corrugated metal pipe or a single or multi-barrel reinforced concrete box culvert.

CREST LENGTH OF DAM - The crest length of the dam is the length of the top of dam. This length includes the spillway(s) and other appurtenant structures. The crest length of dam is basically the length from where the top of dam terminates on one abutment to a similar point on the other abutment.
CUTOFF TRENCH - The cutoff trench is an impervious barrier built into the foundation to reduce seepage under the dam. A cutoff wall or slurry wall could be used as a seepage barrier. The slurry wall is relatively thinner in the horizontal direction when compared to a clay core cutoff trench.

DAM - A dam is any artificial barrier, including appurtenant works, which does or will impound or divert water or any other liquid substance.

DOWNSTREAM SLOPE - The inclined surface of an embankment dam that faces away from the reservoir.

DRAWDOWN STRUCTURE - A drawdown structure is a low level outlet which can be used to lower the reservoir below normal pool stage. This may be necessary for lake management purposes, routine repairs or dam safety purposes.

EARTHFILL DAM - A dam constructed predominantly of fine-grained material. Earthfill dams are also known as rolled fill dams where material is placed in layers and compacted by using rollers or rolling equipment.

END SILL - The end sill is the area at the upstream and downstream end of the stilling basin base slab.

FOUNDATION OF DAM - The foundation of the dam is the natural material on which the dam is placed.

HEEL OF DAM - The heel of the dam is the junction of the upstream slope with the foundation. The heel of the dam is often referred to as the upstream toe.

IMPERVIOUS CORE - The impervious core is a zone of low permeability material. This zone is the water or seepage barrier and is often referred to as the clay core.

INTAKE STRUCTURE - The structure placed at the beginning of an outlet works waterway. The intake structure establishes the ultimate drawdown level of the reservoir by the position of its opening(s) to the outlet works. Intake structures may be vertical or inclined towers (drop inlets).

MAXIMUM CROSS SECTION DAM - Cross section of a dam at the point where the height of the dam is a maximum.

NON-OVERFLOW WALL - Non-overflow walls are walls which are usually constructed parallel to the spillway crest at an elevation equal to the top of dam elevation. These walls
are not designed to be overtopped and are often referred to as a closed dam section.

**NORMAL POOL STAGE** - Normal pool stage for controlled spillways is defined as the water level at the dam to which water may rise under normal operating conditions. This does not include flood surcharge.

**OUTLET GATE** - The outlet gate is a gate on the drawdown structure or spillway which is used to control the outflow of water. These gates are usually located on the upstream end of the drawdown structure, however, they can be located of the downstream end.

**RIPRAP** - Riprap is a layer of large uncoursed stones, broken rock or precast blocks placed in a random fashion on the upstream slope of the dam and stilling basin outlets. Riprap is a flexible type of slope protection which will deform if material is displaced from beneath.

**PIPING** - The progressive internal erosion of an embankment, foundation, or abutment material. The erosion (piping) begins on the downstream side and progresses upstream.

**PROBABLE MAXIMUM FLOOD (PMP)** - The flood that may be expected from the most severe combination of critical meteorologic conditions that are possible in the region.

**PRIMARY OR PRINCIPAL SPILLWAYS** - Primary or principal spillways are the first used spillway during flood flows.

**RETAINING/TRAINING WALLS** - Retaining/training walls are walls which are usually constructed perpendicular to the spillway crest. Retaining walls are walls which support an overturning load. Training walls are walls which confine or guide the flow of water. In many instances, these walls serve both purposes and can be referred to as either a retraining or training wall.

**RISER** - A type of drop inlet spillway with a vertical section of metal or concrete pipe that allows the reservoir to rise to a predetermined level before water flows into the pipe.

**SLOPE** - The embankment slope is the inclined face of the embankment spillway, channel. The slope can be an upstream slope or a downstream slope. The upstream slope is on the lake or reservoir side of the dam.

**SLOPE PROTECTION** - Slope protection is protection against wave action or erosion. The two most common types of slope protection, are riprap and soil cement.

**SLUICE** - A low-level opening for releasing water from a dam.
SOIL CEMENT - Soil cement is a well compacted mixture of soil, portland cement and water that produces a hard pavement. Soil cement is usually placed in horizontal layers. Soil cement is a rigid type of slope protection which attempts to span voids.

SPILLWAY CREST - The spillway crest is the overflow section or weir section of the spillway.

STILLING BASIN - A stilling basin is a basin constructed to dissipate the energy of fast flowing water. The stilling basin area is located just downstream of the spillway crest between the training/retaining walls.

STRUCTURAL HEIGHT - The distance between the lowest point in the excavated foundation and the top of the dam.

SURCHARGE/FLOOD SURCHARGE - Surcharge/flood surcharge is the volume or space between normal pool and the maximum water level.

TAILWATER - Tailwater is the level of water immediately downstream of the dam.

TOE OF DAM - The toe of the dam is the junction of the downstream slope with the foundation. The toe of the dam is often referred to as the downstream toe.

TOP OF DAM/CROWN - The top of dam is the uppermost surface of the dam. The top of dam can also be referred to as the crest of the dam. When the term "crest" is used, it must be specified that it is the "crest of the dam" and not the "crest of the spillway".

UNCONTROLLED OR UNGATED SPILLWAYS - Uncontrolled or ungated spillways are spillways where the flows over the spillway crest are controlled only by the elevation of the spillway crest. This type of spillway is often referred to as a fixed crest spillway. Normal pool stage for uncontrolled spillways is defined as the lowest crest elevation of the principal spillway.

UPSTREAM SLOPE - The inclined surface of an embankment dam that is in contact with the reservoir.
FIGURE 1

Structures that are required to have an approved permit under the State Dam Safety Program.

- Height (feet): 6, 10, 15, 20, 25, 30, 40, 50, 60
- Capacity (acre-feet): 15, 50, 75, 100, 125

Not in State Dam Safety Program.
FIGURE 2

Structures that must be submitted to the Director, Public Works and Flood Control Directorate for review under the State Dam Safety Program.

- No preapplication is required.

Height (Feet):
- 6
- 10
- 20
- 30
- 40
- 50
- 60

Capacity (Acre-Feet):
- 15
- 25
- 50
- 75
- 100
- 125
APPENDIX D
FORM LETTER FROM OWNER OF A DAM

DATE:

Dam Safety Administrator
Louisiana DOTD
P. O. Box 94245, Capitol Station
Baton Rouge, Louisiana 70804-9245

RE: Pond Construction

I am aware that the design, construction and operation of all dams within Louisiana is regulated by the Rules and Regulations for Dam Safety Program as developed by the State of Louisiana, Department of Transportation and Development. I am also aware of the liability that is associated with owning a dam.

Since I am receiving design and construction assistance from the Natural Resources Conservation Service, formerly Soil Conservation Service, the dam described below is excluded from the approval process outlined in the Dam Safety Regulations. However, if for some reason (such as a land use change) the dam no longer comes within the criteria of the Soil Conservation Service National Handbook for Conservation Practices - Standard 378, I agree to modify the structure if necessary to comply with the requirements of the Dam Safety Regulations. I also agree to allow access for inspection of this structure.

Sincerely,

OWNER

DAM LOCATION:

APPENDIX E
PROCEDURAL SEQUENCE

(New Construction)

1. Applicant or his Engineer submits "Letter of Intent"
2. Applicant or his Engineer submits "Pre-Application for Construction of Dam"
3. Applicant publishes "Notice of Application" and a "Public Hearing(s)" is (are) held
4. Applicant or his Engineer completes "Designs, Plans and Specifications" as follows and submit "Application for Construction of Dams"
   a. "Impact (Hazard) Classification"
   b. Determination of controlling design condition and associated storm runoff
   c. Setting of spillway and stilling basin widths and elevations, top of embankment elevation, and normal pool stage
   d. Plans, Specifications, Designs and other Submittals
5. DOTD issues "Approval or Denial of Application"; Approval is an "Approval for Construction"
6. Construction begins; Applicant or his Engineer and DOTD performs "Construction Inspections"
7. If "Deficiencies" are found by DOTD, Applicant or Applicant's Engineer; Applicant or his Engineer correct the deficiencies
8. Supervision of Construction by Owner
9. Applicant or his Engineer submits "Notice of Completion" and "As-Built Drawings" and final "Application for Construction of Dam"
10. DOTD issues "Certificate of Completion/Impoundment Permit"
11. Applicant or his Engineer submits "Maintenance and Operation Procedures" for DOTD's approval
12. Applicant or his Engineer submits "Emergency Preparedness Plan" for DOTD's approval
Since the required submittals may vary for each dam, we recommend that you obtain copies of references number 1 and 2 on page 25 of the Dam Safety Rules and Regulations. After reviewing these documents, we would advise that you contact the Hydraulic Unit of the DOTD for further guidance.
1) All structural, geotechnical, hydrologic and hydraulic design calculations. An engineer's report shall also be submitted which summarizes the design analyses and shall include, but is not limited to, the following:

   a) Formulas, methods and basic data assumptions used in the designs.
   
   b) List of all pertinent design codes.
   
   c) Summary tables which list design load cases, computed design factors of safety and required factors of safety as specified in these Rules and Regulations or required by pertinent design codes.
   
   d) All other information which aided in evaluating the design, supported assumptions and conclusions, and will facilitate an independent review.

2) Plans with sufficient details to construct all features of the dam in accordance with the design intent. Also, the plans shall include details to construct a permanent reference mark (bench mark) near, but separate from, the project. The exact location and elevation above mean sea level must be noted on the "As-Built" plans.

3) Specifications with sufficient details to construct all features of the dam in accordance with the design intent. The specifications shall also provide that the plans and specifications may not be changed without prior written approval by the DOTD.

4) Document(s) to show proof of ownership.

5) An inspection plan specific to the construction activity. The inspection plan is to
detect deficiencies or situations that may result in a threat to life and property.

6) An emergency action plan specific to the construction activity. The inspection plan in item 5 is part of the emergency action plan under this item.

7) If the applicant has an agreement or contract with another entity who will be responsible for the operation and maintenance of the dam, the applicant must provide copies of the agreement or contract document(s).

8) If the applicant is constructing the dam for the specific purpose of transferring ownership to a homeowners' association, a landowners' association, or any other entity, the applicant must provide a document which clearly states his intent, i.e., a dam which is constructed for a subdivision development where ownership will be transferred to a homeowners' association.

9) All other "Permits" required to construct the dam and "Letters of No Objection" which were obtained from various regulatory entities.

10) "As-Built" plans.

11) "Operation and Maintenance Manual".

12) "Emergency Preparedness Plan".

NOTE: The applicant should submit 2 copies of all preliminary submittals. The applicant must submit 5 copies of all final submittals.
Chapter 21. Dam Safety Program

§2101. Dam Safety

A. Introduction

1. The Public Works and Flood Control Directorate of the Department of Transportation and Development (DOTD) serves as the Water Resources agency for the state of Louisiana, providing engineering and technical support for the orderly planning and development of programs and projects related to flood control, drainage, irrigation, water diversions, reservoirs, navigation, port development, hurricane protection, coastal engineering, and management and development of water resources.

2. R.S. 38:21-28 legislation provides for a Dam Safety and Regulatory Program. The Public Works and Flood Control Directorate is charged with the responsibility for administering the program. The program is operated by the DOTD's Water Resources Design and Development Section, with administrative and enforcement authority vested in the Director of the Public Works and Flood Control Directorate.

B. Purpose. The purpose of R.S. 38:21-28 is to recognize the inherent dangers posed by impoundments of significant volumes of water, and to require that owners of structures which impound water (or other liquids) assume the responsibility for that danger by ensuring that such structures are designed, constructed, and maintained so as to minimize the risk to life and property. Regardless of the circumstances of failure, the owner is ultimately responsible for loss of life and property damages that may occur from the failure of his dam. The Department of Transportation and Development, Public Works and Flood Control Directorate, is charged with the responsibility for developing and enforcing a regulatory program to ensure that public safety and welfare is not compromised by the presence of dams or other impoundment facilities. The Louisiana Dam Safety Program defines the minimum standards for the design, construction, operation, and maintenance of dams in the state of Louisiana, and the DOTD has the responsibility and the authority to enforce the standards of the program. This rule documents the minimum standards for design, construction, operation and maintenance of dams and impoundment structures and the policies for the enforcement of those standards.

C. Glossary

Abutments: Those portions of the valley sides which underlie and support the dam structure, and are usually also considered to include the valley sides immediately upstream and downstream from the dam.

Auxiliary or Emergency Spillway: A secondary spillway designed to operate only during unusually large storm events. Louisiana's Dam Safety Program defines "unusually large storm events" as being equal to the 100 year storm event or larger.

Baffle Blocks: Blocks constructed in a stilling basin to dissipate the energy of fast flowing water.
Berm Ca horizontal step in a sloping profile. The berm is usually constructed with a slight slope for drainage purposes. The berm is often referred to as a seepage or stability berm.

Blanket Drain Ca horizontal pervious zone located downstream of the impervious core. This zone is often referred to as a sand blanket.

Breach Ca eroded opening through a dam that drains the reservoir. A controlled breach is an intentionally constructed opening. An uncontrolled breach is an unintentional opening that allows uncontrolled discharge from the reservoir.

Chimney Drain Ca vertical pervious zone located just downstream of the impervious core. The chimney drain is usually constructed with a sand material.

Cofferdam Ca temporary structure enclosing all or part of the construction area so that the construction can proceed in the dry.

Conduit Ca closed channel to convey discharges through or under a dam. The conduit can be a reinforced concrete pipe, a corrugated metal pipe or a single or multi-barrel reinforced concrete box culvert.

Crest Length of Dam Ca the length of the top of dam. This length includes the spillway(s) and other appurtenant structures. The crest length of dam is basically the length from where the top of dam terminates on one abutment to a similar point on the other abutment.

Cutoff Trench Ca impervious barrier built into the foundation to reduce seepage under the dam. A cutoff wall or slurry wall could be used as a seepage barrier. The slurry wall is relatively thinner in the horizontal direction when compared to a clay core cutoff trench.

Dam Ca any artificial barrier, including appurtenant works, which does or will impound or divert water or any other liquid substance.

Downstream Slope Ca the inclined surface of an embankment dam that faces away from the reservoir.

Drawdown Structure Ca low-level outlet which can be used to lower the reservoir below normal pool stage. This may be necessary for lake management purposes, routine repairs or dam safety purposes.

Earthfill Dam Ca a dam constructed predominantly of fine-grained material. Earthfill dams are also known as rolled fill dams where material is placed in layers and compacted by using rollers or rolling equipment.

End Sill Ca the area at the upstream and downstream end of the stilling basin base slab.

Foundation of Dam Ca the natural material on which the dam is placed.

Heel of Dam Ca the junction of the upstream slope with the foundation. The heel of the dam is often referred to as the upstream toe.

Impervious Core Ca zone of low permeability material. This zone is the water or seepage barrier and is often referred to as the clay core.

Intake Structure Ca the structure placed at the beginning of an outlet works waterway. The intake structure establishes the ultimate drawdown level of the reservoir by the position of its opening(s) to the outlet works. Intake structures may be vertical or inclined towers (drop inlets).

Maximum Cross Section of Dam Ca cross section of a dam at the point where the height of the dam is at its maximum.

Maximum Storage Capacity Ca the capacity at maximum storage is the volume in the reservoir in acre-feet when the level in the reservoir is at top of dam elevation.

Non-Overflow Wall Ca a wall which is usually constructed parallel to the spillway crest at an elevation equal to the top of dam elevation. This wall is not designed to be overtopped and are often referred to as a closed dam section.

Normal Pool Stage Ca the water level at which water may rise under normal operating conditions and for uncontrolled spillways is defined as the lowest crest elevation of the principal spillway. This does not include flood surcharge.

Outlet Gate Ca a gate on the drawdown structure or spillway which is used to control the outflow of water.

Piping Ca the progressive internal erosion of an embankment, foundation, or abutment material. The erosion (piping) begins on the downstream side and progresses upstream.

Primary or Principal Spillway Ca the first used spillway during flood flows.

Probable Maximum Flood (PMF) Ca the flood that may be expected from the most severe combination of critical meteorologic conditions that are possible in the region.

Retaining/Training Walls Ca walls which are usually constructed perpendicular to the spillway crest. Retaining walls are walls which support an overturning load. Training walls are walls which confine or guide the flow of water. In many instances, these walls serve both purposes and can be referred to as either a retaining or training wall.

Riprap Ca a layer of large uncoursed stones, broken rock or precast blocks placed in a random fashion on the upstream slope of the dam and stilling basin outlets. Riprap is a flexible type of slope protection which will deform if material is displaced from beneath.

Riser Ca a type of drop inlet spillway with a vertical section of metal or concrete pipe that allows the reservoir to rise to a predetermined level before water flows into the pipe.

Slope Protection Ca protection against wave action or erosion. The two most common types of slope protection, are riprap and soil cement.
Sluice Ca low-level opening for releasing water from a dam.

Soil Cement Ca well compacted mixture of soil, portland cement and water that produces a hard pavement. Soil cement is usually placed in horizontal layers. Soil cement is a rigid type of slope protection which attempts to span voids.

Spillway Crest Cthe overflow section or top of weir section of the spillway.

Stilling Basin Ca basin constructed to dissipate the energy of fast flowing water. The stilling basin area is located just downstream of the spillway crest between the training/retaining walls.

Structural Height Cthe distance between the lowest point in the excavated foundation and the top of the dam.

Surcharge/Flood Surcharge Cthe volume or space between normal pool and the maximum design water level.

Tailwater Cthe level of water immediately downstream of the dam.

Toe of Dam Cthe junction of the downstream slope with the foundation. The toe of the dam is often referred to as the downstream toe.

Top of Dam/Crown Cthe uppermost surface of the dam. The top of dam can also be referred to as the crest of the dam. When the term "crest" is used, it must be specified that it is the "crest of the dam" and not the "crest of the spillway."

Uncontrolled or Ungated Spillways Cspillways where the flows over the spillway crest are controlled only by the elevation of the spillway crest. This type of spillway is often referred to as a fixed crest spillway. Normal Pool Stage for uncontrolled spillways is defined as the lowest crest elevation of the principal spillway.

Upstream Slope Cthe inclined surface of an embankment dam that is in contact with the reservoir.

D. Applicability

1. The regulations of this program will govern the construction, enlargement, alteration or repair, maintenance and operation of all dams as defined by R.S. 38:21-28. The terms dam and impoundment structure are used interchangeably and shall mean the embankment, spillway(s), outlet works and other attendant parts. Included are all artificial barriers together with all appurtenant works which impound or divert water or any other liquid and which are:

   a. twenty-five feet or more in height and have an impounding capacity at maximum storage greater than 15 acre-feet, (See LAC 70:XIII.2103.A) or;

   b. have an impounding capacity at maximum storage of 50 acre-feet or more and are greater than 6 feet in height (See LAC 70:XIII.2103.A).

2. All barriers which are 6 feet or more in height with maximum storage capacities of 15 acre-feet or more must be submitted to the DOTD for review (See LAC 70:XIII.2103.B). The height of a dam is measured from the natural bed of the stream or watercourse at the downstream toe of the barrier, or if it is not across a stream or watercourse, the height from the lowest elevation of the outside limit of the barrier, to the top of the dam.

E. Permitting

1. Application for Permit. Written approval for construction from the DOTD will be required prior to constructing any new impoundment structure or commencing any structural modifications to existing impoundment structures. Permit forms may be obtained from the Director, Public Works and Flood Control Directorate, Louisiana Department of Transportation and Development, Box 94245, Baton Rouge, LA, 70804-9245.

The permitting process is intended to ensure that new structures and modifications to existing structures are designed and constructed in accordance with the requirements documented herein. (See LAC 70:XIII.2103.C)

2. National Resources Conservation Service (NRCS), formally called Soil Conservation Service (SCS). The approval process may be abbreviated if dams meet the requirements of "Pond Standard 378" of the National Resources Conservation Service National Handbook for Conservation Practices and the National Resources Conservation Service's engineering staff provides the design, layout, and construction inspection. In this case, the National Resources Conservation Service will certify that the dam design and construction meets the requirements of "Pond Standard 378" and they will provide the DOTD with the Pond Data Sheet, a map showing the location of the pond, and a letter signed by the owner of the dam (See LAC 70:XIII.2103.D). The National Resources Conservation Service will agree to periodically inspect the structure to ensure that "Pond Standard 378" is being maintained, and to inform the DOTD if the structure ever falls below "Pond Standard 378."

3. Public Hearings. After an application has been filed and accepted, the public in the affected locale will be notified by publication in the local news publication. The Director of Public Works and Flood Control will prepare a notice, assigning a date and place for a public hearing of the application. The notice will contain information describing the application and the name and address of the applicant (See LAC 70:XIII.2103.E). It will be the applicant's responsibility to have the notice published once a week for two consecutive weeks in the official journal of the parish in which the project will be constructed, and shall provide notarized proof of publication on or before the hearing date. The applicant will bear the cost of the publication. The DOTD will conduct the public hearing, and the applicant will be required to attend to describe the nature and purpose of the proposed project and to answer questions.

4. Issuance of a Permit. An "Impoundment Permit/Certificate of Completion" shall be issued for all dams, both existing and new construction. The "Impoundment Permit/Certificate of Completion" is not
TRANSPORTATION

The owner of a dam must notify the DOTD 30 days prior to transferring ownership of the dam, and must return the "Impoundment Permit/Certificate of Completion" to the DOTD.

5. Failure to Obtain Approval. If, prior to beginning construction, the owner fails to obtain approval, the owner will be cited and fined under the statutory authority of R.S. 38:28. Also, the lake may be ordered to be drained until all approvals have been obtained.

F. Submittals

1. All designs for work to be permitted under the program will be submitted for review and approval with all necessary supportive documentation (See LAC 70:XIII.2103.F). Normally it is expected that an owner or prospective owner will establish contact with the DOTD to apply for a permit to construct or modify a dam. An example of a letter notifying the DOTD of intent to construct or modify a dam is provided (See LAC 70:XIII.2103.G). In some cases, however, structures are built and water is impounded without the knowledge or approval of the DOTD. When such structures are discovered, the owners will be contacted by the DOTD and required to furnish documentation that their structure meets the safety requirements of the program. In either case, the applicant shall be guided by the Water Resources Design and Development Section throughout the review and approval process. The documentation required shall be formal engineering designs and calculations, supported by sufficient field information, and certified by a professional civil engineer registered to practice in Louisiana. Because each step in the design of a dam is dependant upon the quality of the design judgments made in the previous steps, the applicant is advised to coordinate each of the design stages identified in the next Section with the DOTD review team prior to proceeding to the next step.

2. After general designs have been approved, the applicant may proceed with plans and specifications, which will also require approval before construction can begin. Plans and specifications will be of professional engineering detail and quality and will include all information and directions necessary to construct the dam in accordance with the design intent.

G Design

1. The proper design of a dam involves a complex combination of engineering applications. It is not within the scope or intent of this document, nor will it be the practice of the staff of the DOTD, to instruct in the detailed procedures for the design of a dam. All dams and impoundment structures to be permitted under this program will be designed by a professional civil engineer(s), registered by the Louisiana State Board of Registration for Professional Engineers and Land Surveyors. The registered civil engineer will certify the designs and plans by professional seal. Designs must conform to nationally recognized standards, further explained in the following Paragraphs and in the Appendices. The completed design package will state the intended design life of the structure, and will include the operations and maintenance procedures necessary to ensure that the structure will function as designed for its stated design life.

2. Failure of an impoundment structure and the instantaneous release of large volumes of water is referred to as a dam breach. It is the primary risk associated with dams, and is the fundamental reason for the state to assume regulatory authority over dams through the Louisiana Dam Safety Program. Breaching may occur during fair weather due to the cumulative effects of erosion or seepage, or it may occur as a result of stresses caused by excess water produced during a storm event. The hydraulic and hydrologic (H and H) design will determine which of the two scenarios poses the greater hazard, the volume of water which is likely to be released, and the rate of flow.

3. It is the H and H design which determines the volumes and flow rates with which the impoundment structure(s) must contend. The geotechnical and structural designs must ensure that the impoundment structure(s) can safely accommodate the hydraulic forces imposed by the conditions predicted by the H and H design. Following are the sequential steps which are necessary in any dam/impoundment structure design, and each step must be documented with design calculations and all supporting data, certified by a Registered Professional Civil Engineer:

   a. Hydrology and Hydraulics (H and H) Design
      i. Impact (Hazard) Classification.
      ii. Determination of controlling design condition and associated storm runoff.
      iii. Setting of spillway and stilling basin widths and elevations, top of embankment elevation, and normal pool stage.

   b. Structural and geotechnical design of embankment, spillways, and drawdown structures.

   c. Development and documentation of operations and maintenance procedures.

   NOTE: For the purpose of the Dam Safety Program, the "Emergency Spillway" shall be defined as being overtopped by the 100-year storm or greater and the "Principal Spillway" shall be defined as being overtopped by a storm less than the 100-year storm.

4. Hydrology and Hydraulics (H and H) Design

   a. Before the structural design of the dam can begin, the requirements of hydraulic capacity must be determined. The height of the dam, the amount of freeboard above normal pool elevation, the size and capacity of the principle and emergency spillways, must all be designed to balance the hydrological and hydraulic properties of the location of the reservoir. A properly designed drawdown structure, capable of reducing the stage of the reservoir at a suitable rate in the event of emergency, must also be designed to meet the capacity requirements of the site.

   b. H and H design begins with the Impact Classification (also referred to as Hazard Classification in some texts) of the dam. The Impact Classification is
determined by an evaluation of the probable maximum impacts of a dam breach. Low impact structures are those for which, because of size and/or location, little or no significant damage to life or property is likely to result from a failure of the structure. Significant impact structures are those which could cause appreciable damage to property or could pose possible threat to human life in the event of failure. High impact structures are those for which failure would cause excessive property damage or make loss of human life likely.

NOTE: The inflow design flood (IDF) is determined by the various Hydrograph Methods after the precipitation amount is developed. The major source of precipitation data is the National Weather Service (NWS). The DOTD has final authority for approval of the method to be utilized to determine the IDF.

<table>
<thead>
<tr>
<th>Impact Category</th>
<th>Potential Loss of Life</th>
<th>Potential Economic Loss</th>
<th>Minimum Inflow Design (IDF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Not Likely</td>
<td>Minimal</td>
<td>50-Yr. Freq.</td>
</tr>
<tr>
<td>Significant</td>
<td>Possible</td>
<td>Appreciable</td>
<td>100-Yr. Freq.</td>
</tr>
<tr>
<td>High</td>
<td>Likely</td>
<td>Excessive</td>
<td>1/2 PMF</td>
</tr>
</tbody>
</table>

c. Further guidance in assessing the potential hazards and associated impact classification for dams may be found in the publication referred to in Subsection N. It is the responsibility of the owner/applicant to establish impact classification, and all dams will be considered to be of High Impact potential until demonstrated to be otherwise by a documented analysis provided by the applicant. The proposed impact classification must be supported by sufficient analysis and documentation, and the DOTD will have final authority for assigning Impact Classification.

d. Having established the Impact Classification for the structure, the next step is to establish the magnitude of the meteorological event on which the entire design is to be based. Dams must be designed to be able to safely withstand the passage of a flood of design magnitude. The Inflow Design Flood (IDF) is the largest storm event to be considered in the design of the structure, and the magnitude of the storm event for which the IDF is computed is related to the Impact Classification. The values shown for IDF in Table I are minimums, and the storm event to be used as the IDF will be determined by a site specific analysis. For low impact structures, the primary consideration is the protection against loss of the dam and its benefits in the event of failure, while for significant and high impact structures, adequate protection of life and property must be assured.

e. For dams classified as high impact, the IDF is defined as the flood event above which a breach of the dam does not increase hazard to downstream interests. The upper limit of the IDF for high impact structures is the Probable Maximum Flood (PMF), which is the flood which may be expected from the most severe combination of critical meteorological and hydrological conditions which are reasonably possible. While the PMF is the upper limit for the IDF, the IDF for high impact dams may be an event of smaller magnitude, depending upon an incremental hazard assessment. The incremental assessment is a routing of floods of increasingly larger magnitude through the structure and downstream channel reaches, comparing conditions with and without a dam failure, until a flood magnitude is reached for which the dam failure condition does not appreciably increase the hazard potential.

f. Dams classified as having significant impacts may or may not require a formal incremental hazard evaluation, depending upon the extent of existing and potential downstream development, the size of the reservoir, and the type and use of the dam. The upper limit of the IDF for significant impact structures is the PMF.

g. For dams with low impact classification, the incremental hazard evaluation is not required, and the IDF can be based upon factors related to loss of service of the dam, potential maintenance costs, etc., but with the 50-year frequency storm being the minimum design event.

h. The Water Resources Design and Development Section should be a partner in establishing the IDF, and designs should not proceed until agreement has been reached between the DOTD and the owner's engineer on the choice of the IDF. Establishing the IDF is the foundation for the entire design process, since the dam must be designed to safely pass and/or contain the IDF. A guideline for performing the incremental hazard evaluation necessary to establish the IDF is provided in the publication referred to in Subsection N.

i. How the IDF is to be safely passed by the dam structure and the stability of the dam against the long-term effects of hydrostatic forces is the subject of the balance of the design effort, including the general configuration of the dam; length, elevation, and composition of principal and emergency spillways; storage capacity above normal pool elevation; erosion protection; and stability design. The most practical way of assuring the integrity of the dam during an IDF is to provide a concrete spillway which is capable of carrying the peak flow of the storm. Principal spillways are normally sized to carry flows from all but the largest of storms, with emergency spillways, which are not normally armored, functioning only during major storm events. If the peak flow from the IDF can be contained within the principal and emergency spillways, the stability of the dam is not likely to be threatened by the erosive action of water flowing over the embankment. The designer may wish to balance the relative economy of providing spillway capacity versus storage capacity above normal pool stage. But, if design calculations indicate that the embankment will be overtopped by the IDF, provisions must be included in the design to prevent the embankment from failing under the erosive forces of the overtopping flows.

5. Geotechnical Design

a. It is essential to the stability of the structure that the material used in the impoundment structure, as well as the foundation and adjoining earth have the necessary structural properties to withstand the hydrostatic forces required by the design, that potential for destructive seepage is identified and appropriately dealt with, and that the
sufficient information to enable the DOTD to required to provide such works or tests as may be needed to made by representatives of the DOTD. The owner will be work has been done in compliance with the approved plans impoundment of water, the engineer shall certify that all shall be under the responsible charge of a registered civil application, designs, plans and specifications are required removal of a dam or reservoir for which approved owner shall report on the construction to the DOTD. The construction procedures meet or exceed those specified. The approved designs and specifications. Adequate records shall be designed to resist the most critical loading combination of dead loads plus live loads that may occur during its construction or design life. Some of the loads which must be considered in the design are: buoyancy forces, sliding forces, hydrostatic uplift forces, bearing forces, overturning forces, water drag forces, wing drag forces, gate-lifting and closing forces, soil and water pressure forces, impact forces, uniform and point live load forces, etc. The minimum factors of safety for buoyancy and sliding shall be 1.5 and 2.0, respectively. The overturning analysis must indicate that the resultant force falls within the center 1/3 of the base. The minimum factor of safety for pile design shall be 2.0.

6. Structural Design. Structural Designs are to be prepared in accordance with generally accepted structural engineering practices such as those of the American Concrete Institute, the American Institute of Steel Construction and the American Institute of Timber Construction. Components of the spillway or other appurtenant structures shall be designed to resist the most critical loading combination of dead loads plus live loads which may affect the condition or safety of the reservoir. Also, the Director will be notified prior to any planned draw downs of the reservoir.

I. Maintenance and Operations

1. Once in service, the integrity of the impoundment structure must be sustained by regular maintenance, in accordance with the approved Operations and Maintenance document provided by the designer. The Operations and Maintenance Manual should contain forms and schedules for records and documentation of inspections, maintenance procedures, and repairs. The owner will be responsible for certifying, through properly documented records, to the DOTD that the required periodic inspections have been made, for correcting any deficiencies revealed during such inspections, and for maintaining records of all operations and maintenance activities, as well as of original construction and any subsequent modifications.

2. An Emergency Preparedness Plan is required for all dams and reservoirs. The plan shall comply with the guidelines of the current issue of Louisiana's Emergency Action Plan Guidelines, available from the DOTD's Director of Public Works and Flood Control. The Emergency Preparedness Plan will be a condition of the permit for the project, and it will be the owner's responsibility to implement the provisions of the plan in the event of emergency.

J. Inspections

1. The DOTD will periodically inspect every dam in the jurisdiction of the program. The purpose of the DOTD inspections is to ascertain whether the structure is being properly maintained in accordance with the approved Operations and Maintenance procedures. The DOTD inspections are "limited inspections" and do not relieve the owner of responsibility to perform and document periodic inspections. If an inspection by the DOTD reveals that a dam is unsafe or in danger of becoming unsafe, the DOTD, through the Director of Public Works and Flood Control, shall direct the owner to take whatever action is necessary to restore the dam to its design condition.

2. The owner has the primary responsibility for insuring the safe condition of the structure by regular maintenance and periodic inspection. The owner is required to immediately inform the Director of Public Works and Flood Control of any unusual circumstances or occurrences which may affect the condition or safety of the reservoir. Also, the Director will be notified prior to any planned draw downs of the reservoir.

K. Enforcement. If any dam or impoundment structure is determined to be unsafe, the Director of Public Works and Flood Control, pursuant to R.S. 38:21-28, shall direct any such repairs or remediations for a dam or impoundment structure as he deems necessary to insure that life and property are not unduly threatened by the impoundment. such remedial action may include:

### Table 2. Factor of Safety for Stability Analysis

<table>
<thead>
<tr>
<th>Analysis Condition</th>
<th>Factor of Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid Drawdown</td>
<td>1.25</td>
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<tr>
<td>Partial Pool</td>
<td>1.40</td>
</tr>
<tr>
<td>Steady Seepage</td>
<td>1.40</td>
</tr>
<tr>
<td>After Construction</td>
<td>1.30</td>
</tr>
<tr>
<td>Earthquake</td>
<td>1.15</td>
</tr>
</tbody>
</table>
1. direction that the water level behind the structure be lowered to a safe level; or

2. that the impoundment be completely drained until all necessary corrections to the structure have been made.

L. Existing Structures

1. All dams constructed or under construction prior to promulgation of these Rules will be reviewed to assess their disposition under the program regulations. Each dam is unique and must be judged on the basis of its own particular set of circumstances. Based on the circumstances of each individual case, a judgment will be made of what modifications or repairs are necessary to meet program standards. It is the intent of the program to eventually have every dam upgraded to meet program standards. The DOTD will be the sole judge of whether an existing deficiency creates an unacceptable risk to the general public. While it is not the intent of this program to lower the standards for existing dams, the DOTD recognizes that it is not practical to require all dam owners to immediately retrofit their structures to meet new minimum Inflow Design Flood standards.

2. An "Impoundment Permit" is required for existing dams and will be issued after reviewing all historical data (designs, plans, specifications, operation and maintenance records, etc.) and performing a technical inspection (or inspections) to adequately assess the safety of the dam. The owner shall provide all historical data, if available.

M. Emergency Preparedness Plan

1. An Emergency Preparedness Plan is required for all dams and reservoirs both existing and new construction. The plan will comply with the guidelines of the current issue of Louisiana's Emergency Action Plan Guidelines, available from the Director of Public Works and Flood Control, and shall be submitted as a necessary component of the Maintenance and Operating Procedures and as a condition of the permitting process. It is the owner's responsibility to assure that the provisions of the Emergency Action Plan are implemented in the event of an emergency situation.

2. A breach analysis is required to develop the emergency preparedness plan. The breach analysis will establish the magnitude of the inundated area (inundation map), peak flood elevations and arrival times of the peak flood elevations at critical locations. The worst case scenario breaching event will be somewhere between the "sunny day" breach and that event above which a breach of the dam does not increase hazard to downstream interests. If the dam owner prefers to perform only one breach analysis rather than performing incremental analyses to discover the worst case scenario breaching event, he may perform a breach analysis where the tail water is at the average annual elevation and the reservoir is at maximum design surcharge.

N. References


AUTHORITY NOTE: Promulgated in accordance with R.S. 38:24.


§2103. Figures and Forms

A. Structures that are required to have an approved permit under the State Dam Safety Program.

B. Structures that must be submitted to the Chief Engineer for review under the State Dam Safety Program.
C. Procedural Sequence

1) Applicant or his Engineer submits "Letter of Intent."

2) Applicant or his Engineer submits "Pre-Application for Construction of Dam."

3) Applicant publishes "Notice of Application" and a "Public Hearing(s)" is (are) held.

4) Applicant or his Engineer submits "Designs, Plans and Specifications" as follows and submits "Application for Construction of Dams."
   a) "Impact (Hazard) Classification.
   b) Determination of controlling design condition and associated storm runoff.
   c) Setting of spillway and stilling basin widths and elevations, top of embankment elevation, and normal pool stage.
   d) Plans, Specifications, Designs and other Submittals.

5) The DOTD issues "Approval or Denial of Application"; Approval is an "Approval for Construction."

6) Construction begins; Applicant or his Engineer performs "Construction Inspections."

7) If "Deficiencies" are found by the DOTD, Applicant or Applicant's Engineer; then the Applicant or his Engineer shall correct the deficiencies.

8) Supervision of Construction by the Owner.

9) Applicant or his Engineer submits "Notice of Completion" and "As-Built Drawings" and revised "Application for construction of Dam."

10) The DOTD issues "Certificate of Completion/Impoundment Permit."

11) Applicant or his Engineer submits "Maintenance and Operation Procedures" for the DOTD's approval.

12) Applicant or his Engineer submits "Emergency Preparedness Plan" for the DOTD's approval.

D. Pond Data Sheet

Date:

Dam Safety Administrator
Louisiana DOTD
P. O. Box94245, Capitol Station
Baton Rouge, Louisiana 70804-9245

RE: Pond Construction

I am aware that the design, construction and operation of all dams within Louisiana is regulated by the Rules and Regulations for Dam Safety Program as developed by the State of Louisiana, Department of Transportation and Development. I am also aware of the liability that is associated with owning a dam.

Since I am receiving design and construction assistance from the National Resources Conservation Service, the dam described below is excluded from the approval process outlined in the Dam Safety Regulations. However, if for some reason (such as a land use change) the dam no longer comes within the criteria of the National Resources Conservation Service National Handbook for Conservation Practices-Standard 378, I agree to modify the structure if necessary to comply with the requirements of the Dam Safety Regulations. I also agree to allow access for inspection of this structure.

Sincerely,

OWNER

DAM LOCATION:
DESCRIPTION:

E. Notice of Application

Pursuant to the Rules and Regulations of the Louisiana Dam Safety Program as established by R.S. 38:21-28 interested parties are hereby notified that a "Letter of Intent" and a "Pre-Application for Construction of Dam" have been received by the DOTD Public Works and Flood Control Directorate to construct the proposed Dam and Reservoir Pre-Application Number PA located in Section , Township , Range , Parish.

Applicant:
(Name)
(Address)
(Phone)

Purpose and Brief Description of Dam:

All interested parties are hereby notified that a public hearing on the application will be held at p.m. on at.

Any interested party shall have the right to request a public hearing on the application. Requests for additional public hearings must be in writing and must be submitted no later than the close of the public hearing on . Letters must state, with particularity, the reasons for holding a public hearing, applicant's name and pre-application number. On receiving a written request for an additional hearing(s) within the time limits set forth in this notice, the DOTD Public Works and Flood Control Directorate shall set a date, time and place for conducting a hearing on the application. During the hearings, any interested party shall have the right to protest the application and to appear and present evidence and testimony in support of such protest.

F. Minimum Required Submittals

1) All structural, geotechnical, hydrologic and hydraulic design calculations. An engineer's report shall also be submitted which summarizes the design analyses and shall include, but is not limited to, the following:
   a) Formulas, methods and basic data assumptions used in the designs.
   b) List of all pertinent design codes.
c) Summary tables which list design load cases, computed design factors of safety and required factors of safety as specified in these rules and regulations or required by pertinent design codes.

d) All other information which aided in evaluating the design, supported assumptions and conclusions, and will facilitate an independent review.

2) Plans with sufficient details to construct all features of the dam in accordance with the design intent. Also, the plans shall include details to construct a permanent reference mark (bench mark) near but separate from, the project. The exact location and elevation above mean sea level must be noted on the "as-built" plans.

3) Specifications with sufficient details to construct all features of the dam in accordance with the design intent. The specifications shall also provide that the plans and specifications may not be changed without prior written approval by the DOTD.

4) Document(s) to show proof of ownership.

5) An inspection plan specific to the construction activity. The inspection plan is to detect deficiencies or situations that may result in a threat to life and property.

6) An emergency action plan specific to the construction activity. The inspection plan in item 5 is part of the emergency action plan under this item.

7) If the applicant has an agreement or contract with another entity who will be responsible for the operation and maintenance of the dam, the applicant must provide copies of the agreement or contract document(s).

8) If the applicant is constructing the dam for the specific purpose of transferring ownership to a homeowners' association, a landowners' association, or any other entity, the applicant must provide a document which clearly states his intent, i.e., a dam which is constructed for a subdivision development where ownership will be transferred to a homeowners' association.

9) All other "Permits" required to construct the dam and "Letters of No Objection" which were obtained from various regulatory entities.

10) "As-Built" plans.

11) "Operation and Maintenance Manual".

12) "Emergency Preparedness Plan".

NOTE: The applicant should submit 2 copies of all preliminary submittals. The applicant must submit 5 copies of all final submittals.

G Letter of Intent

Purpose: To notify the Louisiana Dam Safety Program of the applicant's intent to construct, enlarge, alter, repair or remove a dam within the state.

Address To: Louisiana Dam Safety Program
Louisiana Department of Transportation and Development
Public Works and Flood Control Directorate
Box 94245
Baton Rouge, LA 70804-9245

Contents: 1) Name of proposed or existing dam
2) Purpose of dam:
3) Owner's:
   Name:
   Address:
   Telephone:
4) Location of dam (section, township, range, parish).
5) Brief description of proposed dam construction, enlargement, alteration, repair or removal.
*6) Height of Dam (height in feet from top of dam to lowest point at downstream toe of dam).
*7) Reservoir Capacity (volume in acre-feet with water at top of dam).

NOTE: *Items 6 and 7 can be approximated at this time.

H Letter of "Notice of Completion and As-built Drawings"

Purpose: To notify the Louisiana Dam Safety Program that the construction of the subject project is complete and to certify that said construction was done in accordance with the approved designs, plans, drawings and specifications.

From: Applicant's Consulting Engineering Firm
(letter must be signed and sealed by a Registered Professional Civil Engineer licensed in the State of Louisiana).

Address To: Louisiana Dam Safety Program
Louisiana Department of Transportation and Development
Public Works and Flood Control Directorate
Box 94245
Baton Rouge, LA 70804-9245

NOTE: As-Built Drawings must be received by the DOTD Public Works and Flood Control Directorate within 30 days after completion.

I. Letters of No Objection and Other Permits. The applicant must forward copies of the pre-application to the appropriate state, federal and local agencies to obtain letters of no objection and/or permits as required by these agencies. Copies of the letters of no objection and permits must be submitted to the Louisiana Dam Safety Program as part of the applicant's application under this program.
J. Minimum Hydrologic and Hydraulic Submittals to Establish Impact Classification and Inflow Design Flood (IDF). Since the required submittals may vary for each dam, it is recommended that applicant or his engineer obtain copies of references number 1 and 2 of the Dam Safety Rules and Regulations. After reviewing these documents, the applicant or his engineer is advised to contact the Dam Safety Program of the Water Resources Design and Development Section of the DOTD for further guidance.

AUTHORITY NOTE: Promulgated in accordance with R.S. 38:24.

Chapter 7. Dam Safety Program

Subchapter A. Dam Safety

*Editor's Note: The name of the agency, The Public Works and Flood Control Directorate of the Department of Transportation and Development (DOTD), has changed to The Public Works and Hurricane Flood Protection Division of the Louisiana Department of Transportation and Development.

§701. Introduction

A. The *Public Works and Flood Control Directorate of the Department of Transportation and Development (DOTD) serves as the Water Resources agency for the state of Louisiana, providing engineering and technical support for the orderly planning and development of programs and projects related to flood control, drainage, irrigation, water diversions, reservoirs, navigation, port development, hurricane protection, coastal engineering, and management and development of water resources.

B. R.S. 38:21-28 legislation provides for a Dam Safety and Regulatory Program. The *Public Works and Flood Control Directorate is charged with the responsibility for administering the program. The program is operated by the DOTD's Water Resources Design and Development Section, with administrative and enforcement authority vested in the Director of the Public Works and *Flood Control Directorate.

AUTHORITY NOTE: Promulgated in accordance with R.S. 38:24.


§703. Purpose

A. The purpose of R.S. 38:21-28 is to recognize the inherent dangers posed by impoundments of significant volumes of water, and to require that owners of structures which impound water (or other liquids) assume the responsibility for that danger by ensuring that such structures are designed, constructed, and maintained so as to minimize the risk to life and property. Regardless of the circumstances of failure, the owner is ultimately responsible for loss of life and property damages that may occur from the failure of his dam. *The Department of Transportation and Development, Public Works and Flood Control Directorate, is charged with the responsibility for developing and enforcing a regulatory program to ensure that public safety and welfare is not compromised by the presence of dams or other impoundment facilities. The Louisiana Dam Safety Program defines the minimum standards for the design, construction, operation, and maintenance of dams in the state of Louisiana, and the DOTD has the responsibility and the authority to enforce the standards of the program. This rule documents the minimum standards for design, construction, operation and maintenance of dams and impoundment structures and the policies for the enforcement of those standards.

AUTHORITY NOTE: Promulgated in accordance with R.S. 38:24.


§705. Glossary

Abutment—those portions of the valley sides which underlie and support the dam structure, and are usually also considered to include the valley sides immediately upstream and downstream from the dam.

Auxiliary or Emergency Spillway—a secondary spillway designed to operate only during unusually large storm events. Louisiana's Dam Safety Program defines "unusually large storm events" as being equal to the 100 year storm event or larger.

Baffle Blocks—blocks constructed in a stilling basin to dissipate the energy of fast flowing water.

Berm—a horizontal step in a sloping profile. The berm is usually constructed with a slight slope for drainage purposes. The berm is often referred to as a seepage or stability berm.

Blanket Drain—a horizontal pervious zone located downstream of the impervious core. This zone is often referred to as a sand blanket.

Breach—an eroded opening through a dam that drains the reservoir. A controlled breach is an intentionally constructed opening. An uncontrolled breach is an unintentional opening that allows uncontrolled discharge from the reservoir.

Chimney Drain—a vertical pervious zone located just downstream of the impervious core. The chimney drain is usually constructed with a sand material.

Cofferdam—a temporary structure enclosing all or part of the construction area so that the construction can proceed in the dry.

Conduit—a closed channel to convey discharges through or under a dam. The conduit can be a reinforced concrete pipe, a corrugated metal pipe or a single or multi-barrel reinforced concrete box culvert.

Crest Length of Dam—the length of the top of dam. This length includes the spillway(s) and other appurtenant structures. The crest length of dam is basically the length from where the top of dam terminates on one abutment to a similar point on the other abutment.

Cutoff Trench—an impervious barrier built into the foundation to reduce seepage under the dam. A cutoff wall or slurry wall could be used as a seepage barrier. The slurry wall is relatively thinner in the horizontal direction when compared to a clay core cutoff trench.

Dam—any artificial barrier, including appurtenant works, which does or will impound or divert water or any other liquid substance.

Downstream Slope—the inclined surface of an embankment dam that faces away from the reservoir.
Drawdown Structure—a low-level outlet which can be used to lower the reservoir below normal pool stage. This may be necessary for lake management purposes, routine repairs or dam safety purposes.

Earthfill Dam—a dam constructed predominantly of fine-grained material. Earthfill dams are also known as rolled fill dams where material is placed in layers and compacted by using rollers or rolling equipment.

End Sill—the area at the upstream and downstream end of the stilling basin base slab.

Foundation of Dam—the natural material on which the dam is placed.

Heel of Dam—the junction of the upstream slope with the foundation. The heel of the dam is often referred to as the upstream toe.

Impervious Core—a zone of low permeability material. This zone is the water or seepage barrier and is often referred to as the clay core.

Intake Structure—the structure placed at the beginning of an outlet works waterway. The intake structure establishes the ultimate drawdown level of the reservoir by the position of its opening(s) to the outlet works. Intake structures may be vertical or inclined towers (drop inlets).

Maximum Cross Section of Dam—cross section of a dam at the point where the height of the dam is at its maximum.

Maximum Storage Capacity—the capacity at maximum storage is the volume in the reservoir in acre-feet when the level in the reservoir is at top of dam elevation.

Non-Overflow Wall—a wall which is usually constructed parallel to the spillway crest at an elevation equal to the top of dam elevation. This wall is not designed to be overtopped and are often referred to as a closed dam section.

Normal Pool Stage—the water level at the dam to which water may rise under normal operating conditions and for uncontrolled spillways is defined as the lowest crest elevation of the principal spillway. This does not include flood surcharge.

Outlet Gate—a gate on the drawdown structure or spillway which is used to control the outflow of water.

Piping—the progressive internal erosion of an embankment, foundation, or abutment material. The erosion (piping) begins on the downstream side and progresses upstream.

Primary or Principal Spillway—the first used spillway during flood flows.

Probable Maximum Flood (PMF)—the flood that may be expected from the most severe combination of critical meteorologic conditions that are possible in the region.

Retaining/Training Walls—walls which are usually constructed perpendicular to the spillway crest. Retaining walls are walls which support an overturning load. Training walls are walls which confine or guide the flow of water. In many instances, these walls serve both purposes and can be referred to as either a retaining or training wall.

Riprap—a layer of large uncoursed stones, broken rock or precast blocks placed in a random fashion on the upstream slope of the dam and stilling basin outlets. Riprap is a flexible type of slope protection which will deform if material is displaced from beneath.

Riser—a type of drop inlet spillway with a vertical section of metal or concrete pipe that allows the reservoir to rise to a predetermined level before water flows into the pipe.

Slope Protection—protection against wave action or erosion. The two most common types of slope protection, are riprap and soil cement.

Sluice—a low-level opening for releasing water from a dam.

Soil Cement—a well compacted mixture of soil, portland cement and water that produces a hard pavement. Soil cement is usually placed in horizontal layers. Soil cement is a rigid type of slope protection which attempts to span voids.

Spillway Crest—the overflow section or top of weir section of the spillway.

Stilling Basin—a basin constructed to dissipate the energy of fast flowing water. The stilling basin area is located just downstream of the spillway crest between the training/retaining walls.

Structural Height—the distance between the lowest point in the excavated foundation and the top of the dam.

Surcharge/Flood Surcharge—the volume or space between normal pool and the maximum design water level.

Tailwater—the level of water immediately downstream of the dam.

Toe of Dam—the junction of the downstream slope with the foundation. The toe of the dam is often referred to as the downstream toe.

Top of Dam/Crown—the uppermost surface of the dam. The top of dam can also be referred to as the crest of the dam. When the term "crest" is used, it must be specified that it is the "crest of the dam" and not the "crest of the spillway."

Uncontrolled or Ungated Spillways—spillways where the flows over the spillway crest are controlled only by the elevation of the spillway crest. This type of spillway is often referred to as a fixed crest spillway. Normal Pool Stage for uncontrolled spillways is defined as the lowest crest elevation of the principal spillway.

Upstream Slope—the inclined surface of an embankment dam that is in contact with the reservoir.

AUTHORITY NOTE: Promulgated in accordance with R.S. 38:24.

§707. Applicability

A. The regulations of this program will govern the construction, enlargement, alteration or repair, maintenance and operation of all dams as defined by R.S. 38:21-28. The terms dam and impoundment structure are used interchangeably and shall mean the embankment, spillway(s), outlet works and other attendant parts. Included are all artificial barriers together with all appurtenant works which impound or divert water or any other liquid and which are:

1. 25 feet or more in height and have an impounding capacity at maximum storage greater than 15 acre-feet, (See §729, Appendix 1); or

2. have an impounding capacity at maximum storage of 50 acre-feet or more and are greater than 6 feet in height (See §729, Appendix 1).

B. All barriers which are 6 feet or more in height with maximum storage capacities of 15 acre-feet or more must be submitted to the DOTD for review (See §731, Appendix 2). The height of a dam is measured from the natural bed of the stream or watercourse at the downstream toe of the barrier, or if it is not across a stream or watercourse, the height from the lowest elevation of the outside limit of the barrier, to the top of the dam.

AUTHORITY NOTE: Promulgated in accordance with R.S. 38:24.


§709. Permitting

A. Application for Permit. Written approval for construction from the DOTD will be required prior to constructing any new impoundment structure or commencing any structural modifications to existing impoundment structures. Permit forms may be obtained from the Director, *Public Works and Flood Control Directorate, Louisiana Department of Transportation and Development, Box 94245, Baton Rouge, LA, 70804-9245.

The permitting process is intended to ensure that new structures and modifications to existing structures are designed and constructed in accordance with the requirements documented herein. (See §733, Appendix 3.)

B. National Resources Conservation Service (NRCS), formally called Soil Conservation Service (SCS). The approval process may be abbreviated if dams meet the requirements of "Pond Standard 378" of the National Resources Conservation Service National Handbook for Conservation Practices and the National Resources Conservation Service's engineering staff provides the design, layout, and construction inspection. In this case, the National Resources Conservation Service will certify that the dam design and construction meets the requirements of "Pond Standard 378" and they will provide the DOTD with the Pond Data Sheet, a map showing the location of the pond, and a letter signed by the owner of the dam (See §735, Appendix 4). The National Resources Conservation Service will agree to periodically inspect the structure to ensure that "Pond Standard 378" is being maintained, and to inform the DOTD if the structure ever falls below "Pond Standard 378."

C. Public Hearings. After an application has been filed and accepted, the public in the affected locale will be notified by publication in the local news publication. The Director of Public Works and Flood Control will prepare a notice, assigning a date and place for a public hearing of the application. The notice will contain information describing the application and the name and address of the applicant (See §737, Appendix 5). It will be the applicant's responsibility to have the notice published once a week for two consecutive weeks in the official journal of the parish in which the project will be constructed, and shall provide notarized proof of publication on or before the hearing date. The applicant will bear the cost of the publication. The DOTD will conduct the public hearing, and the applicant will be required to attend to describe the nature and purpose of the proposed project and to answer questions.

D. Issuance of a Permit. An "Impoundment Permit/Certificate of Completion" shall be issued for all dams, both existing and new construction. The "Impoundment Permit/Certificate of Completion" is not transferable. The owner of a dam must notify the DOTD 30 days prior to transferring ownership of the dam, and must return the "Impoundment Permit/Certificate of Completion" to the DOTD.

E. Failure to Obtain Approval. If, prior to beginning construction, the owner fails to obtain approval, the owner will be cited and fined under the statutory authority of R.S. 38:28. Also, the lake may be ordered to be drained until all approvals have been obtained.

AUTHORITY NOTE: Promulgated in accordance with R.S. 38:24.


§711. Submittals

A. All designs for work to be permitted under the program will be submitted for review and approval with all necessary supportive documentation (See §739, Appendix 6). Normally it is expected that an owner or prospective owner will establish contact with the DOTD to apply for a permit to construct or modify a dam. An example of a letter notifying the DOTD of intent to construct or modify a dam is provided (See §741, Appendix 7). In some cases, however, structures are built and water is impounded without the knowledge or approval of the DOTD. When such structures are discovered, the owners will be contacted by the DOTD and required to furnish documentation that their structure meets the safety requirements of the program. In either case, the applicant shall be guided by the Water Resources Design and Development Section throughout the review and approval process. The documentation required shall be formal engineering designs and calculations, supported by
sufficient field information, and certified by a professional civil engineer registered to practice in Louisiana. Because each step in the design of a dam is dependant upon the quality of the design judgments made in the previous steps, the applicant is advised to coordinate each of the design stages identified in the next Section with the DOTD review team prior to proceeding to the next step.

B. After general designs have been approved, the applicant may proceed with plans and specifications, which will also require approval before construction can begin. Plans and specifications will be of professional engineering detail and quality and will include all information and directions necessary to construct the dam in accordance with the design intent.

AUTHORITY NOTE: Promulgated in accordance with R.S. 38:24.


§713. Design

A. The proper design of a dam involves a complex combination of engineering applications. It is not within the scope or intent of this document, nor will it be the practice of the staff of the DOTD, to instruct in the detailed procedures for the design of a dam. All dams and impoundment structures to be permitted under this program will be designed by a professional civil engineer(s), registered by the Louisiana State Board of Registration for Professional Engineers and Land Surveyors. The registered civil engineer will certify the designs and plans by professional seal. Designs must conform to nationally recognized standards, further explained in the following Paragraphs and in the Appendices. The completed design package will state the intended design life of the structure, and will include the operations and maintenance procedures necessary to ensure that the structure will function as designed for its stated design life.

B. Failure of an impoundment structure and the instantaneous release of large volumes of water is referred to as a dam breach. It is the primary risk associated with dams, and is the fundamental reason for the state to assume regulatory authority over dams through the Louisiana Dam Safety Program. Breaching may occur during fair weather due to the cumulative effects of erosion or seepage, or it may occur as a result of stresses caused by excess water produced during a storm event. The hydraulic and hydrologic (H and H) design will determine which of the two scenarios poses the greater hazard, the volume of water which is likely to be released, and the rate of flow.

C. It is the H and H design which determines the volumes and flow rates with which the impoundment structure(s) must contend. The geotechnical and structural designs must ensure that the impoundment structure(s) can safely accommodate the hydraulic forces imposed by the conditions predicted by the H and H design. Following are the sequential steps which are necessary in any dam/impoundment structure design, and each step must be documented with design calculations and all supporting data, certified by a Registered Professional Civil Engineer:

1. Hydrology and Hydraulics (H and H) Design
   a. Impact (Hazard) Classification.
   b. Determination of controlling design condition and associated storm runoff.
   c. Setting of spillway and stilling basin widths and elevations, top of embankment elevation, and normal pool stage.

2. Structural and Geotechnical Design of Embankment, Spillways, and Drawdown Structures

3. Development and Documentation of Operations and Maintenance Procedures

   NOTE: For the purpose of the Dam Safety Program, the Emergency Spillway shall be defined as being overtopped by the 100-year storm or greater and the Principal Spillway shall be defined as being overtopped by a storm less than the 100-year storm.

D. Hydrology and Hydraulics (H and H) Design

1. Before the structural design of the dam can begin, the requirements of hydraulic capacity must be determined. The height of the dam, the amount of freeboard above normal pool elevation, the size and capacity of the principle and emergency spillways, must all be designed to balance the hydrological and hydraulic properties of the location of the reservoir. A properly designed drawdown structure, capable of reducing the stage of the reservoir at a suitable rate in the event of emergency, must also be designed to meet the capacity requirements of the site.

2. H and H design begins with the Impact Classification (also referred to as Hazard Classification in some texts) of the dam. The Impact Classification is determined by an evaluation of the probable maximum impacts of a dam breach. Low impact structures are those for which, because of size and/or location, little or no significant damage to life or property is likely to result from a failure of the structure. Significant impact structures are those which could cause appreciable damage to property or could pose possible threat to human life in the event of failure. High impact structures are those for which failure would cause excessive property damage or make loss of human life likely.

NOTE: The inflow design flood (IDF) is determined by the various Hydrograph Methods after the precipitation amount is developed. The major source of precipitation data is the National Weather Service (NWS). The DOTD has final authority for approval of the method to be utilized to determine the IDF.

<table>
<thead>
<tr>
<th>Impact Category</th>
<th>Potential Loss of Life</th>
<th>Potential Economic Loss</th>
<th>Minimum Inflow Design (IDF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Not Likely</td>
<td>Minimal</td>
<td>50-Yr. Freq.</td>
</tr>
<tr>
<td>Significant</td>
<td>Possible</td>
<td>Appreciable</td>
<td>100-Yr. Freq.</td>
</tr>
<tr>
<td>High</td>
<td>Likely</td>
<td>Excessive</td>
<td>1/2 PMF</td>
</tr>
</tbody>
</table>

Table 1. Impact Classification and Inflow Design Flood
3. Further guidance in assessing the potential hazards and associated impact classification for dams may be found in the publication referred to in §727. It is the responsibility of the owner/applicant to establish impact classification, and all dams will be considered to be of High Impact potential until demonstrated to be otherwise by a documented analysis provided by the applicant. The proposed impact classification must be supported by sufficient analysis and documentation, and the DOTD will have final authority for assigning Impact Classification.

4. Having established the Impact Classification for the structure, the next step is to establish the magnitude of the meteorological event on which the entire design is to be based. Dams must be designed to be able to safely withstand the passage of a flood of design magnitude. The Inflow Design Flood (IDF) is the largest storm event to be considered in the design of the structure, and the magnitude of the storm event for which the IDF is computed is related to the Impact Classification. The values shown for IDF in Table I are minimums, and the storm event to be used as the IDF will be determined by a site specific analysis. For low impact structures, the primary consideration is the protection against loss of the dam and its benefits in the event of failure, while for significant and high impact structures, adequate protection of life and property must be assured.

5. For dams classified as high impact, the IDF is defined as the flood event above which a breach of the dam does not increase hazard to downstream interests. The upper limit of the IDF for high impact structures is the Probable Maximum Flood (PMF), which is the flood which may be expected from the most severe combination of critical meteorological and hydrological conditions which are reasonably possible. While the PMF is the upper limit for the IDF, the IDF for high impact dams may be an event of smaller magnitude, depending upon an incremental hazard assessment. The incremental assessment is a routing of floods of increasingly larger magnitude through the structure and downstream channel reaches, comparing conditions with and without a dam failure, until a flood magnitude is reached for which the dam failure condition does not appreciably increase the hazard potential.

6. Dams classified as having significant impacts may or may not require a formal incremental hazard evaluation, depending upon the extent of existing and potential downstream development, the size of the reservoir, and the type and use of the dam. The upper limit of the IDF for significant impact structures is the PMF.

7. For dams with low impact classification, the incremental hazard evaluation is not required, and the IDF can be based upon factors related to loss of service of the dam, potential maintenance costs, etc., but with the 50-year frequency storm being the minimum design event.

8. The Water Resources Design and Development Section should be a partner in establishing the IDF, and designs should not proceed until agreement has been reached between the DOTD and the owner’s engineer on the choice of the IDF. Establishing the IDF is the foundation for the entire design process, since the dam must be designed to safely pass and/or contain the IDF. A guideline for performing the incremental hazard evaluation necessary to establish the IDF is provided in the publication referred to in Subsection N.

9. How the IDF is to be safely passed by the dam structure and the stability of the dam against the long-term effects of hydrostatic forces is the subject of the balance of the design effort, including the general configuration of the dam; length, elevation, and composition of principal and emergency spillways; storage capacity above normal pool elevation; erosion protection; and stability design. The most practical way of assuring the integrity of the dam during an IDF is to provide a concrete spillway which is capable of carrying the peak flow of the storm. Principal spillways are normally sized to carry flows from all but the largest of storms, with emergency spillways, which are not normally armored, functioning only during major storm events. If the peak flow from the IDF can be contained within the principal and emergency spillways, the stability of the dam is not likely to be threatened by the erosive action of water flowing over the embankment. The designer may wish to balance the relative economy of providing spillway capacity versus storage capacity above normal pool stage. But, if design calculations indicate that the embankment will be overtopped by the IDF, provisions must be included in the design to prevent the embankment from failing under the erosive forces of the overtopping flows.

E. Geotechnical Design

1. It is essential to the stability of the structure that the material used in the impoundment structure, as well as the foundation and adjoining earth have the necessary structural properties to withstand the hydrostatic forces required by the design, that potential for destructive seepage is identified and appropriately dealt with, and that the surfaces of the structure are adequately protected from surface erosion.

2. Field investigations shall be adequate to define the soils and ground water conditions with respect to stability and seepage control. Stability analysis should consider after-construction conditions, based on the undrained shear strength parameters determined by laboratory tests. Long-term steady seepage, partial pool, and rapid drawdown analyses should also be performed, using shear properties appropriate to the subject materials and minimum safety factors shown in the following Table.

<table>
<thead>
<tr>
<th>Table 2. Factor of Safety for Stability Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analysis Condition</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>Rapid Drawdown</td>
</tr>
<tr>
<td>Partial Pool</td>
</tr>
<tr>
<td>Steady Seepage</td>
</tr>
<tr>
<td>After Construction</td>
</tr>
<tr>
<td>Earthquake</td>
</tr>
</tbody>
</table>

6. Structural Design. Structural Designs are to be prepared in accordance with generally accepted structural engineering practices such as those of the American Concrete Institute, the American Institute of Steel Construction and the American Institute of Timber
Construction. Components of the spillway or other appurtenant structures shall be designed to resist the most critical loading combination of dead loads plus live loads that may occur during its construction or design life. Some of the loads which must be considered in the design are: buoyancy forces, sliding forces, hydrostatic uplift forces, bearing forces, overturning forces, water drag forces, wing drag forces, gate-lifting and closing forces, soil and water pressure forces, impact forces, uniform and point live load forces, etc. The minimum factors of safety for buoyancy and sliding shall be 1.5 and 2.0, respectively. The overturning analysis must indicate that the resultant force falls within the center 1/3 of the base. The minimum factor of safety for pile design shall be 2.0.

**AUTHORITY NOTE:** Promulgated in accordance with R.S. 38:24.

**HISTORICAL NOTE:** Promulgated by the Department of Transportation and Development, Office of Public Works, LR 22:1237 (December 1985), repromulgated by the Department of Transportation and Development, Office of Public Works, LR 31:942 (April 2005).

§715. **Construction**

A. It will be the owner's responsibility to ensure by the presence of professional construction supervision personnel that the structure is built in strict compliance with the approved designs and specifications. Adequate records shall be maintained to document that all materials and construction procedures meet or exceed those specified. The owner shall report on the construction to the DOTD. The work of construction, enlargement, alteration, repair or removal of a dam or reservoir for which approved application, designs, plans and specifications are required shall be under the responsible charge of a registered civil engineer. Upon completion of the work and prior to the impoundment of water, the engineer shall certify that all work has been done in compliance with the approved plans and specifications (See §743, Appendix 8).

B. During construction, periodic inspections may be made by representatives of the DOTD. The owner will be required to provide such works or tests as may be needed to disclose sufficient information to enable the DOTD to determine that conformity with approved plans and specifications is being maintained. Inspections made by the DOTD are "limited inspections" and do not relieve the owner or the owner's engineer from their responsibilities for conformance to accepted designs and procedures.

**AUTHORITY NOTE:** Promulgated in accordance with R.S. 38:24.

**HISTORICAL NOTE:** Promulgated by the Department of Transportation and Development, Office of Public Works, LR 22:1239 (December 1985), repromulgated by the Department of Transportation and Development, Office of Public Works, LR 31:942 (April 2005).

§717. **Maintenance and Operations**

A. Once in service, the integrity of the impoundment structure must be sustained by regular maintenance, in accordance with the approved operations and maintenance document provided by the designer. The Operations and Maintenance Manual should contain forms and schedules for records and documentation of inspections, maintenance procedures, and repairs. The owner will be responsible for certifying, through properly documented records, to the DOTD that the required periodic inspections have been made, for correcting any deficiencies revealed during such inspections, and for maintaining records of all operations and maintenance activities, as well as of original construction and any subsequent modifications.

B. An Emergency Preparedness Plan is required for all dams and reservoirs. The plan shall comply with the guidelines of the current issue of Louisiana's *Emergency Action Plan Guidelines*, available from the DOTD's Director of Public Works and Flood Control. The Emergency Preparedness Plan will be a condition of the permit for the project, and it will be the owner's responsibility to implement the provisions of the plan in the event of emergency.

**AUTHORITY NOTE:** Promulgated in accordance with R.S. 38:24.

**HISTORICAL NOTE:** Promulgated by the Department of Transportation and Development, Office of Public Works, LR 22:1239 (December 1985), repromulgated by the Department of Transportation and Development, Office of Public Works, LR 31:942 (April 2005).

§719. **Inspections**

A. The DOTD will periodically inspect every dam in the jurisdiction of the program. The purpose of the DOTD inspections is to ascertain whether the structure is being properly maintained in accordance with the approved operations and maintenance procedures. The DOTD inspections are "limited inspections" and do not relieve the owner of responsibility to perform and document periodic inspections. If an inspection by the DOTD reveals that a dam is unsafe or in danger of becoming unsafe, the DOTD, through the Director of Public Works and Flood Control, shall direct the owner to take whatever action is necessary to restore the dam to its design condition.

B. The owner has the primary responsibility for insuring the safe condition of the structure by regular maintenance and periodic inspection. The owner is required to immediately inform the Director of Public Works and Flood Control of any unusual circumstances or occurrences which may affect the condition or safety of the reservoir. Also, the director will be notified prior to any planned draw downs of the reservoir.

**AUTHORITY NOTE:** Promulgated in accordance with R.S. 38:24.

**HISTORICAL NOTE:** Promulgated by the Department of Transportation and Development, Office of Public Works, LR 22:1239 (December 1985), repromulgated by the Department of Transportation and Development, Office of Public Works, LR 31:942 (April 2005).

§721. **Enforcement**

A. If any dam or impoundment structure is determined to be unsafe, the Director of Public Works and Flood Control, pursuant to R.S. 38:21-28, shall direct any such repairs or remediations for a dam or impoundment structure as he
deems necessary to insure that life and property are not unduly threatened by the impoundment. Such remedial action may include:

1. direction that the water level behind the structure be lowered to a safe level; or
2. that the impoundment be completely drained until all necessary corrections to the structure have been made.

AUTHORITY NOTE: Promulgated in accordance with R.S. 38:24.


§723. Existing Structures

A. All dams constructed or under construction prior to promulgation of these Rules will be reviewed to assess their disposition under the program regulations. Each dam is unique and must be judged on the basis of its own particular set of circumstances. Based on the circumstances of each individual case, a judgment will be made of what modifications or repairs are necessary to meet program standards. It is the intent of the program to eventually have every dam upgraded to meet program standards. The DOTD will be the sole judge of whether an existing deficiency creates an unacceptable risk to the general public. While it is not the intent of this program to lower the standards for existing dams, the DOTD recognizes that it is not practical to require all dam owners to immediately retrofit their structures to meet new minimum Inflow Design Flood standards.

B. An "Impoundment Permit" is required for existing dams and will be issued after reviewing all historical data (designs, plans, specifications, operation and maintenance records, etc.) and performing a technical inspection (or inspections) to adequately assess the safety of the dam. The owner shall provide all historical data, if available.

AUTHORITY NOTE: Promulgated in accordance with R.S. 38:24.


§725. Emergency Preparedness Plan

A. An Emergency Preparedness Plan is required for all dams and reservoirs both existing and new construction. The plan will comply with the guidelines of the current issue of Louisiana's Emergency Action Plan Guidelines, available from the Director of Public Works and Flood Control, and shall be submitted as a necessary component of the maintenance and operating procedures and as a condition of the permitting process. It is the owner's responsibility to assure that the provisions of the Emergency Action Plan are implemented in the event of an emergency situation.

B. A breach analysis is required to develop the emergency preparedness plan. The breach analysis will establish the magnitude of the inundated area (inundation map), peak flood elevations and arrival times of the peak flood elevations at critical locations. The worst case scenario breach event will be somewhere between the "sunny day" breach and that event above which a breach of the dam does not increase hazard to downstream interests. If the dam owner prefers to perform only one breach analysis rather than performing incremental analyses to discover the worst case scenario breach event, he may perform a breach analysis where the tail water is at the average annual elevation and the reservoir is at maximum design surcharge.

AUTHORITY NOTE: Promulgated in accordance with R.S. 38:24.


§727. References


AUTHORITY NOTE: Promulgated in accordance with R.S. 38:24.


Subchapter B. Figures and Forms

§729. Appendix 1, Structures—Approved Permit

A. Structures that are required to have an approved permit under the State Dam Safety Program.
Structures that are required to have an approved permit under the State Dam Safety Program:

- - - - - - - In State Dam Safety Program
E.18. Maine
Maine Revised Statute Title 37-B, Chapter 24: DAM SAFETY

Table of Contents

Section 1111. DEFINITIONS.......................................................................................................... 3
Section 1112. ADMINISTRATION.................................................................................................. 4
Section 1113. DUTIES OF THE DEPARTMENT........................................................................... 4
Section 1114. POWERS OF THE DEPARTMENT......................................................................... 5
Section 1115. JURISDICTION....................................................................................................... 5
Section 1116. DESIGN STANDARDS........................................................................................... 6
Section 1117. INSPECTORS OF DAMS....................................................................................... 6
Section 1118. DAM HAZARD EVALUATION............................................................................. 6
Section 1119. DAM CONDITION INSPECTION.......................................................................... 7
Section 1120. ENFORCEMENT..................................................................................................... 8
Section 1121. APPEAL.................................................................................................................... 8
Section 1122. EXEMPTIONS........................................................................................................ 9
Section 1123. RIGHTS OF OWNER.............................................................................................. 9
Section 1124. IMMUNITY............................................................................................................ 9
Section 1125. RELIEF OF OBLIGATION................................................................................... 9
Section 1126. ACCESS AND NOTIFICATION.......................................................................... 9
Section 1127. EMERGENCY ACTION PLANS........................................................................... 10
Section 1128. NOTICE OF TRANSFER OF OWNERSHIP.................................................... 10
Section 1129. VIOLATIONS........................................................................................................ 10
Section 1130. DAM REPAIR AND RECONSTRUCTION FUND................................................ 10
Section 1131. ESTABLISHMENT OF COMMISSION.............................................................. 11
37-B §1111. DEFINITIONS

As used in this chapter, unless the context otherwise indicates, the following terms have the following meanings. [2001, c. 460, §3 (NEW).]

1. Dam. "Dam" means any artificial barrier, including appurtenant works, the site on which it is located and appurtenant rights of flowage and access, that impounds or diverts water, and that:
   A. Is 25 feet or more in height from the natural bed of the watercourse measured at the downstream toe of the barrier or from the lowest elevation of the outside limit of the barrier to the maximum water storage elevation and impounds at least 15 acre-feet of water; or [2001, c. 460, §3 (NEW).]
   B. Is 6 feet or more in height from the natural bed of the watercourse measured at the downstream toe of the barrier or from the lowest elevation of the outside limit of the barrier to the maximum water storage elevation and has an impounding capacity at maximum water storage elevation of 50 acre-feet or more. [2001, c. 460, §3 (NEW).]


3. Emergency. "Emergency" means breaches and all conditions leading to or causing a breach, overtopping or any other condition in a dam and its appurtenant structures that may be construed as unsafe or threatening to life and property.

4. Emergency situation. "Emergency situation" means a situation determined by the commissioner, after consultation with other state and federal agencies if time permits, to present a potential but real and impending danger to life, limb or property because of flooding or potential and imminent flooding and includes a situation that the Governor declares to be an emergency pursuant to section 742.

5. Emergency action plan. "Emergency action plan" means a set of written instructions or guidelines for use by public officials that recommends actions that, when implemented, will minimize the effects of a dam failure on people and property.

6. Hazard potential. "Hazard potential" means the possible adverse incremental consequences that result from the release of water or stored contents due to failure of the dam or misoperation of the dam or appurtenances. The hazard potential classification of a dam does not reflect in any way on the current condition of the dam and its appurtenant structures. The classifications are as follows:
   A. High hazard potential dam. "High hazard potential dam" means a dam assigned the high hazard potential classification where failure or misoperation will probably cause loss of human life; [2001, c. 460, §3 (NEW).]
   B. Low hazard potential dam. "Low hazard potential dam" means a dam assigned the low hazard potential classification where failure or misoperation results in no probable loss of human life and low economic and environmental losses. Losses are principally limited to the owner's property; and [2001, c. 460, §3 (NEW).]
C. Significant hazard potential dam. "Significant hazard potential dam" means a dam assigned the significant hazard potential classification where failure or misoperation results in no probable loss of human life but can cause major economic loss, environmental damage or disruption of lifeline facilities or affect other concerns. Significant hazard potential dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure. [2001, c. 460, §3 (NEW)].

7. **Necessary remedial measure.** "Necessary remedial measure" means any repair or hazard-reducing measure relating to a structural component or operation of a dam needed to mitigate a specific condition at the dam that constitutes a threat to public safety.

[2001, c. 460, §3 (NEW)].

8. **Person.** "Person" means any individual, firm, association, partnership, corporation, trust, municipality, quasi-municipal corporation, state department, federal department or other legal entity.

[2001, c. 460, §3 (NEW)].

9. **Public safety.** "Public safety" or "safety of the public" means protection of life, health or property from any condition, event or action at a dam that might compromise the safety, stability or integrity of the dam or its ability to function safely.

[2001, c. 460, §3 (NEW)].

10. **State dam inspector.** "State dam inspector" means an inspector appointed or hired under section 1117.

[2001, c. 460, §3 (NEW)].

SECTION HISTORY
2001, c. 460, §3 (NEW).

### 37-B §1112. ADMINISTRATION

The department shall administer this chapter. In carrying out the provisions of this chapter, the department shall consult as appropriate with other state agencies, including the Department of Conservation, the Department of Environmental Protection, the Department of Inland Fisheries and Wildlife, the Department of Marine Resources, the Department of Public Safety, the Department of Transportation, the Maine Land Use Regulation Commission and the State Planning Office, for their aid and assistance. [2009, c. 561, §35 (AMD)].

SECTION HISTORY

### 37-B §1113. DUTIES OF THE DEPARTMENT

The department shall inspect existing dams and reservoirs to determine their hazard potential, review the design and construction of new and reconstructed dams, assist dam owners in developing emergency action plans to minimize the effects of dam failure and take all necessary actions in emergency situations of probable dam failure in order to protect life and property. [2001, c. 460, §3 (NEW)].
Except for the Federal Government, a person may not exercise any authority over the emergency regulation or supervision of any dams or reservoirs in the State when that exercise would conflict with the powers and authority vested in the department. [2001, c. 460, §3 (NEW).]

SECTION HISTORY
2001, c. 460, §3 (NEW).

37-B §1114. POWERS OF THE DEPARTMENT

1. Rules. In accordance with Title 5, chapter 375, subchapter II, the department may adopt, modify or repeal rules for carrying out this chapter. Rules adopted under this section are routine technical rules pursuant to Title 5, chapter 375, subchapter II-A. [2001, c. 460, §3 (NEW).]

2. Emergency situation. When an emergency situation arises, the commissioner shall warn the public of the emergency and, notwithstanding any other provision of law, shall take all actions necessary to protect life and property, which may include, but are not limited to, the following:
   A. Taking full charge and control of any dam or reservoir; [2001, c. 460, §3 (NEW).]
   B. Lowering the water level by releasing water from the reservoir; [2001, c. 460, §3 (NEW).]
   C. Completely emptying the reservoir; [2001, c. 460, §3 (NEW).]
   D. Breaching or removing the dam itself; and [2001, c. 460, §3 (NEW).]
   E. Taking other necessary steps to safeguard life and property. [2001, c. 460, §3 (NEW).]

3. Investigations. For the purpose of enabling it to make decisions as compatible as possible with economy and protection of life and property and for the purpose of determining compliance with this chapter, the department may make necessary investigations and inspections. In making investigations and inspections required or authorized by this chapter, the department or its representatives may, as necessary in emergency situations, enter upon public or private property or in nonemergency situations secure administrative warrants from any District Court Judge or Superior Court Justice for the purpose of gaining entry onto private property. [2001, c. 460, §3 (NEW).]

4. Injunction; civil or criminal proceedings. In the event of violation of any of the provisions of this chapter or of any rule, order or decision of the department, the department may institute injunctive proceedings or other civil action as provided in this chapter. [2001, c. 460, §3 (NEW).]

SECTION HISTORY
2001, c. 460, §3 (NEW).

37-B §1115. JURISDICTION

The inspection of and design standards for all dams are under the sole jurisdiction of the department, except that the department does not have jurisdiction over any dam licensed or inspected by any department of the Federal Government or by the International Joint Commission. [2001, c. 460, §3 (NEW).]

SECTION HISTORY
2001, c. 460, §3 (NEW).
37-B §1116. DESIGN STANDARDS

All new dams that reasonably will be classified as high or significant hazard potential dams must be designed, constructed or reconstructed under the supervision of a registered professional engineer. Prior to construction, the dam owner shall provide a copy of the plans and specifications to the department.  
[2001, c. 460, §3 (NEW).]

SECTION HISTORY
2001, c. 460, §3 (NEW).

37-B §1117. INSPECTORS OF DAMS

The commissioner shall appoint or hire one or more dam inspectors who are licensed as professional engineers under Title 32, chapter 19 and who are experienced in the inspection and design of dams.  
[2001, c. 460, §3 (NEW).]

SECTION HISTORY
2001, c. 460, §3 (NEW).

37-B §1118. DAM HAZARD EVALUATION

1. Evaluation. The commissioner shall evaluate all dams to assign or reassign a hazard potential classification in accordance with the following schedule:

A. New or reconstructed dams, within 6 months of construction or reconstruction;  
[2001, c. 460, §3 (NEW).]

B. All other dams, at least once every 6 years;  
[2001, c. 460, §3 (NEW).]

C. Any dam, within 30 days of a request for an evaluation from the dam owner, the municipality in which the dam is located or the emergency management director of the county in which the dam is located; and  
[2001, c. 460, §3 (NEW).]

D. At any time a dam for which, in the judgment of the commissioner, such an evaluation is appropriate.  
[2001, c. 460, §3 (NEW).]

Notwithstanding the schedule of this subsection, the commissioner shall evaluate the hazard classification of a significant or high hazard potential dam within 30 days of receipt by the commissioner of a notice of transfer of ownership of the dam as required under section 1128 unless the dam has been evaluated under this subsection within 4 years preceding the notice of transfer of ownership.

Until the commissioner assigns or reassigns a hazard potential classification, a dam retains the hazard potential classification assigned in the 1981 United States Army Corps of Engineers' Inventory of Dams in the United States.  
[2001, c. 460, §3 (NEW).]

2. Factors considered. Before assigning a dam a hazard potential classification, the commissioner shall consider the potential risk to public safety and property that may result from the failure or operation of the dam. In addition, when reassigning a hazard potential classification, the commissioner shall review any changes in upstream and downstream conditions since the last hazard classification evaluation.  
[2001, c. 460, §3 (NEW).]

3. Hazard report. Before the commissioner assigns or reassigns a dam hazard potential classification, a state dam inspector shall visually inspect that dam and its upstream and downstream environs and provide a report to the commissioner recommending a hazard classification for that dam. The commissioner shall provide a copy of the report by certified mail to the dam owner, lessee or other person in control of the dam,
to the municipality in which the dam is located and to the emergency management director of the county in which the dam is located. The dam owner, lessee or other person in control of the dam must notify the commissioner within 20 days of receipt of the report if the dam owner, lessee or other person in control of the dam disagrees with the recommended hazard classification and must file within 3 months of receipt of the commissioner's classification the basis of the appeal with the commissioner. The commissioner may extend the 3 month period for good cause shown, but not more than an additional 3 months. The commissioner shall consider the evidence presented by the dam owner, lessee or other person in control of the dam as well as the evidence of the state inspector before issuing a final determination.

[ 2001, c. 460, §3 (NEW) .]

SECTION HISTORY
2001, c. 460, §3 (NEW).

37-B §1119. DAM CONDITION INSPECTION

1. Inspections. A state dam inspector shall conduct an inspection of all high and significant hazard potential dams to determine whether the integrity, structural stability, function or operation of those dams constitutes a threat to public safety, in accordance with the following schedule:

   A. All significant hazard potential dams, at least once every 4 years; [2001, c. 460, §3 (NEW).]

   B. All high hazard potential dams, at least once every 2 years; [2001, c. 460, §3 (NEW).]

   C. Any dam, within 30 days of a request for an inspection from the dam owner or the municipality in which the dam is located; and [2001, c. 460, §3 (NEW).]

   D. At any time any dam that may, in the judgment of the commissioner, constitute a potential risk to public safety. [2001, c. 460, §3 (NEW).]

Notwithstanding the schedule outlined in this subsection, a state dam inspector shall conduct an inspection of a significant or high hazard potential dam within 30 days of receipt by the commissioner of a notice of transfer of ownership of the dam as required under section 1128 unless the dam has been inspected under this subsection within 4 years preceding the notice of transfer of ownership.

[ 2001, c. 460, §3 (NEW) .]

2. Condition report. After the on-site dam inspection, a state dam inspector shall provide a condition report to the commissioner detailing the operation and material condition of the dam and recommending all necessary remedial measures. The commissioner shall send a copy of the state dam inspector's condition report by certified mail to the dam owner, lessee or other person in control of the dam, the municipality in which the dam is located and the emergency management director of the county in which the dam is located if the condition report recommends any necessary remedial measures. The dam owner, lessee or other person in control of the dam must notify the commissioner within 20 days of receipt of the report if the owner disagrees with the findings and recommendations of the report. The dam owner, lessee or other person in control of the dam must provide the basis of disagreement to the commissioner within 3 months of receipt of the inspector's report. The dam owner, lessee or other person in control of the dam may apply for and be granted an extension of this deadline for good cause, but not for more than an additional 3 months.

[ 2001, c. 460, §3 (NEW) .]

3. Review conference. After receiving the inspector's report and prior to issuing any dam safety order, the commissioner shall hold a review conference and shall invite the emergency management director of the county in which the dam is located to the review conference as well as representatives from appropriate state agencies which may include the Department of Conservation, the Department of Environmental Protection, the Department of Inland Fisheries and Wildlife, the Department of Marine Resources, the Department of
Public Safety, the Department of Transportation, the Maine Land Use Regulation Commission and the State Planning Office, to discuss the public safety, environmental, economic and other concerns relating to the dam and the necessary remedial measures under consideration. A state dam inspector shall attend the review conference. The commissioner shall maintain a written record of the conference and shall make a copy of this record available to all parties participating in the conference.

[2009, c. 561, §36 (AMD).]

4. Order. The commissioner shall consider the inspector's report, the evidence presented by the dam owner, lessee or other person in control of the dam and the record from the review conference before issuing a dam safety order directing that necessary remedial measures be undertaken by the dam owner, lessee or other person in control of the dam. The commissioner may issue such an order only if the commissioner determines that the integrity, structural stability, function or operation of the dam constitutes a threat to public safety. Necessary remedial measures may include, but are not limited to:

A. Breach or removal of the dam; [2001, c. 460, §3 (NEW).]
B. Repair or maintenance of the dam in a specified manner; [2001, c. 460, §3 (NEW).]
C. Operation of the dam in a specified manner; [2001, c. 460, §3 (NEW).]
D. Preparation of and adherence to any emergency action that is approved by the commissioner; and [2001, c. 460, §3 (NEW).]
E. Maintenance of appropriate records relating to water levels, dam operation and dam maintenance. [2001, c. 460, §3 (NEW).]

[2001, c. 460, §3 (NEW).]

SECTION HISTORY

37-B §1120. ENFORCEMENT

The commissioner may commence an action to enjoin the violation of any provision of this chapter. The commissioner may enforce any order by any other appropriate remedy, including, but not limited to, entering the dam premises to carry out the terms of the order. [2001, c. 460, §3 (NEW).]

The owners, lessees or persons in control of the dam are jointly and severally liable for any costs incurred by the department in carrying out its responsibilities under section 1114, subsection 2 or in enforcing any order. If the owners, lessees or persons in control of the dam refuse to comply or do not fully comply with the department's order, the department shall initiate a civil action against the owners, lessees or other persons in control of the dam for damages in the amount of the costs incurred by the department in enforcing its order. [2001, c. 460, §3 (NEW).]

SECTION HISTORY
2001, c. 460, §3 (NEW).

37-B §1121. APPEAL

Any person aggrieved by an order of the commissioner may appeal to the Superior Court under Title 5, chapter 375, subchapter VII. [2001, c. 460, §3 (NEW).]
37-B §1122. EXEMPTIONS

Dams licensed by or subject to the jurisdiction of the Federal Energy Regulatory Commission are exempt from this chapter. [2001, c. 460, §3 (NEW).]

SECTION HISTORY
2001, c. 460, §3 (NEW).

37-B §1123. RIGHTS OF OWNER

This chapter may not be construed to deprive any owner of recourse to the court in which that owner may be entitled to relief under the laws of this State. [2001, c. 460, §3 (NEW).]

SECTION HISTORY
2001, c. 460, §3 (NEW).

37-B §1124. IMMUNITY

An action may not be brought against the State, the department or its agents or employees for any action taken or failure to take action pursuant to this chapter. [2001, c. 460, §3 (NEW).]

SECTION HISTORY
2001, c. 460, §3 (NEW).

37-B §1125. RELIEF OF OBLIGATION

This chapter may not be construed as relieving a person of duties, responsibilities or liabilities imposed by any other law, regulation, municipal ordinance or rule of law, including, but not limited to, the need to obtain permits or other approvals required to authorize repairs or other remedial measures at a dam and the need to comply with the terms and conditions of any outstanding water level or dam release order, except in an emergency situation as defined by this chapter. [2001, c. 460, §3 (NEW).]

SECTION HISTORY
2001, c. 460, §3 (NEW).

37-B §1126. ACCESS AND NOTIFICATION

1. Department access. A state dam inspector and any department staff member must have full access to any dam site under the commissioner's jurisdiction for the purpose of conducting an inspection or enforcing an order under this chapter subject to the Maine Rules of Civil Procedure, Rule 80E.

[ 2001, c. 460, §3 (NEW) .]

2. Owners, lessees; necessary access. The owners, lessees or persons in control of a dam must have access over land abutting the dam site owned by others if the access, including the passage of vehicles, machinery and equipment, is reasonably necessary to comply with an order issued under this chapter. In passing over land owned by abutters, the owners, lessees or persons in control of a dam shall make every effort to minimize the intrusion, shall restore the land to its preexisting condition to the maximum extent practicable and are liable to the abutters for all property damage caused by their activities on the abutters' land. The abutters may not be held liable to any person for any personal injuries or property damage arising from the crossing of their land by the owners, lessees or persons in control of a dam.

[ 2001, c. 460, §3 (NEW) .]

SECTION HISTORY
37-B §1127. EMERGENCY ACTION PLANS

Within 6 months after the determination of classification, the owner of a dam under the commissioner's jurisdiction that is classified as high or significant hazard potential shall prepare an emergency action plan, which must be updated every 2 years. Such emergency action plans must be reviewed for adequacy by the department. Emergency plans must follow a model plan supplied by the department. All emergency action plans must be available and on file at the appropriate local and county government offices and at the department. [2001, c. 460, §3 (NEW).]

SECTION HISTORY
2001, c. 460, §3 (NEW).

37-B §1128. NOTICE OF TRANSFER OF OWNERSHIP

Forty-five days prior to any change of ownership of a dam, whether by sale, lease or gift, the owner or owners of a dam classified as a high or significant hazard potential dam shall provide in writing to the commissioner the name and address of the prospective new owner or owners along with any plan that the prospective owner has with regard to maintaining competent operations and correcting unsafe conditions, if any. For purposes of this section, "competent operations" means properly and safely maintaining the dam and ensuring compliance with all safety, environmental and water level rules or orders. [2001, c. 460, §3 (NEW).]

SECTION HISTORY
2001, c. 460, §3 (NEW).

37-B §1129. VIOLATIONS

In addition to any other forfeitures or penalties provided by law, a person who violates any provisions of this chapter or any rule or order adopted, promulgated or issued under this chapter is subject to a civil penalty as assessed by the commissioner of not less than $100 nor more than $5,000 for each day that the violation continues. The penalty is payable to the State, to be recovered in a civil action. [2001, c. 460, §3 (NEW).]

SECTION HISTORY
2001, c. 460, §3 (NEW).

37-B §1130. DAM REPAIR AND RECONSTRUCTION FUND

1. Fund established. The Dam Repair and Reconstruction Fund, referred to in this section as the "fund," is established within the department. The department shall administer the fund and make low-interest loans from the fund for purposes pursuant to this section. The department may seek assistance from the Finance Authority of Maine in administering the fund.

[2001, c. 460, §3 (NEW).]

2. Purposes. The department may use the fund to provide low-interest loans to municipalities for engineering, legal and construction costs involved in acquiring title to, establishing a long-term management plan for, repairs to, reconstruction of, breaching of or removal of a dam or to pay emergency costs incurred for actions taken pursuant to section 1114.

[2007, c. 167, §12 (AMD).]
3. Rulemaking. The department shall adopt rules to implement this section, including criteria and procedures for the application for and award of low-interest loans from the fund and for repayment of loans to the fund. Rules adopted pursuant to this section are routine technical rules as defined in Title 5, chapter 375, subchapter II-A.

[2001, c. 460, §3 (NEW).]

4. Nonlapsing. Any balance in the fund at the end of the fiscal year may not lapse but must be carried forward to the next fiscal year.

[2001, c. 460, §3 (NEW).]

SECTION HISTORY

37-B §1131. ESTABLISHMENT OF COMMISSION

1. Establishment of commission. The River Flow Advisory Commission, as established by Title 5, section 12004-G, subsection 13-E and referred to in this section as the "commission," shall act as a technical advisory commission to the department and the Governor's office on issues of flow of the State's rivers and streams. The commission shall also facilitate communication of river flow data between dam operators, river basin managers, state agencies, the United States Geological Survey and the National Weather Service during floods and droughts and shall administer the State's hydrologic monitoring program in cooperation with the United States Geological Survey.

[2001, c. 662, §99 (NEW).]

2. Membership. The commission is composed of these members:

A. The Director of the Maine Emergency Management Agency or the director's designee; [2003, c. 404, §11 (AMD).]

B. The State Geologist or the State Geologist's designee; [2001, c. 662, §99 (NEW).]

C. The Commissioner of Agriculture, Food and Rural Resources or the commissioner's designee; [2001, c. 662, §99 (NEW).]

D. The Commissioner of Environmental Protection or the commissioner's designee; [2001, c. 662, §99 (NEW).]

E. The Commissioner of Inland Fisheries and Wildlife or the commissioner's designee; [2001, c. 662, §99 (NEW).]

F. The Commissioner of Marine Resources or the commissioner's designee; [2001, c. 662, §99 (NEW).]

G. The Director of the State Planning Office or the director's designee; [2001, c. 662, §99 (NEW).]

H. The Commissioner of Transportation or the commissioner's designee; [2001, c. 662, §99 (NEW).]

I. The District Chief of the United States Geological Survey Water Resources Division Maine District Office; [2001, c. 662, §99 (NEW).]

J. The Meteorologists-in-Charge of the National Weather Service Forecast Offices in this State or the designee of the Meteorologists-in-Charge; [2003, c. 404, §12 (AMD).]
K. Representatives from private commerce and industry, including, but not limited to, the major hydroelectric power generators, as determined by the cochairs of the commission; [2003, c. 404, §12 (AMD).]

L. A representative of the public, appointed by the Governor; [2003, c. 404, §12 (AMD).]

M. The Commissioner of Health and Human Services or the commissioner's designee; and [2003, c. 404, §13 (NEW); 2003, c. 404, Pt. B, §7 (REV).]

N. The director of the Senator George J. Mitchell Center for Environmental and Watershed Research at the University of Maine, or the director's designee. [2003, c. 404, §13 (NEW).]

3. Chair. The District Chief of the United States Geological Survey Water Resources Division Maine District Office and the Director of the Maine Emergency Management Agency or the director's designee shall act as cochairs of the commission.

4. Terms of office. The term of office of the public member is 5 years. The public member may be removed from office for cause by the Governor. Members from the State Government or Federal Government shall serve a term coincident with their governmental position. Members from private commerce and industry serve a term as determined by the respective entities that they represent.

5. Voting. A quorum of at least 7 members must be present for voting.


7. Records. The commission shall keep accurate records of its proceedings and shall file them with the Maine Emergency Management Agency.

8. Compensation. Members of the commission are not entitled to receive compensation.

9. Meetings. The commission shall meet at least once per calendar year at the call of either of the cochairs to review hydrologic conditions prior to the spring snowmelt and runoff for the purpose of issuing an advisory statement on the potential for major river flooding. Either of the cochairs may call additional meetings as needed.

10. Powers and duties. The commission has the power and duty only to:

A. Advise the department and the Governor on issues of flow within the State's rivers and streams; [2001, c. 662, §99 (NEW).]
B. Assist in communication of river flow data between dam operators, river basin managers, state agencies and federal agencies; and [2001, c. 662, §99 (NEW).]

C. Administer the State's cooperative hydrologic monitoring program in cooperation with the United States Geological Survey. [2001, c. 662, §99 (NEW).]

[ 2001, c. 662, §99 (NEW) .]

SECTION HISTORY

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1. **Introduction**

The determination of the "safety and sufficiency of a dam or reservoir" as defined in 38 M.R.S.A. §811 shall be made pursuant to this rule. When a dam or reservoir is in addition found to be "unsafe or dangerous to the lives or property of persons residing, carrying on business, or employed near or below the same" (§812), the inspector of Dam shall recommend alterations, repairs and additions to the dam or reservoir for the protection of life and property. These include but are not limited to recommendations that the reservoir level be lowered in a safe manner, that structural repairs or additions be made to the dam or reservoir, that certain operating procedures be adopted or implemented, or that the dam or reservoir be removed. Failure of the dam owner to comply with these recommendations may result in court action as described in 38 M.R.S.A. §812.

2. **Scope of Dam inspection**

A. The inspector of Dam shall make a safety assessment of a given dam or reservoir with a degree of thoroughness appropriate for the particular facility, taking into account such factors as:

   a. consequences of a total failure of the facility
   b. stage of life of the project
   c. level of safety required
   d. nature of the facility and its site

The Inspector of Dam shall first make the appropriate determination of the level of consequences of a complete failure of the dam or reservoir. He shall then determine appropriate criteria for the performance of the facility. Next, he shall make a site inspection in which he searches for any field evidence of possible malfunctions of the facility. During or following the site inspection, the Inspector of Dam shall obtain any available documents on the investigation, design, construction, and performance of the dam.

B Following such site inspection, the Inspector of Dams shall take the testimony of witnesses concerning the safety and sufficiency of the dam or reservoir as provided in 38 M.R.S.A. §811 and according to the procedure for the conduct of hearings contained in 01-019 CMR
3. Decision

A. Following the determination of the consequences of failure, the site inspection and hearing, and appropriate analyses, the Inspector of Dams shall forthwith report his findings and his opinion of the safety and sufficiency of the dam or reservoir to the Commissioner of the Department of Agriculture, Food and Rural Resources. Pursuant to 38 M.R.S.A. §812, said findings and opinion shall include the Inspector's conclusion as to whether or not such dam or reservoir is unsafe or dangerous to the lives or property of persons residing, carrying on business or employed near or below the same.

B. Such findings and opinion shall simultaneously be mailed to a representative of the petitioners, any intervenors, and the owners of the dam or reservoir. Within fourteen days of their receipt of such findings and opinion, these parties may file with the Inspector proposed findings, written comments, statements and arguments thereon. In the discretion of the inspector, additional time may be granted if the dam or reservoir owner desires to commission, at his own expense, an additional safety assessment of the dam or reservoir. Such request must be made within fourteen days of receipt of the Inspector's findings and opinion. Title 01-019 CMR 30.5M shall apply to these proceedings as modified by the procedures set forth herein.

C. Upon the expiration of the comment period or the Inspector's receipt of an additional safety assessment, as the case may be, the record shall be closed (subject to 01-019 CMR 30.5N). The Inspector shall thereupon issue a final report to the Commissioner of Agriculture, Flood and Rural Resources. In the case of finding a dam to be unsafe, or insufficient, the Commissioner shall notify all interested parties, including owners with riparian rights, municipalities in which the dams are located and any other persons or organizations he deems necessary.

4. Definition of "Unsafe and Insufficient"

A dam or reservoir shall be declared to be "unsafe" or "insufficient" if the Inspector of Dams, after utilizing all available data and testimony and making appropriate calculations using known values or reasonable assumptions, finds that the dam or reservoir does not meet minimum performance criteria appropriate to the facility. The types of performance features that should be evaluated are listed below:

A. Forces acting on the dam and evidence of horizontal translation that suggests there is too much force acting at any time against the facility;

B. Evidence of large total or differential deformation;
C. Evidence of slumps or bulges on the faces of the dam; an end-of-construction or steady state factor of safety against shear sliding and the factor of safety under conditions of reservoir drawdown and during appropriate earthquake loading;

D. Evidence that the phreatic surface within the dam during the full reservoir condition exists on the downstream face of the dam except through properly designed drains; evidence of bulges, seeps, or soft zones on the downstream face of the dam or on the immediate abutments; evaluation of the effective stress within the dam;

E. Evidence that the dam is experiencing internal erosion of dam material or that the dam abutments or foundation could be subject to piping; an evaluation of internal drain design; an evaluation of seepage gradient within the dam;

F. An evaluation of the quantity and quality of seepage through the dam

G. An evaluation of whether a dam or reservoir is safe from runoff overtopping that could wash out the containment structure. In making this evaluation, the inspector shall consider whether the dam can safely sustain overtopping by the appropriate design storm, and if not, whether an emergency spillway is present. In appropriate cases where it is determined that an emergency spillway should be present, and only one spillway exists, the principal spillway may be considered to serve as an emergency spillway, provided that the principal spillway is large enough so that it cannot be blocked by driftwood and other floating or suspended debris. For each class of structure identified in paragraphs (1), (2) and (3), the inspector shall consider whether an emergency spillway is able to transmit without erosion, or whether the dam can retain its integrity during overtopping, a storm of the frequency specified

(1) For class "a" structures, which are located in rural, agricultural, or urban areas dedicated to remain in flood tolerant usages where failure may only damage non-residential buildings, agricultural land, floodplains, or township and country roads: 25-year storm or flood;

(2) For Class "b" structures, which are located in predominantly rural or agricultural areas where failure may damage homes, industrial or commercial buildings, highways or railroads, or where failure may cause interruption of use or service of utilities: 100-year storm or flood;

(3) For Class "c" structures, where failure may cause loss of life: maximum probable flood.

H. An evaluation of the minimum freeboard during the reservoir levels that will prevail during the appropriate design storm or flood described in sub-section G above; in a reservoir where landsliding of earth or rock into the reservoir is possible, the potential for wave generation and wave run-up on the dam;

I. Evidence of holes or burrows that could render the dam unsafe;

J. Consequences of inappropriate dam placement;

K. An earthdam shall not be covered by brush, shrubs, or trees;
L. The mechanical facilities that provide control of the water levels in a reservoir shall be in good working order.

5. Qualifications in Declaring a Dam Safe

The Inspector of Dam shall declare a dam or reservoir "safe" if he finds no evidence that the dam or reservoir is unsafe during his field inspection or through his calculations of the safety based upon reasonable assumptions. In a case where the Inspector is of the opinion that there are insufficient field measurements or other data to verify definitively that certain safety criteria have been met (such as described in section 3, Sub-sections A through L), then the Inspector of Dam may declare a dam or reservoir safe subject to further specific studies which he shall recommend to the dam owner. The Inspector may also declare a dam safe subject to review by the Inspector at some later date.

STATUTORY AUTHORITY:
38 M.R.S.A. §811 et seq.; 5 M.R.S.A. §8051; Batterton v. Francis, 432 U.S. 416, 424, n. 9 (1976), General Electric Co. v. Gilbert, 429 U.S. 141-45 (1976), and Skidmore v. Swift & Co., 323 U.S. 134, 14 (1944), as to the inherent authority of an agency to promulgate interpretative regulations as opposed to regulations having the force of law. See also 2 Davis, Administrative Law §7.9 et seq. (2d ed. 1979).

EFFECTIVE DATE:
June 30, 1981

EFFECTIVE DATE (ELECTRONIC CONVERSION):
May 4, 1996

CONVERTED TO MS WORD:
May 20, 2008
3.1 GENERAL PROVISIONS

a. In accordance with the provisions of Section 1063, Chapter 22, Title 37-B M.R.S.A., it is the intent of these dam regulations to provide for the proper and safe design and construction of impounding structures not exempt from the law to the extent required for the protection of public safety.

b. These regulations shall not be construed or interpreted to relieve the owner or operator of any impoundment or impounding structure of any legal duties, obligations, or liabilities incident to ownership, design, construction, operation, or maintenance of the impounding structure.

c. These regulations shall not serve to negate nor to satisfy requirements applicable to existing or proposed impounding structures which may be imposed through provisions of other local, state or federal laws, regulations, or ordinances.

d. Any owner who owns, controls, operates, maintains, or manages an impounding structure or impoundment not exempt from the law, or any owner who proposes to perform any of the preceding, or any owner who proposes to construct an impounding structure not exempt from the law, shall engage a licensed Professional Engineer who is practicing in Maine in accordance with applicable laws of Maine to perform any engineering analysis required to comply with these regulations. Such plans and specifications, engineering analyses, and any other document prepared in compliance with the provisions of these dam regulations shall bear the Maine seal of the licensed Professional Engineer who has been engaged to prepare same.

e. These regulations are effective July 1, 1990.
3.2 DEFINITIONS

The following definitions shall apply to the terms used in these regulations:


b. "Dam" means any man-made artificial barrier, including appurtenant works, the site on which it is located and appurtenant rights of flowage and access, which impounds or diverts a river, stream or great pond and which is 2 feet or more in height and has an impounding capacity at water storage elevation of 15 acre-feet or more. Any such artificial barrier constructed solely for the purpose of impounding water to allow timber to be floated downstream in a logging operation shall not be considered a dam for the purposes of this chapter, unless it has been repaired, modified or maintained by or with the knowledge of the owner, lessee or person in control since the discontinuance of its use in connection with logging operations. Any adjacent property, easements, roads, bridges or works not necessary for the operation or maintenance of a dam or access to the dam shall not be included under the provisions of this chapter.

For the purpose of this regulation, a dam shall be considered an "impounding structure".

c. "Dam reconstruction" means the rebuilding or replacement of all or part of an existing dam that no longer functions in the manner for which it was originally constructed.

d. "Director" means the Director of the Maine Emergency Management Agency.

e. "Emergency Operations Plan" means a set of written instructions or guidelines for use by public officials which recommends actions which, when implemented, will minimize the effects of a dam failure on people and property.

f. "High or significant hazard" means that condition which poses a risk of loss of human life and substantial property damage.

g. "Public safety" or "safety of the public" means protection of life, health or property from any condition, event or action at a dam which might compromise the safety, stability or integrity of the dam or its ability to function safely.

h. "State Dam Inspector" means an inspector appointed or hired under Section 1064, Chapter 22, Title 37-B M.R.S.A.

i. "Impoundment" means a body of water the storage of which is caused by any existing or proposed impounding structure not exempt from the law.
j. "Owner" means the owner of the land on which is situated, and/or the holder of an easement permitting the construction of a dam and/or any person or entity agreeing to maintain a dam, which includes the State or any of its political subdivisions, including, but not limited to sanitation district commissions and authorities, and public or private institution, corporation, association, firm, or company organized or existing under the laws of this or any other state or country, or any person or group of persons acting individually or as a group.

k. "Design flood" is the runoff, at the site of the impounding structure, utilized in impounding structure design, construction, operation, and maintenance, which will be safely passed by the impounding structure and shall not be less than that recommended spillway design flood commensurate with the size and hazard potential of the particular impounding structure in accordance with the procedures recommended in these regulations.

l. "Design freeboard" means the minimum freeboard which would occur during passage of the design flood.

m. "Inundation zone" means an area that would be inundated in excess of storm water by the water released by the impoundment in the event of a dam breach and is that area which would be inundated immediately downstream from the site of the impounding structure extending to that point on the stream where the calculated water surface profile resulting from the design flood, determined absent the impounding structure, converges with that calculated water surface profile which would result from failure of the impounding structure at the appropriate impounding capacity, with the time of such failure to be considered coincident with the time of occurrence of maximum inflow to the impoundment resulting from the design flood.

n. "Height" means the structural height of a dam which is defined as the vertical distance from the natural bed of the stream or watercourse measured at the downstream toe of the dam to the top of the dam.

o. "Maximum impounding capacity" means normal full pond. It also means the volume in acre-feet that is capable of being impounded at the elevation of the crest of the impoundment structure including flash boards if any or the elevation of top of gates, if appropriate.

p. "Impounding capacity" means the volume in acre-feet that is capable of being impounded at the elevation of the crest of the highest ungated outlet from the impoundment.

q. "Life of impounding structure" and "life of the project" means that period of time during which the impounding structure is designed and planned to perform effectively, including that period of time required to remove the structure when it is no longer capable of functioning as planned and designed.
r. "An impoundment constructed, maintained, or operated primarily for agricultural purposes" means an impoundment that is certified by the owner to be such.

s. "Watercourse" means a natural channel having a well-defined bed and banks and in which water flows when it normally does flow.

t. "Acre-foot" means a unit of volume equal to 43,560 cubic feet or 325,853 gallons (one foot of depth over one acre of area).

u. "Flood plain" means those areas adjoining a river, stream or watercourse which have been or hereafter are likely to be covered by flood waters.

3.3 THE CLASSES OF IMPOUNDING STRUCTURES

a. For the purposes of these regulations, existing or proposed impounding structures shall be classified as one of three categories in accordance with Table 1 of this chapter.

b. For the purposes of these regulations, hazards pertain to potential loss of human life or property damage(s) in the flood plain downstream from the structure in event of failure. Structures conforming to criteria for the "low hazard" potential category generally will be found in rural or agricultural areas where failure may damage some farm buildings, limited agricultural land, or country roads. "Significant hazard" potential category structures will be those located in predominantly rural or agricultural areas where failure may damage isolated homes, secondary highways, minor railroads, or other impounding structures or cause interruption of use of service of relatively important public utilities. Impounding structures in the "high hazard" potential category will be those located where failure may cause serious damage to homes, extensive agricultural, industrial, and commercial facilities, important public utilities, main highways, railroads, or other impounding structures. Hazard potential classifications shall be proposed by the owner and shall be subject to approval by the Agency. Present and projected development of the flood plain downstream from the impounding structure shall be considered in determining the classification. Impounding structures shall be subject to reclassification as set forth in Section 1065 of Chapter 22, Title 37-B M.R.S.A.
TABLE I

Hazard Potential Classification

<table>
<thead>
<tr>
<th>Category</th>
<th>Urban Development</th>
<th>Economic Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Hazard</td>
<td>No permanent structure for human habitation</td>
<td>Minimal (undeveloped to occasional structures or agriculture)</td>
</tr>
<tr>
<td>Significant Hazard</td>
<td>No urban development and no more than a small number of habitable structures</td>
<td>Appreciable (notable agriculture, industry, or structures)</td>
</tr>
<tr>
<td>High Hazard</td>
<td>Urban development with more than a small number of habitable structures</td>
<td>Excessive (extensive community, industry, or agriculture)</td>
</tr>
</tbody>
</table>

SOURCE: U.S. Army Corps of Engineers

3.4 PROCEDURE(S)

3.41 WHO MUST FILE

An owner who proposes to construct or reconstruct an impounding structure, shall file with the Agency, on forms provided by the Agency for that purpose, a statement concerning the location, purpose, impounding capacity, and height of the existing or proposed impounding structure. If a proposed impounding structure is not exempt from the provisions of the law, construction may not commence until a full and complete filing has been completed with the agency.
3.42 PRELIMINARY REPORT

The owner of a proposed new impoundment or owner of an existing impoundment which is to be constructed or reconstructed shall submit to the Agency a written Preliminary Report regarding the proposed impounding structure. As a minimum, the Preliminary Report shall include the following information:

a. A general description of the impounding structure and appurtenances and a proposed classification as set forth in Section 3.3 of these regulations. The description shall include a statement of the purpose for which the impoundment and impounding structure is to be used.

b. A general description of properties located in the inundation zone downstream from the site of the proposed impounding structure, including the location and number of residential structures, buildings, roads, utilities and other property that would be endangered should failure of the impounding structure occur.

c. A statement from the governing body of the local political subdivision that they are aware of the intent to build or reconstruct an impounding structure and a description of the zoning ordinances and land use classifications applicable to the affected flood plain downstream and upstream from the site of the proposed impounding structure.

d. Maps showing the general location of the proposed impounding structure that include: the county or city in which the (existing or proposed) impounding structure (or would be) located, the location of roads, access to the site, and the outline of the impoundment. Existing serial photographs and existing topographic maps may be used for the purpose.

e. Preliminary drawings of a general nature which include cross sections, plans and profiles of the impounding structure, proposed pool levels, and type of spillways.

f. Preliminary design criteria, including a description of the size, ground cover conditions, and extent of development of the watershed, the geological and the geotechnical engineering assumptions for the foundations and materials to be used.

g. The owner's written request for preliminary and final inspection.

h. Written documentation by the owner's engineers certifying that dam construction will be consistent with final design plans and as-built plans.

i. A schedule for filling the reservoir.

3.43 FINAL DESIGN REPORT
Construction or reconstruction may not commence until a final design report is received by the Agency. The final design report shall include:

a. A report of geotechnical investigations of the foundation soils or bedrock and of the materials to be used to construct or reconstruct the impounding structure.

b. Design assumptions and analyses sufficient to indicate that the impounding structure will be stable during its construction or reconstruction and during the life of the impounding structure under all conditions of reservoir operations, including rapid filling and rapid drawdown of the impoundment.

c. Confirmation of the stability of the reservoir rim area in order to safeguard against reservoir ruin slides of such magnitude as to create waves capable of overtopping the impounding structure and confirmation of stability during seismic activity.

d. Design assumptions and analyses to indicate that seepage in, around, through, or under the impounding structure, foundation, and abutments will be reasonably and practically controlled so that internal or external forces or results thereof will not endanger the stability of the impounding structure.

e. Calculations and assumptions relative to design of the spillway(s).

f. Provision to insure that the impounding structure and appurtenances will be protected against significant deterioration or erosion due to freezing and thawing, wind and rain, or any combination thereof.

g. Other pertinent design data, assumptions, and analyses commensurate with the nature of the particular impounding structure and individual site conditions. When required by the Agency, a delineation of the inundation zone will be prepared by the owner for "high" and "significant hazard" impounding structures.

h. Plans and specifications as outlined in Section 3.54 of this chapter.

i. After verifying that the dam construction methods and design specifications were met, authorization to impound water will be issued prior to filling the reservoir.

j. The Agency shall accept, review, and notify the owner within [45] working days whether the Preliminary Design Report is acceptable or not. The same procedure shall be followed for the Final Design Report.
3.5 DESIGN OF STRUCTURES AND HYDROLOGY

3.51 INVESTIGATION; FOUNDATIONS; CONSTRUCTION MATERIALS, SURVEYS; AND HYDROLOGIC CALCULATIONS

a. The owner shall complete all investigations prior to submitting the design report. The scope and degree of precision required is a matter of engineering judgement based on the complexities of the site and the hazard potential classification of the proposed structure. The geotechnical engineering investigation shall consist of borings, test pits, and other subsurface exploration necessary to define adequately the existing conditions. The investigations shall be performed so as to define the soil, rock, and groundwater conditions.

b. All construction materials shall be adequately specified to insure that their properties meet design criteria. If on-site materials are specified, they shall be located and determined to be adequate in extent and in properties.

c. Surveys shall be made with sufficient accuracy to locate the proposed construction and to define the volume of the storage in the impounding structure. The area downstream from the proposed impounding structure shall be investigated in order to delineate the areas and extent of potential damage in case of failure. Locations of center lines and other horizontal and vertical control shall be shown on a map of the site.

d. The drainage area shall be determined. Present and projected conditions shall be reasonably considered in determining the runoff characteristics of the drainage area. All hydrologic assumptions shall be included in the design calculations which shall be submitted as part of the design report.

e. Periodic inspections will be conducted by a qualified Dam Inspector during the construction or reconstruction of all dams in this State. Additionally, written reports noting all conditions found will be forwarded to the Director, MEMA, within 15 working days. Conditions affecting public safety of employees shall be forwarded to the Director at the earliest opportunity.

3.52 THE DESIGN FLOOD

The magnitude of the minimum design flood to be utilized in impounding structure design, construction, operation, and maintenance shall not be less than the recommended spillway design flood commensurate with the size and hazard potential of the particular impounding structure in accordance with the recommended procedures contained within the Corps of Engineers published guidance and those which are incorporated in these regulations by reference to the extent they are not inconsistent with other provisions of these regulations and existing laws of Maine.
3.53 SPILLWAY DESIGN

a. Every impounding structure shall have a spillway system with adequate capacity to discharge water in keeping with potential hazards involved without endangering the safety of the impounding structure.

b. A spillway shall be required, unless it is demonstrated by the applicant that adequate capacity is provided by other means to prevent endangering the integrity of the impounding structure.

c. A vegetated earth or unlined emergency spillway may be approved when demonstrated that it will pass the spillway design flood without jeopardizing the safety of the structure.

3.54 PLANS AND SPECIFICATIONS

The plans and specifications for a new or reconstructed impounding structure shall consist of the following as a minimum:

a. The name of the project; the name of the owner; classification of the impounding structure as set forth in Chapter 3 of these regulations; designated access to the project; and the location with respect to highways, roads, streams, and existing impounding structures and impoundments that would affect or be affected by the proposed impounding structure.

b. Cross sections, profiles, logs of test borings, laboratory and in situ test data, drawings of principal and emergency spillways, and other additional drawings in sufficient detail to indicate clearly the extent and complexity of the work to be performed.

c. The technical provisions, as may be required to describe the methods of construction and construction quality control for the project.

d. Special provisions, as may be required to describe technical provisions needed to insure that the impounding structure is installed according to the approved plans and specifications.

Plans and specifications shall be submitted with the final design report.

e. The owner shall notify the Agency of any proposed changes in design, plans, and specifications that will affect the safety of the impounding structure.

3.6 CONSTRUCTION SCHEDULE
3.61 The applicant shall submit a construction schedule with the final design report that includes:

a. A time and construction sequence schedule that includes the estimated time to complete the construction activities.

b. Techniques to be used to divert stream flow during construction to prevent hazard to life, health, and property.

c. A plan of quality control testing to confirm that materials and construction methods met the design requirements set form in the specifications.

3.7 ACCEPTABLE DESIGN PROCEDURE AND REFERENCES

3.71 The following are acceptable as design procedures and references:

a. The design procedures, manuals, and criteria used by the United States Army Corps of Engineers.

b. The design procedures, manuals, and criteria used by the United States Department of Agriculture, Soil Conservation Service.

c. The design procedures, manuals, and criteria used by the United States Department of the Interior, Bureau of Reclamation.

d. The design procedures, manuals, data, and criteria used by the United States Department of Commerce, National Weather Service.

STATUTORY AUTHORITY: Section 1063 of Chapter 22, Title 37-B M.R.S.A.

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