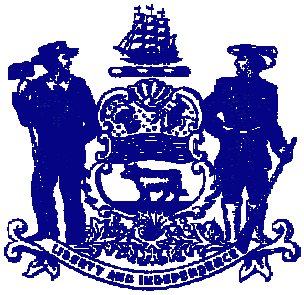
The Development of a Dam Safety Program for the State of Delaware

April 2003



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THE DEVELOPMENT OF A DAM SAFETY PROGRAM FOR THE STATE OF DELAWARE

April 2003

Introduction

In 1996, the President signed Public Law 104-303 that established a National Dam Safety Program Act. The law authorized the Federal Emergency Management Agency (FEMA) to provide funding and technical assistance to states willing to "work toward" developing a Statewide Dam Safety Program. The purpose of the National Dam Safety Program is to reduce the risk of loss of life, economic loss, and property destruction that could result from dam emergencies.

Delaware is presently one of only two States in the USA which do not have a State Dam Safety Program. Alabama is the other state. The FEMA has advised Delaware to join the other 48 States in working toward developing a State Dam Safety Program.

According to the U.S. Army Corps of Engineers National Inventory of Dams, eleven (11) dams in Delaware are rated as high hazard structures (potential downstream loss of life and property damage in the event of unlikely failure). Twenty-seven (27) dams in Delaware have a significant damage hazard (potential downstream property damage). Fifty-five (55) dams have a low hazard potential (low potential for property damage). A total of ninety-three (93) dams are listed in the State of Delaware according to the inventory. Hoopes Reservoir owned by the City of Wilmington is a high hazard structure and is the largest dam in Delaware (Figures 2 and 3).

In 1999, the FEMA and the Delaware Emergency Management Agency (DEMA) jointly awarded funding to the University of Delaware, Institute for Public Administration, Water Resources Agency to develop a Dam Safety Program for the State of Delaware. The President of the Association of State Dam Safety Officials (ASDSO) was instrumental in lobbying for funding to develop the Delaware Dam Safety Program.

The UDWRA developed the program using model legislation and criteria adapted from the *National Dam Safety Program, Implementation Plan*, September 1999; *Model State Dam Safety Program*, March 1998; and *National Inventory of Dams*, updated 1995-1996. The UDWRA prepared the draft legislation and delivered it to the Delaware Department of Natural Resources and Environmental Control and the DEMA. The draft dam safety legislation will be introduced by DNREC to the Delaware General Assembly during 2003 and, if adopted, the Delaware Dam Safety Program will be underway.

Utilizing graduate research students from the engineering technology curriculum and public policy students from the School of Urban Affairs and Public Policy, the University of Delaware developed the Delaware Dam Safety Program with the following elements:

1. Develop a Dam Safety Law and Legislation for consideration by the Delaware General Assembly by the end of the legislative session in June 2003.

2. Develop a dam permit application package for the construction, rehabilitation, or abandonment of dams in Delaware.

3. Develop a program of regular dam inspection including an inspection checklist and recommended frequency of inspection.

4. Update the National Inventory of Dams in CD-ROM for Delaware to year 2000 conditions.

5. Develop a Delaware dam owner education and training program with brochures, fact sheets, newsletter, news releases and a web site. Set up a dam safety publications library at the University of Delaware.

Dam Safety Legislation

The UDWRA developed a draft dam safety law for introduction to the Delaware General Assembly (Appendix A). The law was based on model dam safety regulations obtained from the FEMA *Model State Dam Safety Program*, March 1998. The bill was revised and first introduced by the Delaware DNREC to the Delaware House of Representatives and passed during the last week of the legislative session in June 2000. The bill went to the Senate and was tabled due to concerns by several private dam owners. It is expected that the General Assembly will meet to act on the dam safety legislation during the 2003 session. The draft law includes the definition of a dam in Delaware, which would be a minimum height of 25 feet or a minimum height of 6 feet plus a minimum storage capacity of 50 acre-feet.

The draft legislation specifies the following inspection frequency:

Hazard Potential Class	Inspection
Class I - High	Every year
Class II - Significant	Every two years
Class III - Low (may not be included in law)	Every five years

Visibility regarding the need for a Delaware dam safety law has increased due to several events: (1) the failure of the Silver Lake dam near Middletown during Hurricane Floyd in September 1999, ((2) the failure of the Hearns Pond dam near Seaford in August 2001, (3) the City of Newark in designing the dam for its new reservoir used dam safety criteria from adjacent States of Maryland and Pennsylvania in lieu of criteria not available by law in Delaware, (4) an assessment of infrastructure in Delaware by the American Society of Civil Engineers which gave Delaware an "F" for dam infrastructure due to lack of a law, and (5) articles in the *News Journal* the local newspaper, pointing out the lack of a dam program in Delaware.

Coordination of the dam safety program was conducted through an Interim Delaware Dam Safety Council consisting of:

- Delaware DNREC, Division of Soil and water Conservation (Dam Safety Officer)
- Delaware Emergency Management Agency
- Delaware Geological Survey
- Delaware Department of Transportation
- Delaware DNREC
- Federal Emergency Management Agency
- City of Wilmington (Hoopes Reservoir Dam Owner)
- Private Dam Owners
- University of Delaware, Institute for Public Administration, Water Resources Agency

The DNREC has appointed a new Delaware Dam Safety Officer in the Division of Soil and Water Conservation. The DNREC has formed a Delaware Dam Safety Guidance Committee to advise on the completion of the legislation.

Dam Permit Application Package

The UDWRA drafted a dam permit application package for the construction, rehabilitation, or abandonment of dams in Delaware (Appendix B). This package was based on successful programs in Arizona and New Jersey and includes sections on review fees, drawings, specifications, hydraulic, geotechnical, and engineering design. This dam permit application package is intended to provide existing and future dam owners in Delaware with a set of minimum requirements and guidelines for dam safety.

Dam Inspection Checklist

The UDWRA developed a Delaware-version of a dam inspection checklist drawing from the FEMA *Model State Dam Safety Program*, March 1998 (Appendix C). The package includes a program of regular dam inspection including a checklist and recommended frequency of inspection. The dams in Delaware rated as high hazard structures - a potential risk to life and structures downstream - are recommended for inspection every year. The dams in Delaware with a significant damage hazard -a potential risk to structures downstream in the event of failure - are recommended for inspection every 2 years. The dams with a low hazard potential - a low risk to downstream structures - are recommended for inspection every 5 years. With the adoption of these inspection procedures, the dam owners in Delaware will have a recommended program for preventative maintenance and rehabilitation of the dam infrastructure.

Dam Safety Inventory

The next task included updating the National Inventory of Dams in CD-ROM for Delaware to year 2000 conditions (Appendix D). The UDWRA reviewed existing reports to fill in and verify missing data such as the height and storage capacity of the dams. Dams in the Delaware range from the 6 feet high Dragon Creek dam with 68 acre-feet of storage capacity to the 135 feet high Hoopes Reservoir dam with 6300 acre-feet storage capacity which is the only concrete dam in Delaware. Many hours were spent identifying the latitude and longitude of the dams in Delaware. Once the dam safety inventory was updated, UDWRA completed a GIS map of the

dams in Delaware in an ArcView format (Figure 4). The map include the dams classified by hazard potential (high, significant, low) along with data such as the owner, height (ft.), storage capacity (ac-ft), and downstream floodplain. The GIS map can used to map downstream floodplains and potential dam failure paths for use in the development of emergency action plans (EAPs) and response to failures.

Public Education

The UDWRA established a dam safety public education program. The University of Delaware, Water Resources Agency in the DGS Annex now houses a dam safety library for Delaware filled with publications from FEMA and other sources (Appendix E). This report will be posted on the www.wr.udel.edu web site which will provide the public with digital versions of the dam safety law, permit package, dam inspection procedures, the dam safety inventory, and the GIS dam map. The Delaware DNREC and the DELDOT will be working to train their inspectors to conduct in-house inspections of state-owned dams at roadways and fishing access ponds.

Conclusion

There has been progress toward developing a dam safety program for Delaware. The University of Delaware Water Resources Agency drafted dam safety legislation and delivered it to DNREC for introduction to the Delaware General Assembly for consideration. The Delaware DNREC has appointed a State Dam Safety Engineer in the Division of Soil and Water Conservation.

Delaware is a state with only 3 counties and only a hundred or so dams and many have wondered about the need for a dam safety program in such a small state. But with passage of a pending dam safety law, Delaware could be well on its way to join the other 48 states with a formal dam safety program to protect the public health, safety, and infrastructure.

References

Delaware Department of Transportation, Division of Highways. *Ponds and Impoundments*. revised May 1988.

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Federal Emergency Management Agency and U.S. Army Corps of Engineers. *National Inventory of Dams*. updated 1998-1999.

Martin, C. C. and R. W. Miller. Delaware's Public Ponds. Delaware Division of Fish and Wildlife.1999.

University of Delaware Technical Services and the U.S. Army Corps of Engineers. *Inventory of Major Non-Federal Dams and Their Impounded Waters in the State of Delaware*. April 30, 1974.

Figure 1. Delaware and Surrounding Environs

Figure 2. Upstream Face of Hoopes Reservoir Dam, Built 1932, Height 135 feet, Storage 6300 acre-feet, Owner City of Wilmington, Delaware

Figure 3. Downstream Face of Hoopes Reservoir Concrete Dam

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Figure 4. Location Map of Dams in Delaware

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Appendix A. Draft Delaware Dam Safety Legislation

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141TH GENERAL ASSEMBLY

AN ACT TO AMEND DELAWARE CODE TO DEVELOP A DAM SAFETY PROGRAM

BE IT ENACTED BY THE GENERAL ASSEMBLY OF THE STATE OF DELAWARE:

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Section 1. Definitions

(a) Unless the context otherwise requires, the definitions in this section govern the construction of this Act.

(b) **"Abandonment"** means to render a dam non-impounding by dewatering and filling the reservoir created by that dam with solid materials and by diverting the natural drainageway around the site.

(c) **"Adverse Consequences"** means negative impacts that may occur upstream, downstream, or at locations remote from the dam. The primary concerns are loss of human life, economic loss (including property damage), lifeline disruption, and environmental impact.

(d) **"Agency"** means the Delaware Department of Natural Resources and Environmental Control, Division of Soil and Water Conservation.

(e) **"Alterations"** or **"repairs"** means only such alterations or repairs to existing dam and appurtenant structures as may directly affect the safety of the dam or reservoir, as determined by the agency.

(f) **"Application Approval"** means authorization in writing issued by the agency to an owner who has applied to the agency for permission to construct, reconstruct, enlarge, repair, alter, remove, maintain, operate or abandon a dam and which specifies the conditions or limitations under which work is to be performed by the owner or under which approval is granted.

(g) **"Appurtenant works"** include, but are not limited to, such structures as spillways, either in the dam or separate therefrom; the reservoir and its rim; low level outlet works; and water conduits such as tunnels, pipelines or penstocks, either through the dam or its abutments.

(h) **"Breach"** means partial removal of a dam, creating a channel through the dam to the original stream bottom elevation.

(i) **"Certificate of Approval to lmpound"** means authorization in writing issued by the agency to an owner who has completed construction, reconstruction, enlargement, repair, or alteration of a dam and which specifies the conditions or limitations under which the dam and reservoir are to be maintained and operated.

(j) **"Dam"** means any artificial barrier, including appurtenant works, with the ability to impound water, wastewater, or liquid borne materials and which:

1. is 25 feet or more in height from the natural bed of the stream or watercourse measured at the downstream toe of the barrier, or from the lowest elevation of the outside limit of the barrier, if it is not across a stream channel or watercourse, to the maximum water storage elevation; or
2. has an impounding capacity at maximum water storage elevation of 50 acre-feet or more.

    1. This definition does not apply to any such barrier that is not in excess of 6 feet in height regardless of storage capacity or which has a storage capacity at maximum water storage elevation not greater than 15 acre feet regardless of height, unless such a barrier, due to its location or other physical characteristics, is classified as a high hazard potential dam;
    2. No obstruction in a canal used to raise or lower water shall be considered a dam; and
    3. A fill or structure for highway or railroad use or for any other purpose, which may impound water, may be subject to review by the agency and shall be considered a dam if the criteria of Section 1009 are found applicable and is classified as a high hazard potential dam.

(k) **"Days"** used in establishing deadlines, means calendar days, including Sundays and holidays.

(l) **"Emergency"** includes, but is not limited to, 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 or property.

(m) **"Engineer"** means a qualified professional engineer. The term "qualified professional engineer" as used in this law is intended to mean an individual who has a background in civil engineering and;

1. Is a licensed professional engineer in the State of Delaware;
2. Is competent in areas related to dam investigation, design, construction, and operation for the type of dam being investigated, designed, constructed or operated;
3. Has at least ten (10) years of relevant experience in areas such as investigation, design, construction, reconstruction, enlargement, repair, alteration, maintenance, operation, breach, removal or abandonment of dams; and
4. Understands adverse dam incidents, failures and the potential causes and consequences of failures.

(n) **"Enlargement"** means any change in or addition to an existing dam or reservoir, which raises or may raise the water storage elevation of the water impounded by the dam.

(o)

(p) **"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 appurtenances. The hazard potential classification of a dam does not reflect in anyway on the current condition of the dam and its appurtenant structures (e.g., safety, structural integrity, flood routing capacity).

(q) **"High Hazard Potential Dam"** means a dam assigned the highest hazard potential classification where failure will probably cause loss of human life.

(r) **"Incremental"** means under the same conditions (e.g., flood, earthquake, or other event), the difference in impacts that would occur due to failure or of the dam or those that would have occurred without failure of the dam and appurtenances.

(s) **"Low Hazard Potential Dam"** means a dam assigned the lowest hazard potential classification where failure results in no probable loss of human life or structural damages and low environmental losses. Losses are principally limited to the owner's property.

(t) **"Owner"** includes any of the following who own, control, operate, maintain, manage, or propose to construct, reconstruct, enlarge, repair, alter, remove or abandon a dam or reservoir:

1. The state and its departments, institutions, agencies, and political subdivisions;
2. Every municipal or quasi-municipal corporation;
3. Every public utility;
4. Every district;
5. Every person;
6. The duly authorized agents, lessees, or trustees of any of the foregoing; and
7. Receivers or trustees appointed by any court for any of the foregoing.

"Owner" does not include any agency of the United States government, including those who operate and maintain dams owned by the United States. Dams designed and constructed by the United States that will be operated by an owner other than the United States shall be within the jurisdiction of the state from their inception, including application approval of design and inspection of construction.

(t) **"Person"** means any person, firm, association, organization, partnership, business trust, corporation, or company.

(u) **"Probable"** means likely to occur; reasonably expected; realistic.

(v) **"Reconstruction"** means removal and replacement of an existing dam.

(w) **"Removal"** means complete elimination of the dam embankment or structure to restore the approximate original topographic contours of the valley.

(x) **"Reservoir"** means any basin that contains or will contain impounded water, wastewater, or liquid-borne materials by virtue of its having been impounded by a dam.

(y) "**Significant Hazard Potential Dam"** means a dam assigned the significant (medium) hazard potential classification where failure results in no probable loss of human life but can cause major economic loss, environmental damage, disruption of lifeline facilities, or structural or property damage.

(z) **"Water Storage Elevation"** means the maximum elevation of water surface that can be obtained by the dam or reservoir.

Section 2. General Provisions

(a) It is the intent of the legislature by this Act to provide for the regulation of all dams and reservoirs exclusively by the state for the protection of public safety.

(b) No city or county has authority, by ordinance enacted by the legislative body thereof or adopted by the people under the initiative power, or otherwise, to regulate, supervise, or provide for the regulation or supervision of any dams or reservoirs in this state, or the construction, reconstruction, enlargement, repair, alteration, maintenance, operation, breach, removal or abandonment thereof, nor to limit the size of dam or reservoir or the amount of water which may be stored therein, where such authority would conflict with the powers and authority vested in the agency by this Act. This Act shall not prevent a city or county from adopting ordinances regulating, supervising, or providing for the regulation or supervision of dams and reservoirs that:

1. are not within the state's jurisdiction; and
2. are not subject to regulation by another public agency or body, or apply only to appurtenances such as roads and fences not germane to the safety of the structure.

(c) All plans and specifications for initial construction, reconstruction, enlargement, alteration, repair, operation, breach, abandonment, or removal of dams and supervision of construction shall be in the charge of an engineer, assisted by qualified engineering geologists and other specialists as necessary.

(d) No action shall be brought against the state, the agency or its agents or employees for the recovery of damages caused by the partial or total failure of any dam or reservoir by reason of control and regulation thereof by any of them pursuant to duties imposed upon them under the provisions of this Act including but not limited to any of the following:

1. Design and construction application approval of the dam or approval of flood handling plans during construction, reconstruction, enlargement, repair, alteration, breach, removal, or abandonment;
2. The issuance or enforcement of orders relative to maintenance or operation of the dam or reservoir;
3. Control and regulation of the dam or reservoir;
4. Measures taken to protect against failure of the dam during an emergency; or
5. Failure to act.

(e) Nothing in this Act shall be construed to relieve an owner or operator of a dam or reservoir of the legal duties, obligations, or liabilities incident to the ownership or operation of the dam or reservoir.

(f) The findings and orders of the agency, application approval and the certificate of approval to impound of any dam or reservoir issued by the state are final, conclusive and binding upon all owners, and state agencies, regulatory or otherwise, as to the safety of design, construction, reconstruction, enlargement, repair, alteration, breach, removal, abandonment, maintenance, and operation of any dam or reservoir.

(g) Nothing in this Act shall be construed to deprive any owner of such administrative or judicial recourse to the courts as he may be entitled to under the laws of this state.

(h) Records of official actions of the agency and its correspondence pertaining to the supervision of dams and reservoirs are public documents.

(i) Current owners shall notify the agency of any proposed change in ownership of any dam subject to this Act prior to the transfer of ownership.

(j) The agency may report all dam incidents as defined by the National Performance of Dams Program (NPDP), to the NPDP archive.

Section 3. Administrative Provisions

(a) The agency shall be administered and directed by an engineer, licensed by this state, or an individual otherwise clearly qualified by training and experienced in the design, construction, reconstruction, enlargement, repair, alteration, breach, removal, maintenance, operation and abandonment of dams and reservoirs, and it shall employ such clerical, engineering, and other assistants as are necessary for carrying on the work of dam and reservoir supervision in accordance with this Act.

(b) When the safety and technical considerations pertaining to an application approval, a certificate of approval to impound, a dam, a reservoir, or to plans and specifications require it, or when requested in writing to do so by the owner, the agency shall appoint a consulting board of three or more consultants to report to the agency on the safety features involved. The cost and expense of a consulting board if appointed on the request of an owner shall be paid by the owner.

Section 4. Powers of the Agency

Subsection 1. Powers in General

(a) The agency, under the police power of the state, shall review and approve the design, construction, reconstruction, enlargement, alteration, repair, maintenance, operation, breach, abandonment and removal of dams and reservoirs for the protection of life and property as provided in this Act.

(b) All dams and reservoirs in the state shall be under the jurisdiction of the agency, except those dams that are federally owned and operated.

(c) It is unlawful to construct, reconstruct, enlarge, repair, alter, remove, maintain, operate or abandon any dam or reservoir coming within the purview of this Act except upon application approval of the agency, provided that this section shall not be deemed to apply to routine maintenance and operation not affecting the safety of the structure.

(d) In order to protect life and property, owners of high and significant hazard potential dams shall develop, and periodically test and update, a plan of action to be implemented in the event of an emergency involving that owner's dam(s). This plan shall include, but not be limited to, the following elements:

1. Emergency notification plan with flowchart;
2. Statement of purpose;
3. Project description;
4. Emergency detection, evaluation, and classification;
5. General responsibilities;
6. Preparedness;
7. Inundation maps or other acceptable description of the inundated area; and
8. Appendices.

(e) For the purposes of evaluating the adequacy of a dam owner's emergency action plan, the agency shall review and approve each emergency action plan submitted under the provisions of this Act.

(f) In making any investigation or inspection necessary to enforce or implement this Act, the agency or its representatives may enter upon such private property of the dam owner as may be necessary.

(g) When the agency determines that a dam and reservoir constitutes a risk to life or property, the agency shall order the owner to take such action as necessary to remove the resultant risk to life and property.

Subsection 2. Investigations and Studies

(a) The agency shall investigate and gather or cause the owner to gather such data including advances made in safety practices elsewhere, as may be needed for a proper review and study of the various features of the design, construction, reconstruction, repair, enlargement, alteration, breach, removal, maintenance, operation, or abandonment of dams, reservoirs, and appurtenances.

(b) The agency shall make or cause the owner to make such watershed investigations and studies as shall be necessary to keep abreast of development affecting run-off and peak storm discharges from the dam.

(c) The agency shall make or cause the owner to make seismic investigations and studies as shall be necessary to keep abreast of developments affecting seismic stability of dams.

Subsection 3. Administrative and Legal Actions

(a) The agency may take any administrative or legal action necessary for the enforcement of this Act.

(b) An action or proceeding under this subsection may be initiated whenever any owner or any person acting as a agent of any owner is:

1. Failing to comply with the requirements imposed by this Act or by any application approval, certificate of approval to impound, order, rule, regulation, or requirement of the agency under the authority of this Act; or
2. Committing or allowing the commission of violations of this Act or any application approval, certificate of approval to impound, order, rule, regulation, or requirement of the agency under this Act.

(c) Any action or proceeding under this subsection shall be initiated either administratively or by appropriate legal filing in a court of appropriate jurisdiction in which:

1. The dam, area of hazard potential, or some part thereof exists;
2. The owner or person complained of has its principal place of business; or
3. The person complained of resides.

Subsection 4. Regulations and Standards

(a) The agency shall have the power and duty to adopt such regulations and standards for the design, construction, reconstruction, enlargement, alteration, operation, monitoring, maintenance, modification, repair, breach, abandonment and removal of dams and reservoirs to carry out the purposes of this Act. The regulations shall include, but are not limited to, rules establishing:

1. Standards and criteria for the siting and design of dams considering both existing and projected conditions which may affect the safety of a project during its construction and operational life;
2. Requirements for operation of dams including operational plans to be prepared and implemented by owners;
3. Requirements for monitoring, inspection and reporting of conditions affecting the safety of dams;
4. Requirements for emergency action plans to be prepared and implemented by owners, in cooperation with civil authorities;
5. Reasonable fees for the processing of applications and periodic inspections, for the purpose of reimbursing the state for the costs of administration of this Act; and
6. Proof of financial responsibility.

(b) In promulgating regulations pursuant to this Act applicable to dams regulated by this Act which may present a risk to life or property, the agency shall consider:

1. the inclusion of the best available preventative measures necessary to assure protection of life, health, property and the environment with an adequate factor of safety;
2. water management and the impacts of development in watersheds and;
3. the state of scientific and technological knowledge at the time the regulations are adopted.

(c) In promulgating regulations pursuant to this Act applicable to water obstructions and encroachments that do not present substantial potential risks to life or property, the dam safety agency shall consider:

1. the state of scientific and technological knowledge and good engineering practice relating to various types of water obstructions and encroachments;
2. the economic impact upon the state and its citizens;
3. the relationship of water obstructions and encroachments in hydrologic management in the watershed as a whole; and
4. the impacts of water obstructions and encroachments upon water quality and the environment.

Section 5. Applications

Subsection 1. New Dams or Enlargements of Dams

(a) Construction of any new dam or the enlargement of any dam shall not be commenced until the owner has applied for and obtained from the agency written application approval of plans and specifications.

(b) A separate application for each dam shall be filed with the agency upon forms provided by the agency. Plans and specifications signed and sealed by the design engineer must accompany the application.

(c) The application shall provide the following information:
1. The name and address of the owner;
2. The location, type, size, purpose, and height of the proposed dam and reservoir and appurtenant works;
3. The storage capacity and reservoir surface areas for normal pool and maximum water storage elevation;
4. Plans for proposed permanent instrument installations in the dam;
5. As accurately as may be readily obtained, the area of the drainage basin, rainfall and stream-flow records, flood-flow records and estimates;
6. Maps and design drawings showing plans, elevations, and sections of all principal structures and appurtenant works with other features of the project in sufficient detail, including design analyses, to determine safety, adequacy and suitability of design; and
7. Such other pertinent information as the agency requires.

(d) The agency shall, when in its judgment it is necessary, also require the following:
1. Data concerning subsoil and rock foundation conditions and the materials involved in the construction, or enlargement of the dam or reservoir;
2. Investigations of, and reports on, subsurface conditions, exploratory pits, trenches and adits, drilling, coring, geophysical tests to measure in place and in the laboratory the properties and behavior of foundation materials at the dam and reservoir site;
3. Investigations and reports on the geology of the dam or reservoir site, possible geologic hazards, seismic activity, faults, weak seams and joints, availability and quality of construction materials, and other pertinent features; and
4. Such other appropriate information as may be necessary.

Subsection 2. Reconstruction, Repairs, Alterations, Abandonment, Breach or Removals

(a) Before commencing the reconstruction, repair, or alteration of a dam, or the abandonment, breach or removal of a dam so that it no longer constitutes a dam as defined in this Act, the owner shall file an application and secure the written application approval of the agency. Repairs shall not be deemed to apply to routine maintenance and operation not affecting the safety of the dam.

1. The application shall give such pertinent information or data concerning the dam, as may be required by the agency;
2. The application shall give the name and address of applicant, and shall adequately detail, with appropriate references to the existing dam, the proposed reconstruction, repair, alteration, abandonment, breach, or removal of the dam. The application shall be accompanied by plans and specifications signed and sealed by the design engineer. The agency may waive any of the requirements of this section if the requirements are unnecessary for the application approval;
3. In case of an emergency where the agency declares that repairs or breaching of the dam are necessary to safeguard life and property, repairs or breaching shall be started immediately by the owner or by the agency

at the owner's expense. The agency shall be notified at once of emergency repairs or breaching when instituted by the owner, and

4. The proposed repairs, breaching and work shall conform to such orders as the agency issues.

Subsection 3. Application Approval

(a) Upon receipt of an application the agency shall approve or disapprove the application within the time provided in Section 1107.

(b) If an application is incomplete or defective, it shall be returned to the applicant to correct the defects. It must be corrected and returned to the agency within 30 days or such additional time as may be allowed by the agency. If the application is not returned, it shall be rejected.

(c) No applications shall be approved in fewer than 10 days after the receipt of the fee required by Section 1125, but all applications shall be approved or disapproved as soon as practicable thereafter. At the discretion of the agency, public hearings may be held on each application.

(d) Application approval shall be granted with terms, conditions, and limitations necessary to safeguard life and property.

(e) Actual construction, reconstruction, enlargement, repair, alteration, breach, removal, or abandonment shall be commenced within the time frame set by the agency; otherwise, the application approval becomes void.

(f) The agency may, upon written application and for good cause shown, extend the time for commencing construction, reconstruction, repair, alteration, breach, removal, or abandonment.

(g) Written notice shall be provided to the agency at least 10 days before construction, reconstruction, repair, alteration, breach, removal, or abandonment is to begin and such other notices shall be given to the agency as it may require.

Section 6. Fees

(a) The application for construction, reconstruction, enlargement, repair, alteration, breach, removal, or abandonment of a dam shall set forth the estimated cost of the dam and shall be accompanied by a filing fee as established in the dam safety permit regulations based upon the estimated cost.

(b) Only one filing fee shall be collected for an enlargement by flashboards, sandbags, earthen levees, gates, or other works, devices, or obstructions which are, from time to time, to be removed and replaced or opened and shut and thereby operated so as to vary the surface elevation of the reservoir.

(c) For the purposes of this Act, the estimated cost of the dam construction, reconstruction, enlargement, repair, alteration, breach, removal, or abandonment involved shall include the following:

1. The cost of all labor and materials for the dam, appurtenant works and reservoir;
2. The cost of preliminary investigations and surveys;
3. The cost of the construction plant properly chargeable to the cost of the dam and reservoir; and
4. Any and all other items entering directly into the cost of the dam and reservoir.

(d) Excluded from the cost listed in Section 1127 shall be:

1. The costs of right-of-way, detached powerhouses, electrical generating machinery, and roads and railroads affording access to the dam and reservoir; and
2. Any and all other items not entering directly into the cost of the dam and reservoir.

(e) Dams and reservoirs that are 90 percent or more constructed, reconstructed, enlarged, repaired, altered, removed or abandoned on the effective date of this Act as determined by the agency and that are subject to the

provisions of this Act shall not be required to pay a fee but shall submit an application for approval and issuance of an application approval. Application approvals of dams and reservoirs that are made subject to this Act that are found by the agency to have been less than 90 percent constructed, reconstructed, enlarged, repaired, altered, removed or abandoned on the effective date of this Act shall be accompanied by fees reduced by the percentage of construction, reconstruction, enlargement, repair, alteration, breach, removal or abandonment found by the agency to have been completed on that date.

(f) An application approval shall not be considered by the agency until the filing fee is received. All or part of the filing fee may be returned to the applicant only if he withdraws or cancels the application any time prior to the start of construction, reconstruction, enlargement, repair, alteration, breach, removal or abandonment. The amount of the refund will be determined by the agency with due regard to funds actually expended by the agency in review of the application.

(g) Within 30 days after giving the notice of completion required in Section 1150 and Section 1156, the owner shall file an affidavit with the agency stating the actual cost of the dam and reservoir or enlargement thereof to determine whether a further fee is due. In the event the owner of a new or enlarged dam, because of loss of records, recent change of ownership, or other causes beyond his control, is unable to report the actual cost of construction reconstruction, enlargement, repair, alteration, breach, removal or abandonment, he shall file an affidavit, stating the reasons why. The agency shall then make its own appraisal of the cost of construction reconstruction, enlargement, repair, alteration, breach, removal or abandonment, and determine what further fee, if any, is required.

(h) All filing fees and other charges collected under the provisions of this Act shall be paid into a special fund in the state treasury, to be available to the agency for expenditures for the purposes authorized by this Act.

(i) The fees provided for in this subsection shall be required of all owners as defined in Section 1 of this Act.

(j) Annual Registration Fees and Inspection Fees:

1. Owners of existing dams holding certificates of approval to impound shall be assessed an annual registration fee as established in the regulations. Existing certificates of approval to impound will be extended for one year upon receipt of the annual registration fee. Any certificate of approval to impound is void without notification to the person holding the certificate of approval to impound when the annual registration fee is more than forty-five (45) days past due. Resubmission of an application is required where a certificate of approval to impound has become void due to failure to pay the appropriate annual registration fee within 45days of the date due; and
2. Dam owners shall pay a fee following state inspections conducted in accordance with Section 1177 of this Act. The amount of the fee shall be one hundred fifty dollars plus two dollars per foot of height of dam.

Section 7. Inspection and Certificate of Approval to Impound

Subsection 1. New, Reconstructed or Enlarged Dams and Reservoirs

(a) Immediately upon completion of a new or reconstructed dam and reservoir, or enlargement of a dam and reservoir, the owner shall give a notice of completion to the agency. The owner shall file with the agency a statement signed by the design engineer certifying that the project was constructed, reconstructed or enlarged in conformance with approved plans and specifications, accompanied by supplementary drawings or descriptive matter signed and sealed by the design engineer showing or describing the dam and reservoir as actually constructed, reconstructed, or enlarged. Such supplementary materials shall include but not be limited to the following:

1. A record of all geological boreholes and grout holes and grouting;
2. A record of permanent location points, benchmarks and instruments embedded in the structure;
3. A record of tests of concrete or other material used in the construction, reconstruction, or enlargement of the dam and reservoir; and
4. A record of initial seepage flows and embedded instrument readings.

(b) In connection with the enlargement of a dam and reservoir, the supplementary drawings and descriptive matter need apply only to the new work.

(c) A certificate of approval to impound shall be issued by the agency upon a finding by the agency that the dam and reservoir are safe to impound water within the limitations prescribed in the application approval. No water shall be impounded by the structure prior to issuance of the certificate to impound.

Subsection 2. Certificates of Approval to Impound

(a) Each certificate of approval to impound issued by the agency under this Act shall contain such terms and conditions as the agency may prescribe.

(b) The agency shall revoke, suspend,. or amend any certificate of approval to impound whenever it determines that the dam or reservoir constitutes a danger to life and property.

(c) Before any certificate of approval to impound is revoked by the agency, the agency shall hold a public hearing. Written notice of the time and place of the hearing shall be mailed, at least 20 days prior to the date set for the hearing, to the holder of the certificate to impound. Any interested person(s) may appear at the hearing and present their views and objections to the proposed action. Any petition to a court of appropriate jurisdiction to inquire into the validity of action of the agency revoking a certificate of approval to impound shall be commenced within 30 days after service of notice of the revocation on the holder of the certificate of approval to impound.

Subsection 3. Repaired or Altered Dams and Reservoirs

(a) Immediately upon completion of the repair or alteration of any dam or reservoir, the owner shall give written notice of completion to the agency. The design engineer shall file with the agency a written statement certifying that the repairs or alterations were completed in accordance with the approved plans and specifications. The statement shall be accompanied by supplementary drawings and descriptive matter signed and sealed by the design engineer describing the dam and reservoir as repaired or altered together with such maps, data, records, and information pertaining to the dam and reservoir as repaired or altered.

(b) A certificate of approval to impound shall be issued upon a finding by the agency that the dam and reservoir are safe to impound water within the limitations prescribed in the application approval. Pending issuance of a new or revised certificate of approval to impound, the owner of the dam or reservoir shall not cause the dam or reservoir to impound water beyond the limitations prescribed in the existing application approval.

Subsection 4. Removal, Breach, or Abandonment of Dams and Reservoirs

(a) Upon completion of the removal, breach, or abandonment of a dam, the design engineer shall file with the agency a written statement certifying that the breach, removal or abandonment was completed in accordance with the approved plans and specifications.

(b) Before final approval of the removal of a dam or reservoir is issued, the agency shall inspect the site of the work and determine that all work was accomplished in substantial conformance with the approved application.

(c) Following the removal of a dam or reservoir, the agency may report this event in a timely manner to the National Performance of Dams Program (NPDP) and to the National Inventory of Dams (NID).

Subsection 5. Complaints of Unsafe Conditions

(a) Upon receipt of a written complaint alleging that the person or property of the complainant is endangered by the construction, reconstruction, enlargement, repairs, alterations, maintenance, or operation of any dam and reservoir, the agency shall cause an inspection and investigation to be made unless the data, records, and inspection reports on file are found adequate to make a determination whether the complaint is valid. The complainant shall be provided with a copy of the official report of the inspection and investigation.

(b) If it is found that an unsafe condition exists, the agency shall notify the owner to take such action as is necessary to render or cause the condition to be corrected, including breaching or removal of any dam found beyond repair.

Subsection 6. Inspection During Progress of Work

(a) During the construction, reconstruction, enlargement, repair alteration, breach, abandonment or removal of any dam or reservoir, the agency shall make periodic inspections for the purpose of ascertaining compliance with the approved plans and specifications. The agency shall require the owner to direct the design engineer to provide adequate supervision during construction, reconstruction, enlargement, repair, alteration, breach, removal or abandonment and to provide sufficient information to enable the agency to determine that conformity with the approved plans and specifications is being attained.

(b) If, after any inspection or investigation, during the construction, reconstruction, enlargement, repair, alteration, breach, removal or abandonment, or at any time prior to issuance of a certificate of approval to impound, it is found by the agency that modifications or changes are necessary to ensure the safety of the dam, the agency shall order the owner to revise his plans and specifications. The owner may, pursuant to Section 1051, request an independent consulting board to review the order of the agency.

(c) lf at any time during construction, reconstruction, enlargement, repair alterations, breach, removal, or abandonment of any dam and reservoir, the agency finds that the work is not being done in accordance with the provisions of the approved plans and specifications, the agency shall deliver a written notice of noncompliance to the owner. The notice shall be delivered by registered mail or by personal service to the owner.

1. The notice of non-compliance shall state the particulars in which the approved plans and specifications are not being or have not been complied with and shall order the immediate compliance with the approved plans and specifications; and
2. The agency may order that no further work be done until such compliance has been effected and approved by the agency.

(d) A failure to comply with the application approval may cause revocation of application approval by the agency. If compliance with the notice is not forthcoming in sixty days, the agency shall order the incomplete structure removed sufficiently to eliminate any safety hazard to life.

Section 8. Maintenance, Operation and Emergency Actions

Subsection 1. Maintenance and Operation

(a) The agency shall regulate the maintenance and operation of dams and reservoirs as necessary to safeguard life and property from a dam failure.

(b) The agency shall require owners to keep available and in good order, records of original and any modification construction. The owner shall report annually with respect to maintenance, operation and engineering, including horizontal and vertical controls, seepage measurements, piezometric data and geologic investigations. The agency shall issue such rules and regulations and orders as necessary to secure adequate maintenance, operation and inspection by owners. The agency shall require engineering and geologic investigations to safeguard life and property. The agency may accept reports of equivalent inspections prepared by governmental agencies. In addition, the owner of a dam and reservoir shall immediately advise the agency of any flood or unusual circumstances that may affect the safety of the dam and reservoir.

(c) The agency shall make inspections of dams and reservoirs for the purpose of determining their safety. The agency shall inspect high hazard potential dams annually, significant hazard potential dams biennially, and low hazard potential dams every five years. The agency may conduct additional inspections at any time. If serious safety concerns are found by the agency during the inspections, the agency shall require the owner to

conduct tests and investigations sufficient for the agency to determine the condition of the dam. After review of the tests or investigations, the agency may require modification, removal or breach of the dam or alteration of operating procedures to restore or improve the safety of the dam, and may require installation of instrumentation to monitor the performance of the dam.

(d) The agency may report the results of dam inspections that determine unsafe conditions or non-compliance to the National Performance of Dams Program (NPDP).

Subsection 2. Emergency Actions

(a) The owner of a dam has the primary responsibility for determining when an emergency involving a dam exists. When the owner of a dam determines an emergency does exist, the owner shall immediately implement the emergency action plan as required in Section 1078. The owner shall immediately notify any persons who may be endangered if the dam should fail, notify emergency management organizations, take necessary remedial action to prevent or mitigate the consequences of failure, and notify the agency. The agency shall take any remedial action necessary to protect life and property if, in its judgement either:

1. The condition of any dam or reservoir is so dangerous to the safety of life or property as not to permit time for the issuance and enforcement of an order relative to maintenance or operation; or
2. Passing or imminent floods or any other condition threatens the safety of any dam or reservoir.

(b) In applying the remedial means provided for in this subsection, the agency may in an emergency with its own forces, or by other means at its disposal, do any or all of the following:

1. Take full charge and control of any dam or reservoir;
2. Lower the water level by releasing water from the reservoir;
3. Completely drain the reservoir;
4. Perform any necessary remedial or protective work at the site; or
5. Take such other steps as may be essential to safeguard life and property.

(c) The agency shall continue in full charge and control of such dam and reservoir and its appurtenances until they are rendered safe or the emergency occasioning the action has ceased and the owner is able to take back such operations. The agency's take-over shall not relieve the owner of a dam or reservoir of liability for any negligent acts of the owner.

(d) The agency may report emergency actions involving the safety of a dam or reservoir to the National Performance of Dams Program (NPDP) in a timely manner.

Subsection 3. Emergency and Nonemergency Funding

(a) The cost and expense of the remedial means provided in this subsection, including cost of any work done to render a dam and reservoir or its appurtenances safe, shall be collected by presentation of bills to owners in the same manner as other debts to the state are recoverable. If the owners do not promptly pay such bills, the cost shall be recovered by the state from the owner by action brought by the agency in a court of appropriate jurisdiction.

(b) The agency may spend monies from the emergency dam repair fund established by Section 1185 with the following provisions:

1. If monies in the emergency dam repair fund are insufficient to pay for such remedial measures, the agency may transfer monies from the nonemergency dam repair fund established by Section 1186 to meet necessary costs of employing remedial measures;

2. The agency shall remain in full charge and control of the dam, reservoir and appurtenances until they have been rendered safe or the emergency has terminated;

3. The costs and expenses of the control, regulation and abatement provided by this section, including costs of construction, reconstruction, enlargement, repair, alteration, breach, removal or abandonment work done to render the dam, reservoir, or appurtenances safe, shall constitute a lien against all property of the owner. The lien shall be prior and superior to all other mortgages, liens or encumbrances of record. The lien shall have the force and effect of a mechanic's lien, and may be foreclosed at any time within two years;

4. The lien referred to in Subsection 1184(c) may be perfected and foreclosed in advance of construction, reconstruction, enlargement, repair, alteration, breach, removal or abandonment or after completion of the construction, reconstruction, enlargement, repair, alteration, breach, removal or abandonment. If in advance, the lien shall be perfected by the filing of an affidavit of the agency setting forth the estimate of the costs of construction, reconstruction, enlargement, repair, alteration, breach, removal or abandonment within the county in which the dam is located in the same manner as prescribed for mechanic's liens, and may be foreclosed in the same manner as a mechanic's lien. When the affidavit is filed, the amount set forth in the affidavit shall be a lien in such amount against all property of the owner. If the actual cost of construction, reconstruction, enlargement, repair, alteration, breach, removal or abandonment exceeds the estimated cost, the agency may amend the affidavit setting forth the additional estimated cost. If the estimated cost exceeds the actual costs of construction, reconstruction, enlargement, repair, alteration, breach, removal or abandonment at completion, the agency shall file an amended affidavit at completion. If a lien is perfected in advance and the construction, reconstruction, enlargement, repair, alteration, breach, removal or abandonment is not commenced within two years from the date of perfection, the lien shall be void. The agency shall file a satisfaction of lien upon payment of the costs of construction, reconstruction, enlargement, repair, alteration, breach, removal or abandonment by the owner; and

5. Monies collected in full or partial satisfaction of a lien created pursuant to Subsection 1184(c) of this section shall be deposited in the emergency dam repair fund established by Section 1185.

(c) Emergency Dam Repair Fund: The emergency dam repair fund is funded through monies appropriated by the legislature and monies collected by the agency in full or partial satisfaction of liens created by Subsection 1184(c). Monies in the fund shall be used to employ remedial measures necessary to protect life and property in accordance with provisions of Section 1180 and Section 1181. The agency shall administer the fund. On notice from the agency, the state treasurer shall invest and divest monies in the fund and monies earned from investment shall be credited to the fund. Monies in the emergency dam repair fund are exempt from lapsing.

(d) Nonemergency Dam Repair Fund: The nonemergency dam repair fund is funded through monies appropriated by the legislature, agency inspection fees collected, filing fees collected pursuant to Section 1125 and Section 1134, payments of principal and interest collected by the agency pursuant to Section 1184, civil penalties collected pursuant to Section 1204, monies paid to the fund pursuant to directive of the legislature and all interest earned on the investment of monies in the fund by the state treasurer. The following provisions apply:

1. Monies in the fund shall be used for loans and grants as provided in Section 1187 and Section 1188. The agency may transfer monies in the fund to the emergency dam repair fund established by Section 1185 to pay necessary costs of remedial measures as authorized in Section 1180 and Section 1181; and
2. Monies in the nonemergency dam repair fund are exempt from lapsing.

(e) Nonemergency Dam Repair Loans: The agency may grant loans from the nonemergency dam repair fund to dam owners to defray the costs of repairing dams which the agency determines to be dangerous to the safety of life and property but which are not in an emergency condition. Loans shall be granted on such terms and conditions as may be imposed by the agency. The following provisions apply:

1. The loans granted by the agency shall be for a term of not more than twenty years;
2. The loans shall bear interest at rates set by the agency in the regulations;
3. If the balance of the nonemergency dam repair fund exceeds one million dollars, no single loan shall be made for more than twenty percent of the monies available in the fund. No loan shall be made to any dam owner that, at the time of the loan application, has more than twenty percent of the outstanding loans of the fund;

4. Each loan shall be evidenced by a contract between the dam owner and the agency, acting on behalf of this state. The contract shall provide for the loan by this state of a stated amount to defray some or all of the costs of repairing the dam. The contract shall provide for equal annual payments of principal and interest for the term of the loan; and
5. The attorney general may commence whatever actions are necessary to enforce the contract and achieve repayment of loans provided by the agency pursuant to this section.

(f) Nonemergency Dam Repair Grants: The agency may provide grants from the nonemergency dam repair fund to dam owners to defray the costs of repairing dams which the agency determines to be dangerous to the safety of life and property but which are not in an emergency condition. Grants shall be provided on such terms and conditions as may be imposed by the agency and may be in addition to loans granted under Section 1185. The following provision applies:

1. If the balance of the nonemergency dam repair fund exceeds one million dollars, no single grant shall be made for more than ten percent of the monies available in the fund unless prior approval of the joint legislative budget committee is obtained. No grant shall be made to any dam owner that, at the time of the grant application, has more than twenty percent of the outstanding loans of the fund.

Section 9. Offenses and Penalties

(a) Every person who violates any of the provisions of this Act or of any application approval, certificate of approval to impound, order, rule, regulation, or requirement of the agency is guilty of a misdemeanor and punishable by a fine and/or by imprisonment in accordance with state code. In the event of a continuing violation, each day that the violation continues constitutes a separate and distinct offense.

(b) Any person who willfully obstructs, hinders, or prevents the agency from performing the duties imposed by this Act is guilty of a misdemeanor and punishable as provided in this section.

(c) Any owner or any person who engages in the construction, reconstruction, enlargement, repair, alteration, maintenance, operation, removal, breach, or abandonment of any dam and reservoir, or who knowingly does work or permits work to be executed on the dam or reservoir without the approval of the agency or in violation of this Act, and who fails to immediately notify the agency thereof is guilty of a misdemeanor and punishable as provided in this section.

(d) Cease and Desist Order; Temporary Cease and Desist Order; Hearing; Injunctive Relief

1. Except as provided by Subsection (b) of this section, if the agency has reason to believe that an owner or person is violating or has violated a provision of this Act, application approval, certificate of approval to impound, rule, regulation, order or requirement of the agency issued or adopted pursuant to this Act, the agency shall give the owner or person written notice by certified mail that the owner or person may appear and show cause at a hearing before the agency not less than thirty days from the date of mailing of the notice why the owner or person should not be ordered to cease and desist from the violation. The notice shall inform the owner or person of how to request the hearing and the consequences of failure to request a hearing.

2. If the agency finds that an owner or person is constructing, reconstructing, enlarging, repairing, altering, operating, removing, or abandoning a dam without having first obtained the required application approval of the agency, the agency shall issue a temporary order for the owner or person to cease and desist the construction, reconstruction, enlargement, repair, alteration, operation, breach, removal or abandonment pending final action by the agency pursuant to Subsection (c) of this section. The temporary order shall include written notice by certified mail to the owner or person of a hearing before the agency to show cause why the temporary order should be vacated.

3. After a hearing pursuant to Subsection (a) or Subsection (b) of this section, or after the expiration of the time to request a hearing, the agency shall issue a decision and final order. The decision and final order may take such form as the agency determines to be reasonable and appropriate and may include a

determination of violation, a cease and desist order, the recommendation of a civil penalty and an order directing that positive steps be taken to abate or ameliorate any harm or damage arising from the violation. The owner or person affected may appeal the hearing decision to a court of appropriate jurisdiction in which the violation is alleged to have occurred.

4. If the owner or person continues the violation after the agency has issued a final decision and order pursuant to Subsection (c) of this section or a temporary order pursuant to Subsection (b) of this section, the agency may apply for a temporary restraining order or preliminary or permanent injunction from a court of appropriate jurisdiction according to the state rules of civil procedure. A decision to seek injunctive relief does not preclude other forms of relief or enforcement against the violator.

(e) Violation; Civil Penalties: An owner or person who is determined to be in violation of this Act, an application approval, certificate of approval to impound, rule or order issued or adopted pursuant to this Act, may be assessed a civil penalty of $5,000 for each day the violation continues. The following provisions apply:

1. The agency shall bring an action to recover penalties under this section in a court of appropriate jurisdiction in which the violation occurred;
2. In determining the amount of the penalty, the court shall consider the degree of harm to the public, whether the violation was knowing or willful, the past conduct of the defendant, whether the defendant has taken steps to cease, remove or mitigate the violation and any other relevant information; and
3. All penalties collected pursuant to this section shall be deposited in the state nonemergency dam repair fund authorized in Section 1186.

(f) Stay of Agency's Decision; Precedence of Appeals; Review

A decision of the agency shall not be stayed pending appeal, except that the judge to whom the appeal has been assigned may stay the decision of the agency with or without bond on a showing of good cause. In determining if good cause exists under the circumstances, the court may consider whether:

1. The public interest will be adversely affected by a stay;
2. The stay will harm others;
3. There is a high probability that the appellant will succeed on the merits;
4. The appellant will suffer irreparable harm before a decision on the merits can be rendered;
5. For the benefit of the people of this state, appeals under this subsection have precedence, in every court, over all other civil proceedings; and
6. The final decision of the court of appropriate jurisdiction is appealable in the same manner as in civil actions generally and shall be governed by the Rules of Appellate Procedure.

Section 10. Dams and Reservoirs Existing Prior to the Effective Date of this Act

Subsection 1. Dams and Reservoirs Completed Prior to Effective Date of this Act

(a) Every owner of a dam or reservoir that falls within the definition of a dam or reservoir in this Act that was completed prior to the effective date of this Act shall immediately file an application with the agency for an application approval of such dam and reservoir.

(b) A separate application for each dam shall be filed with the agency upon forms supplied by the agency and shall include or be accompanied by such appropriate information concerning the dams and reservoir as the agency requires.

(c) The agency shall give notice to file an application to owners of such dams or reservoirs who have failed to do so as required by this subsection, and a failure to file within 60 days after such notice shall be punishable as provided in this Act.

(d) The notice provided for in this subsection shall be delivered by certified mail to the owner at his last address of record in the office of the county tax assessor in which the dam is located and such mailing shall constitute service.

(e) The agency shall make inspections of such dams and reservoirs.

(f) The agency shall require owners of such dams and reservoirs to perform at their expense such work or tests as may reasonably be required to disclose information sufficient to enable the agency to determine whether to issue certificates of approval to impound, or to issue orders directing further work at the owners expense necessary to safeguard life and property. For this purpose, the agency may require an owner to lower the water level of, or to drain, the reservoir.

(g) If, upon inspection or upon completion to the satisfaction of the agency of all work that may be ordered, the agency finds that the dam and reservoir are safe to impound water, a certificate of approval to impound shall be issued. The owner of the dam and reservoir shall not cause the dam and reservoir to impound water following receipt by the owner of a written notice from the agency that a certificate of approval to impound will not be issued because the dam or reservoir will not safely impound water. Before such notice is given by the agency, the agency shall hold a hearing. Written notice of the time and place of the hearing shall be mailed, at least 20 days prior to the date set for the hearing, to the owner of the dam and reservoir. Any interested persons may appear at the hearing and present their views and objections to the proposed action.

Subsection 2. Dams and Reservoirs Under Construction, Reconstruction, Enlargement, Repair, Alteration, Breach, Removal or Abandonment Before Effective Date of this Act

(a) Any dam or reservoir that falls within the definition of a dam and reservoir in this Act and which the agency finds was under construction, reconstruction, enlargement, repair, alteration, breach, removal or abandonment and based on its findings not 90 percent constructed, reconstructed, enlarged, repaired, altered, removed or abandoned on the effective date of this Act shall, except as provided in Section 1233, be subject to the same provisions in this Act as a dam or reservoir commenced after that date. Every owner of such a dam and reservoir shall file an application with the agency for the agency's written application approval of the plans and specifications.

(b) Construction, reconstruction, enlargement, repair, alteration, breach, removal or abandonment work on such a dam and reservoir may proceed, provided an application for approval of the plans and specifications is filed, until an application approval is received by the owner approving the dam and reservoir or an order is received by the owner specifying how the construction, reconstruction, enlargement, repair, alteration, breach, removal or abandonment must be performed to render the dam or reservoir safe. After receipt of an application approval or order specifying how construction, reconstruction, enlargement, repair, alteration, breach, removal or abandonment of the dam or reservoir must be performed, work thereafter must be in accordance with the application approval or order.

(c) All laws and parts of law in conflict with this Act are hereby repealed.

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Appendix B. Delaware Dam Safety Permit Application Package

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DRAFT SEPTEMBER 2000

DELAWARE DAM PERMIT REQUIREMENTS

CHECKLIST FOR PRELIMINARY REVIEW OF AN APPLICATION

GENERAL

- Application Form Complete - Prepared in duplicate.

- Fee Received and Proper for Cost -The fee is based upon the total estimated project cost. The project cost shall include all costs associated with construction of the dam and appurtenant works. Preliminary investigations and surveys, engineering design, supervision of construction and any other engineering costs shall also be included.

- Two Sets (minimum) of Drawings - Drawings shall be prepared on conventional drafting material such that clear, legible prints can be obtained. Submittal of blue line or black line prints for final approval and signature will be satisfactory.

- Two Sets (minimum) of Specifications - Specifications shall include a detailed description of the work to be performed and a statement of the requirements for the various types of material that will enter into the permanent construction. Of particular importance are those sections describing foundation preparation, placement of materials and construction quality assurance and quality control. Any special techniques should also be carefully described. If not included in the specifications, the construction schedule and a statement of the anticipated sequence of construction operations shall be filed in duplicate with the application.

- Two Design Reports (minimum) - Required for all structures. The Director may waive or enlarge any requirements for information to accompany an application.

- Drawings, Specifications and Design Report Sealed by P. E. - The drawings, specifications and engineering reports (each of which are described in detail below) shall be prepared by a professional engineer registered in Delaware and experienced in the design and construction of dams. The engineer's seal and signature shall appear on all drawings, specifications, and design reports.

DRAWINGS

- Size -All drawings submitted shall be from 22" x 36" to 28" x 42" in size.

- SOD Approval Block - In preparing the drawings, each sheet shall contain, in addition to the normal title block in the lower right hand comer, a space approximately 4" high x 5" wide in proximity to the lower right hand comer for application of the Department' s approval signature block.

- Topographic Map - A topographic map of the dam, spillway, outlet works and reservoir on a scale large enough to accurately locate the dam and appurtenances and to indicate cut and fill lines. Elevations shall be to a real datum base, rather than an assumed elevation. Contour intervals shall be compatible with the height and size of the dam and its appurtenances.

- Location Map - A location map showing all exploration drill holes, test pits, trenches, adits, borrow areas and bench marks with elevations, reference points and permanent ties.

- Reservoir Area and Capacity Tables and/or Curves

- Spillway and Outlet Rating Tables and/or Curves

- Geologic Information with Profile - Geologic information including geologic map(s) of the dam site and reservoir area at scale(s) compatible with the site and geologic complexity, showing logs of exploration drill holes, test pits, trenches, and adits.

- Foundation Profile - A foundation profile along the dam centerline showing the existing ground and proposed finished grade (cut and fill) elevations.

- Dam Profiles and Sections - A profile and a sufficient number of cross-sections of the dam to adequately describe it. Camber, crest details, interior drains, and zone details must be shown. The profile of the dam may be drawn to different horizontal and vertical scales. As a minimum, a maximum section of the dam shall be included; it shall be drawn to a true scale (vertical = horizontal). The outlet conduit may be shown on the maximum section if this is typical of the proposed construction.

- Foundation Plan - A foundation plan showing excavation with proposed grout and drain holes.

- Outlet Works - Plan, profile, and details of the outlet works, including the intake structure, the gate system, conduit details, the trash rack, filter diaphragm, concrete encasement details, and the downstream outlet structure.

- Spillway - The plan, profile, control section and sufficient cross sections of the spillway to adequately describe it. Include details of any concrete work that is contemplated. A complex control structure, a concrete chute or an energy dissipating device for a terminal structure will require additional design details.

- Drainage Area - Hydrologic data, drainage area and flood routing criteria, as appropriate.

SPECIFICATIONS

- Earthwork Specification - Include all material descriptions, placement criteria, and construction requirements.

- Concrete, Grout and Shotcrete Specifications

- Quality Assurance / Quality Control - Third party testing by a registered engineer for all elements of the dam and related structures.

- Foundation Specification - include depths, acceptable material criteria, cleaning, and grouting requirements.

- Control of Stream During Construction

- Blasting - Criteria for blast monitoring and acceptable blast vibration levels (particle velocities) should be included.

DESIGN REPORT

- Hydrologic Calculations - Hydrologic calculations and a summary table of data used in determining the required emergency spillway capacity and freeboard. Input and output listings (both hard copy and on diskette) of any computer programs used should be included

- Hydraulic Calculations - Hydraulic characteristics and engineering data used in determining the capacities of the outlet works and emergency spillway. Input and output listings (both hard copy and on diskette) of any computer programs used should be included.

- Geologic Investigation - Geologic investigation of the dam site and reservoir basin. Results and analysis of subsurface investigation including logs of test borings and geologic cross sections.

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- Blasting Plan - Guidelines and criteria for blasting, if required, to be used by the contractor in preparing the blasting plan.

- Surface Water Diversion Plan - Details of the plan for control or diversion of surface water during construction, if required.

- Dewatering Plan - Details of the dewatering plan for subsurface water during construction, if required.

- Materials Information - Material testing results, including the location of test pits and the logs of these pits.

- Grout Design - Design of the grout curtain and cap.

- Reinforced Concrete Design - Sample calculations and basic assumptions on loads and limiting stresses for reinforced concrete design. Input and output listings (both hard copy and on diskette) of any computer programs used should be included.

- Stability Analysis - A stability analysis of the dam including appropriate seismic loading, safety factors and embankment zone characteristics. The seismicity of the project area and activity of faults in the vicinity must be discussed. Input and output listings (both hard copy and on diskette) of any computer programs used should be included.

- Cutoff Trench Design - Flow net considerations including the cutoff trench design or other cutoff facilities. Input and output listings (both hard copy and on diskette) of any computer programs used should be included.

- Internal Drainage - Internal drainage design including instrumentation necessary to monitor the drainage system. Filter design for protection against piping.

- Foundation Treatment and Abutment Contact Design - Plans to adequately compensate for geological weakness in the dam foundation or in the abutment areas.

- Instrumentation - Systems for monitoring phreatic levels and seepage flows. Post-construction vertical and horizontal movement monitoring system. Strong motion instrumentation may be required at some sites. Recommendation for frequency of monitoring following construction. Identify acceptable range of readings.

- Instructions To Construction Engineer - A statement of the designer's intent with regard to construction testing frequencies, foundation guidelines, etc.

OTHER

- Water Rights - If surface waters are to be impounded, contact the Delaware Department of Natural Resources and Environmental Control, Division of Soil and Water Conservation at 89 Kings Highway, Dover, Delaware 19901, phone (302) 739 4411 for details.

- Corps 404 Permit - Any significant work in or affecting a stream may require a "404 Permit". Contact the U.S. Army, Corps of Engineers for details.

- Emergency Action Plan - For dams classified as having "High" or "Significant" downstream hazard potential, an Emergency Action Plan including dam breach inundation map.

- State Trust Land - If the dam is to be constructed on, any materials for the dam to be borrowed from, or the reservoir will inundate State Trust Land, contact the Delaware Department of Natural Resources and Environmental Control, Division of Soil and Water Conservation phone (302) 739 4411 for details of their requirements.

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- Federal Land - If the dam is to be constructed on, any materials for the dam are to be borrowed from, or the reservoir will inundate federal land, contact the appropriate federal agency for details of their requirements.

- Geotechnical Exploration Holes, Monitoring and Piezometers Wells - Certain types of drilled holes require permits and/or must be abandoned in accordance with prescribed procedures. For details, contact the Delaware Department of Natural Resources and Environmental Control, Division of Soil and Water Conservation at phone (302) 739 4411.

- Dewatering Wells - If dewatering of the dam foundation is required, contact the Delaware Department of Natural Resources and Environmental Control, Division of Soil and Water Conservation at phone (302) 739 4411.

- Floodplain Management - Any activity in a floodplain requires a floodplain use permit from the local flood control district. Any structure that will divert, retard or obstruct the flow of water will require an in-depth review by a flood control district before issuance of the permit. Removal of a dam will also require an in-depth review. Contact the local flood control district.

- Archaeological Clearance - Any activity that involves ground disturbance requires prior clearance regarding cultural resources sensitivity and treatment from the State Historic Preservation Officer. Contact the Delaware Department of Natural Resources and Environmental Control, Division of Soil and Water Conservation at phone (302) 739 4411.

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Delaware Department of Natural Resources and Environmental Control, Division of Soil and Water Conservation

INSTRUCTIONS FOR FILING AN APPLICATION

An application is required for construction of a new dam or enlargement, repair, alteration, or removal of an existing dam.

Applications shall be prepared in duplicate and sent to the Division of Soil and Water Conservation upon forms that will be furnished free on request. Completed applications should be sent to the Division of Soil and Water Conservation at the following address: 89 Kings Highway, Dover, Delaware 19901.

In addition to the application forms, two complete sets of engineering drawings, specifications and engineering design reports shall be considered a part of the application and shall be submitted to the Department with the proper application fees. The drawings, specifications and engineering reports (which are described in detail below) shall be prepared by a professional engineer registered in Delaware and experienced in the design and construction of dams. The engineer's seal and signature shall appear on all drawings, specifications, and design reports.

The Director may waive or enlarge any requirements for information to accompany an application.

As prescribed in the Statutes, no application shall be given consideration unless accompanied by an application fee based on the estimated cost of the project (see paragraph on Fee Requirements) as well as appropriate supporting data.

Plans for the proposed work shall be filed in the form of paper prints. After review of the plans and specifications, the Department will notify the applicant of any required changes. One or more conferences may also be arranged to work out revisions that will meet the Department's requirements.

The revised drawings shall be submitted to the Department in triplicate along with two sets of revised specifications for approval. Upon approval, one set of signed prints and the approved application will be returned to the applicant, one signed set of drawings retained for permanent State record and the third set retained for use by the Department during construction. A half-size set, if available, will be acceptable as the construction set.

FEE REQUIREMENTS

Payment of the application fee is required for all new construction, alteration, repair, enlargement or removal applications for dams. The fee is based upon the total estimated project cost. The project cost shall include all costs associated with construction of the dam and appurtenant works. Preliminary investigations and surveys., engineering design, supervision of construction and any other engineering costs shall also be included.

Based upon these total costs, the fee will be computed according to the following schedule:

- For the first $100,000 of the estimated cost, two (2.0 %) percent;
- For the next $400,000, one and one-half (1.5 %) percent; and
- For the next $500,000, one (1.0 %) percent.
- For all costs in excess of $1,000,000, one-half of one (0.5 %) percent.

Example fee calculation (fee must accompany the application):

ESTIMATED COST	$6,420,000.00
2% x $100,000	2,000.00
1.5% x $400,000	6,000.00
1 % x $500,000	5,000.000
.5% x $5,420,000	27,100.00
TOTAL FEE	**$40,100.00**

Upon completion of the project, the actual total cost shall be tabulated and the fee recomputed for this amount in accordance with the schedule. If the recomputed fee exceeds the fee paid with the application by $50.00 or more, then the owner shall pay the difference between the fee already paid and the recomputed fee. If the recomputed fee is less than the original fee by an amount of $50.00 or more, then the owner shall be entitled to a refund by the amount of the difference between the fee already paid and the recomputed fee.

ENGINEERING DRAWINGS

All drawings submitted shall be from 22" x 36" to 28" x 42" in size. Drawings should be prepared on conventional drafting material such that clear, legible prints can be obtained. Submittal of blue line or black line prints for final approval and signature will be satisfactory.

In preparing the drawings, each sheet shall contain, in addition to the normal title block in the lower right hand comer, a space at least 2-1/2 " x 4 " in proximity to the lower right hand corner for application of the Department's approval signature block.

Drawings accompanying the application for a new dam shall include:

1. A topographic map of the dam, spillway, outlet works and reservoir on a scale large enough to accurately locate the dam and appurtenances and to indicate cut and fill lines. Elevations shall be to a real datum base rather than an assumed elevation. Contour intervals shall be compatible with the height and size of the dam and its appurtenances.

2. Area and storage capacity curves and tables for the reservoir.

3. Spillway and outlet rating curves and tables.

4. A location map showing all exploration drill holes, test pits, trenches, adits, borrow areas and bench marks with elevations, reference points and permanent ties.

5. Geologic information including geologic map(s) of the dam site and reservoir area at scale(s) compatible with the site and geologic complexity, showing logs of exploration drill holes, test pits, trenches, and adits.

6. A foundation profile along the dam centerline showing the existing ground and proposed finished grade (cut and fill) elevations.

7. A profile and a sufficient number of cross-sections of the dam to adequately describe it. Camber, crest details, interior drains, and zone details must be shown. The profile of the dam may be drawn to different horizontal and vertical scales. As a minimum, a maximum section of the dam shall be included; it shall be drawn to a true scale (vertical = horizontal). The outlet conduit may be shown on the maximum section if this is typical of the proposed construction.

8. A foundation plan showing excavation with proposed grout and drain holes.

9. Details of the outlet works, including the intake structure, the gate system, conduit details, the trash rack and the downstream outlet structure.

10. The plan, profile, control section and sufficient cross sections of the spillway to adequately describe it. Include details of any concrete work that is contemplated. A complex control structure, a concrete chute or an energy dissipating device for a terminal structure will require additional design details.

11. Hydrologic data, drainage area and flood routing criteria, as appropriate.

The Director may waive or enlarge any requirements of information to accompany an application.

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SPECIFICATIONS

The specifications shall include a detailed description of the work to be performed and a statement of the requirements for the various types of material that will enter into the permanent construction. Of particular importance are those sections describing foundation preparation, placement of materials and concrete quality control. Any special techniques should also be carefully described. If not included in the specifications, the construction schedule and a statement of the anticipated sequence of construction operations shall be filed in duplicate with the application.

DESIGN REPORT

In addition to plans and specifications, a design report is required for all structures. For new dams, as a minimum, this report should contain the following:

1. Hydrologic calculations and a summary table of data used in determining the required emergency spillway capacity and freeboard. Input and output listings (both hard copy and on diskette) of any computer programs used should be included.

2. Hydraulic characteristics and engineering data used in determining the capacities of the outlet works and emergency spillway. Input and output listings (both hard copy and on diskette) of any computer programs used should be included.

3. Results and analysis of subsurface investigation including logs of test borings and geologic cross sections.

4. Guidelines and criteria for blasting, if required, to be used by the contractor in preparing the blasting plan. Criteria for blast monitoring and acceptable blast vibration levels (particle velocities) should be included.

5. Details of the plan for control or diversion of surface water during construction, if required.

6. Details of the dewatering plan for subsurface water during construction, if required.

7. Material testing results, including the location of test pits and the logs of these pits.

8. Design of the grout curtain and cap.

9. Sample calculations and basic assumptions on loads and limiting stresses for reinforced concrete design. Printouts of any computer programs used should be included.

10. A stability analysis of the dam including appropriate seismic loading, safety factors and embankment zone characteristics. The seismicity of the project area and activity of faults in the vicinity must be discussed. Input and output listings (both hard copy and on diskette) of any computer programs used should be included.

11. Geologic investigation of the dam site and reservoir basin.

12. Plans to adequately compensate for geological weakness in the dam foundation or in the abutment areas.

13. Flow net considerations including the cutoff trench design or other cutoff facilities.

14. Internal drainage design including instrumentation necessary to monitor the drainage system.

15. Systems for monitoring phreatic levels and seepage flows.

16. Foundation treatment and abutment contact design.

17. Post-construction vertical and horizontal movement monitoring system. Strong motion instrumentation may be required at some sites.

18. A statement of the designer's intent with regard to construction testing frequencies, foundation guidelines, etc.

19. For dams classified as having " High" or " Significant" downstream hazard potential, an Emergency Preparedness Plan including dam breach inundation map.

The Director may waive or enlarge any requirements for information to accompany an application.

APPLICATION APPROVAL: COMMENCEMENT OF CONSTRUCTION

Construction may not commence until the Director of the Division of Soil and Water Conservation has approved the owner's application. Approval is provided in writing. Application approval is valid for a one year period in which construction must begin. If construction does not begin within one year, the Department must review the application again in light of changes that may have occurred since the approval was originally given. Upon written request and good cause shown by the owner, the time allowed for commencement of construction may be extended.

OTHER PERMITS

It is not unusual that additional permits from this and/or other government agencies may also be required before construction may commence. Some are described below.

- Water Rights: If surface waters are to be impounded, contact the Delaware Department of Natural Resources and Environmental Control, Division of Soil and Water Conservation.

- Section 404, Clean Water Act: Any significant work in or affecting a stream may require a " 404 Permit". Contact the U.S. Army, Corps of Engineers (COE) for details.

- Federal Land: If the dam is to be constructed on, any materials for the dam are to be borrowed from, or the reservoir will inundate federal land, contact the appropriate federal agency for details of their requirements.

- Water Wells, Mineral Exploration Holes, Grounding, Cathodic Protection, Heat Pump and Monitoring and Piezometer Wells: Certain types of drilled holes require permits and/or must be abandoned in accordance with prescribed procedures. For details, contact the Delaware Department of Natural Resources and Environmental Control, Division of Soil and Water Conservation at phone (302) 739 4411.

- Dewatering Wells: If dewatering of the dam foundation is required and the dam is to be constructed within an Active Management Area, contact the Delaware Department of Natural Resources and Environmental Control, Division of Soil and Water Conservation at phone (302) 739 4411.

Floodplain Management: Any activity in a floodplain requires a floodplain use permit from the local flood control district. Any structure that will divert, retard or obstruct the flow of water will require an in-depth review by a flood control district before issuance of the permit. Removal of a dam will also require an in-depth review. Contact the local flood control district.

LIST OF REFERENCES

Included below is a brief list of references that have proved useful in coping with basic dam design problems. The list is not intended to be all-inclusive. However, many of these references do include comprehensive bibliographies that may provide additional assistance in locating more detailed reference materials. When complex dam design problems are encountered, it is advisable to retain a qualified specialist.

AMERICAN SOCIETY OF CIVIL ENGINEERS, U.S. COMMITTEE ON LARGE DAMS, Design and Construction of Dams, 1967.

ARIZONA DEPARTMENT OF WATER RESOURCES, ENGINEERING DIVISION, SAFETY OF DAMS SECTION, (Draft) Guidelines for the Determination of Spillway Capacity Requirements, (Revised 1991).

CEDERGREN, H.R., Seepage. Drainage, and Flow Nets, Second Edition, New York, John Wiley and Sons, Inc., 1977.

COMMITTEE ON SAFETY OF EXISTING DAMS, Safety-of Existing Dams--Evaluation and improvement, Prepared under auspices of Water Science and Technology Board, Commission on Engineering and Technical Systems, National Research Council, Washington, D.C., National Academy Press, 1983.

DAVIS, C.V. and K.E. SORENSEN, Handbook of Applied Hydraulics, New York, McGraw-Hill Book Co., Inc., 3rdEdition, 1969.

HANSEN, E.M., J.T. RIEDELL, and F.K. SCHWARTZ, Probable Maximum Precipitation Estimates--Colorado River and Great Basin Drainages, Hydrometeorological Report 49, Silver Spring, Maryland, National Weather Service (NWS),National Oceanic and Atmospheric Administration, U.S. Department of Commerce, 1977.

KING, H.W. and E.F. BRATER, Handbook of Hydraulics, 5th Edition, New York, McGraw-HUI Book Co., Inc., 1963.

SHERARD, J.R., R.J. WOODWARD, S.F. GIZIENSKI and W.A. CLEVENGER, Earth and Earth-Rock Dams, New York, John Wiley and Sons, Inc., 1963.

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE (NRCS), Earth Dams and Reservoirs, TR-60, 1985.

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE (NRCS), Earth Spillways, TR-2, 1956.

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE (NRCS), Gated Outlet Appurtenances for Earth Dams, TR46, 1982.

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE (NRCS), Guide for Design and Layout Earth Emergency Spillways as Part of Emergency Spillway Systems for Earth Dams, TR-52,1973.

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE (NRCS), Riprap Lined Plunge Pool for Cantilever Outlet, DN-6,1986.

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE (NRCS), Riprap for Slope Protection Against Wave Action, TR-69, 1983.1

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE (NRCS), Criteria for the Hydraulic Design of Impact Basins Associated with Full Flow in Pipe Conduits, TR-49,1971.

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE (NRCS), Design and Analysis of Rock Chutes, DN-22, 1983.

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE (NRCS), Hydraulics of Broadcrested Spillways, TR-39, 1968.

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE (NRCS), Hydraulic Design of the Box-Inlet Drop Spillway, AH-301, 1966.

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE (NRCS), Flow Net Construction and Use, SMN-5,1973.

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE (NRCS), Guide for Determining the Gradation of Sand and Gravel Filters, SMN-1, 1986.

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE (NRCS), Mechanics of Seepage Analysis, SMN-7, 1979.

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE (NRCS), Soil Mechanics Considerations for Embankment Drains, SMN-3, 1971.

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U.S. DEPARTMENT OF THE ARMY, CORPS OF ENGINEERS (COE), Recommended Guidelines for Safety Inspection of Dams.

U.S. DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION (BOR), Design of Small Dams, A Water Resources Technical Publication, 3rd Edition, Washington, D.C., U.S. Government Printing Office, 1987.

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Delaware Department of Natural Resources and Environmental Control, Division of Soil and Water Conservation

REQUIREMENTS DURING DAM CONSTRUCTION

Delaware Revised Statutes require that the Department supervise, for safety, the construction of jurisdictional dams. Construction may not commence until the Director has approved the owner's application. Approval is provided in writing.

Once an application is approved, it is valid for a one year period in which construction must begin. If construction does not begin within one year, the Department must review the application again in light of changes that may have occurred since the approval was originally given. Upon written request and good cause shown by the owner, the time for commencing construction may be extended.

PRECONSTRUCTION CONFERENCE

Although not mandatory, it is customary for the owner to hold a preconstruction conference prior to commencement of construction activities. From the Department's perspective, the conference provides a final forum for communication of regulatory requirements so that the contractor can plan construction activities accordingly. All involved regulatory agencies, the prime contractor and all sub-contractors should be invited.

CONSTRUCTION CONTROL

The owner and the owner's engineer shall ensure that construction of a new dam, or enlargement, repair, alteration or removal of an existing dam is carried out in accordance with the plans and specifications approved by the Director. Construction supervision shall be under the direction of a registered professional engineer having proficiency in the design and construction of dams.

The Division of Soil and Water Conservation will periodically inspect construction to confirm that it is proceeding according to the approved design and to confirm that proper construction control is being exercised by the owner's engineer. Any unsatisfactory condition shall be remedied by the owner (or the owner's engineer) with the contractor.

The Department shall have access to the dam site for purposes of inspecting all phases of construction including (but not necessarily limited to) the foundation, embankment or concrete placement, inspection and test records, and mechanical installations. At a frequency approved by the Department, the owner's engineer shall submit summary reports of construction activities and test results.

The owner or his engineer shall immediately report to the Department any condition encountered during construction that requires a deviation from the approved plans and specifications. The owner or the owner's engineer shall promptly submit a written request for approval of any necessary change and sufficient data to justify the proposed change. Construction pursuant to the proposed change may not commence without the written approval of the Director.

COMPLETION OF CONSTRUCTION

Upon completion of construction, the Department shall be notified to that effect in writing. A final inspection will be made as soon as practicable. Any deficiencies noted during the final inspection shall be corrected as soon as possible.

Use of the reservoir shall require written permission from the Department.

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Delaware Department of Natural Resources and Environmental Control, Division of Soil and Water Conservation

REQUIREMENTS FOLLOWING COMPLETION OF DAM CONSTRUCTION

AFTER COMPLETION

As soon as possible after completion of the work and full inspection by an engineer from the Division of Soil and Water Conservation, the following shall be filed by the owner or his engineer:

- An Affidavit of the actual cost of construction. Attach a detailed breakdown of the costs, including all engineering costs (see paragraph on fee requirements). A sample Affidavit is attached.
- An additional fee or refund request, as appropriate (see paragraph on fee requirements).
- One set of full size4 as-constructed plans, in the form of paper prints. If changes were made during
- construction, supplemental drawings showing the dam and appurtenances as actually constructed must be filed.
- Construction records such as grouting, materials testing, and locations and baseline readings for permanent benchmarks.
- A brief completion report summarizing the salient features of the project, including a description of and causes for any changes or deviations from the approved drawings and specifications which were made during the construction phase .

For certain projects the Director may also require an operating manual for the dam and its appurtenant structures, including schedules for surveillance activities and baseline readings for any installed instrumentation.

Upon completion of these items and finding that the dam has been constructed in accordance with the approved plans and specifications, a license of full approval will be issued. Pending issuance of a license, use of the reservoir shall require written permission from the Department.

FEE REQUIREMENTS

Payment of the application fee is required for all new construction, alteration, repair, enlargement or removal applications for dams. The fee is based upon the total project cost. The project cost shall include all costs associated with construction of the dam and appurtenant works. Preliminary investigations and surveys, engineering design, supervision of construction and any other engineering costs shall also be included.

Based upon these total costs the fee will be computed according to the following schedule:

- For the first $100,000 of the estimated cost, two (2 %) percent;
- For the next $400,000, one and one-half (1.5 %) percent;
- For the next $500,00, one (1 %) percent;
- For all costs in excess of $1,000,000, one-half of one (0.5 %) percent.

Upon completion of the project, the actual total cost shall be tabulated and the fee recomputed for this amount in accordance with the schedule. If the recomputed fee exceeds the fee paid with the application by $50.00 or more, then the owner shall pay the difference between the fee already paid and the recomputed fee. If the recomputed fee is less than the original fee by an amount of $50.00 or more, then the owner shall be entitled to a refund by the amount of the difference between the fee already paid and the recomputed fee.
Example fee calculation (fee must accompany the application):

ESTIMATED COST	$6,420,000.00
2% x $100,000	2,000.00
1.5% x $400,000	6,000.00

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1 % x $500,000	5,000.000
.5% x $5,420,000	27,100.00
TOTAL FEE	**$40,100.00**

If the actual cost for this project were $6,482,500.00, the recomputed fee would be:

ACTUAL COST.	$6,482,500.00
2% x $100,000	2,000.00
1.5% x $400,000	6,000.00
1 % x $500,000	5,000.000
. 5 % x $5,482,500	27,412.50
RECOMPUTED FEE	**$40,412.50**
Original Fee	- 40,100.00
DIFFERENCE	**$312.50**

In this case the owner would be required to pay an additional fee of $312.50. If the actual cost were $6,320,000.00,then the recomputed fee would be $39,600.00. The difference would be $500.00 in the owner's favor, and the owner would be entitled to a refund of $500.00.

A refund may be obtained by requesting it in writing with supporting documentation. The Department will review the final cost statement and initiate the refund process if a refund is indicated.

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SAMPLE AFFIDAVIT OF TOTAL COST - PLEASE USE YOUR OWN LETTERHEAD

Delaware Department of Natural Resources and Environmental Control, Division of Soil and Water Conservation 89 Kings Highway, Dover, Delaware 19901.

Gentlemen:

1, (Name) _____ am the (Owner or Authorized Agent of Owner) _____
_____of the (Name of Dam and Reservoir) _____.

The final actual total cost of the construction (or enlargement, repair, alteration, or removal, as appropriate) of the dam and appurtenant works to completion thereof is as follows:

*** 1. ENGINEERING**

1.1 Preliminary Investigations and Surveys	$_____
1.2 Preconstruction surveys (geologic, hydrologic, hydraulic, structural, testing and design)	$_____
1.3 Contract administration and construction supervision	$_____
1.4 Construction quality control testing	$_____
TOTAL ENGINEERING	**$_____**

*** 2.CONSTRUCTION CONTRACT PAYMENTS**

**2.1 Final payment for contract bid quantity list	$_____
**2.2 Final payment for change orders to bid quantity list	$_____
TOTAL CONSTRUCTION CONTRACTS	**$_____**
TOTAL CONSTRUCTION COST (Engineering + Construction Contracts)	**$_____**

I hereby declare under penalty of perjury that, to the best of my knowledge and belief, the above statement is true and correct.

Executed on _____ at _____, Delaware.
(Owner's Signature) _____
(Notary) (Date) _____

* The cost breakdown must include all applicable costs as indicated. For projects with two or more features, an allocation of total project cost items to each appropriate feature may be made. Allocations of project cost items may be combined when properly identified to fit the individual circumstances.

** Attach forms showing contract bid quantities with prices and final pay quantities, including change order items.

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CASE 2: NEW JERSEY REQUIREMENTS

(a) The application shall be on forms specified and supplied by the Department and must be accompanied by two copies of the final design report and construction specifications and five sets of all plans, drawings, designs and specifications. Upon the written request of the applicant, the Department may waive certain requirements for documentation in the application stage set forth at (b) to(g) below for a permit to modify or repair an existing dam.

(b) The application shall include a Final Design Report, which must contain the following:

1. A report of the field and laboratory investigations) of the foundation soils and/or bedrock, a location map to identify borings and the materials that will comprise the dam and any dikes or levees. Stability and settlement analyses and seepage and underseepage studies are required, unless the applicant can demonstrate to the satisfaction of the department that these analyses are not necessary.
2. The bases, references, calculations and conclusions relative to hydrologic studies and design of spillway.
3. Structural and hydraulic design studies and calculations. Structural, hydraulic and hydrologic design procedures should be used, as established by one of the following: the U.S. Army Corps of Engineers (COE); the U.S. Bureau of Reclamation(BOR); the U.S. Natural Resource Conservation Service (NRCS); and other procedures universally accepted as sound engineering practice.

(c) The application must include all drawings necessary to fully describe the proposal. Drawings must be prepared in accordance with the following:

1. All drawings must be prepared by a licensed professional engineer or land surveyor, as appropriate. Each drawing shall have a title block that meets the requirements of the State Board of Professional Engineers and Land Surveyors.
2. 2.Drawings must clearly show the datum to which elevations shown are referred. The National Geodetic Vertical Datum of 1929 (N.G.V.D.), formerly known as the U.S. Coast & Geodetic Survey datum, should be used wherever possible. If the N.G.V.D. datum is not used, an appropriate conversion equation must be indicated on the drawings.
3. The applicant must submit drawings showing the following information:

i. A general plan of the dam, drawn to an appropriate scale, which must show accurately the position of all essential details, such as the spillway and its point of discharge into the stream, pipes through the dam, inlets, outlets, screen chambers, gate or valve houses, head-races, the canal mill or power plant, tailraces and downstream bridges which might cause backwater on the dam;

ii. A longitudinal section of the dam and cross-section of the valley at the site of the dam, showing the elevation of the crest of the dam, the elevation of the normal and design storm flow line of the lake or reservoir, the original surface of the ground, the nature and depth of the underlying strata, the probable depth of the excavation for the foundation of the dam and for the cutoff, foundation, treatment, elevation of the restored surface of the ground, the location and elevation of all pipes or conduits passing through the dam, the core wall, if any, and the spillway structure;

iii. Typical cross-sections, including a maximum section of the dam and of a spillway section which shall meet the following requirements;

(1) Cross sections must show the original surface of the ground, subsurface conditions as disclosed by test pits or borings, the probable depth of excavations for the foundation and for cutoff, the elevations of the top of the dam, the crest of the spillway and the normal flow line or water surface in the reservoir;
(2) For earth dams, the depth of stripping must be shown, as well as the position, material and dimensions of the cutoff or core wall, the width at the crest, the slopes and the nature and dimensions of the slope protection, the position and dimensions of the outlet pipes or conduits and

the cutoff to prevent seepage along such structures, the disposition of different classes of embankment material if of varying composition, toe drains and clay blankets;

(3) For concrete or other composite dams, the cross sections shall show all dimensions and shall indicate the position and kinds of material to be included in the structure.

iv. if not clearly indicated on one or more of the drawings listed above, the following details shall be shown on additional detail sheets:

(1) Detail. of spillway or overflow, showing the length and depth of opening, together with the width and shape of the crest, grade and shape of the approach and discharge channels, if any, methods of protecting the toe of the dam or end of the discharge channel from erosion and the dimensions of all walls, floors and paving;

(2) Details of the intake and outlet works' showing the location and dimensions at all valves or sluice gates, intakes, screen chambers, racks, outlet towers and gate houses and appurtenances;

(3) For reinforced concrete dams, detailed drawings must also be submitted, showing the size, spacing and arrangement of all reinforcing steel and expansion joints; and

(4) Special drawings shall be submitted showing any special construction features not otherwise shown, such as piling, fishways, aprons, materials used in the core wall, movable dams, tainter gates and mechanical devices, drains and instrumentation.

(d) The application must include specifications, containing the following:

1. General provisions, specifying the rights, duties and responsibilities of the owner, applicant, applicant's engineer and the builder;
2. The estimated project schedule and sequence of work; and
3. Technical provisions, describing carefully and in detail the approved work methods and procedures, standards for equipment and testing, materials to be used and the results to be obtained.

(e) The applicant shall complete all investigations, including the following, prior to submission of the final design report which shall meet the following requirements:

1. The scope and the degree of precision of investigations required for a specific project shall be based on the complexities of the site, the importance of the proposed structure and the hazard potential created by the proposed structure.
2. The foundation investigation shall consist of borings, test pits, seismic investigations or other subsurface explorations and must be performed so as to accurately define the soil and rock stratigraphy and the ground water conditions to the satisfaction of the Department.
3. Laboratory testing of undisturbed and remolded soil specimens and rock samples may be required by the Department.
4. The applicant must determine the nature and extent of materials which are proposed for use in, the structure, (e.g., borrow material/concrete aggregate, riprap stone, filter materials) and their structural properties when incorporated into the proposed structure.
5. Stability analysis and calculations for the proposed structure to ensure safety against failure due to overturning, sliding or overstressing must be submitted and approved by the Department.
6. Topographic surveys must be performed with sufficient accuracy to locate the proposed construction and to define the volume of the storage in the reservoir and the flowage limits. The upstream and downstream area must be investigated in order to delineate the area of potential damage in case of failure or flooding. Locations of baselines, centerlines and other horizontal and vertical control points must be shown on the topographic map of the site.
7. The drainage area must be accurately determined. Both present and projected future land use must be considered in determining the runoff characteristics of the drainage area. The most severe of these two conditions must be used in the design. The hydrologic assumptions and design calculations used in spillway designs shall be specified and shall include:

i. Drainage area size;

ii. Rainfall and runoff data;
iii. Reservoir inflow hydrographs;
iv. Reservoir area-capacity-elevation data;
v. Spillway elevation-discharge data; and
vi. Reservoir flood routings, except as otherwise provided in this subchapter.

(f) All applicants must submit an Operation and Maintenance Manual in accordance with N.J.A.C. 7:20-1.1 and applicants for Class I and II dams (see N.J.A.C. 7:20-1.8) shall prepare and submit an Emergency Action Plan which shall at least include a Dam Breach Analysis, inundation maps and Emergency Notification and Evacuation Plans.

(g) The Department may require the submission of an Environmental Impact Statement, as defined in N.J.A.C. 7:20 -1.2 by any applicant for a dam permit.

(h) The application to remove or breach a dam shall include the following:

1. Design report, and plans and computations to effect the breach including size of breach, shape of breach, disposal of spoil material;
2. Plans and computations for stabilization of the lake bed including the channel upstream of the breach, and for the control of sediment within the lake and downstream of the breach during and after the breach has been effected;
3. Computations for design of the method and timing for dewatering the lake;
4. Computations detailing the effects of the breach on the downstream channel and demonstrating that the project will not adversely affect flooding conditions downstream during the 10, 50 and 100 year storms;
5. Specifications containing the technical provision which describe in detail the proposed work methods and equipment and, in addition, a work schedule for the entire project;
6. A plan of the existing dam and lake along with surrounding property lines;
7. Evidence that all adjoining property owners of the impoundment and the municipalities where the reservoir or dam is located have received notification that an application has been submitted to the Department to remove or breach a dam and proof of publication of notice of the proposed removal application in at least one newspaper of general circulation in the municipality where the reservoir or dam is located:
8. A description of the potential effects of the dam removal or breach upon the environment; and
9. A description of the potential effects of the dam removal or breach upon life and property downstream of the dam.

Appendix C. Delaware Dam Inspection Checklist

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Delaware Department of Natural Resources and Environmental Control, Division of Soil and Water Conservation

Embankment Dam Inspection Checklist / Report

Each item of the checklist should be completed. Repair is required when obvious problems are observed. Monitoring is recommended if there is a potential for a problem to occur in the future. Investigation is necessary if the reason for the observed problem is not obvious. A brief description should be made of any noted irregularities, needed maintenance, or problems. Abbreviations and short descriptions are recommended.

Dam Number:	**Dam Name:**	**Type**
Contacts:		
Inspected by:	**Date:**	
Reviewed by:	**Date**	
Storage Level: ft. Above/below Spillway Crest	**Total Freeboard:**	**Photos (yes/no)**
Item:	**Comments:**	

Dam Number:	Dam Name:	Type	Page … of …	N/A	no	yes	Monitor	Investigate

1. CREST					
a. Settlements, slides, depressions?					
b. Misalignment?					
c. Longitudinal/Transverse cracking?					
d. Animal burrows?					
e. Adverse vegetation?					
f. Erosion?					
2. UPSTREAM SLOPE					
a. Erosion?					
b. Adequate ground cover?					
c. Adverse vegetation?					
d. Longitudinal/Transverse cracking?					
e. Inadequate riprap?					
f. Stone deterioration?					
g. Settlements, slides, depressions, bulges?					
h. Animal burrows?					
3. DOWNSTREAM SLOPE					
a. Erosion?					
b. Adequate ground cover?					
c. Adverse vegetation?					
d. Longitudinal/Transverse cracking?					
e. Inadequate riprap?					
f. Stone deterioration?					
g. Settlements, slides, depressions, bulges?					
h. Animal burrows?					

i. Soft spots or boggy areas?					
j. Movement at or beyond toe?					
4. DRAINAGE / SEEPAGE CONTROL					
a. Internal drains flowing? Est. Left gpm; Est. Right gpm					
b. Boils at or beyond toe?					
c. Seepage at or beyond toe? Estimated gpm					
d. Does seepage contain fines?					
5. ABUTMENT CONTACTS					
a. Erosion?					
b. Differential movement?					
c. Cracks?					
d. Settlements, slides, depressions, bulges?					
e. Seepage? Est. Left gpm; Est. Right gpm					
f. Animal burrows?					
6. OUTLET WORKS APPROACH CHANNEL **Unlined, concrete, riprap, or other?**					
a. Eroding or backcutting?					
b. Sloughing?					
c. Restricted by vegetation?					
d. Obstructed with debris?					
e. Silted in?					
7. OUTLET WORKS INLET STRUCTURE					
a. Seepage into structure?					
b. Debris or obstructions?					
c. If concrete, do surfaces show:					
1. spalling or scaling?					
2. cracking?					
3. erosion?					
4. exposed reinforcement?					
d. Do the joints show:					
1. displacement or offset?					
2. loss of joint material?					
3. leakage?					
e. Are the trash racks:					
1. broken or bent?					
2. corroded or rusted?					
3. obstructed?					
f. Sluice/Drain gates:					
1. broken or bent?					
2. corroded or rusted?					
3. leaking?					
4. seated properly?					
5. operational?					
6. periodically maintained?					
7. date last operated?					
8. OUTLET WORKS CONDUIT concrete, metal, plastic					
a. Seepage into conduit?					
b. Debris present?					
c. If concrete, do surfaces show:					
1. spalling or scaling?					
2. cracking?					
3. erosion?					
4. exposed reinforcement?					
5. other?					

-

d. If metal, do surfaces show:					
1. corrosion?					
2. protective coating deficit?					
3. misalignment or split seams?					
e. Do the joints show:					
1. displacement or offset?					
2. loss of joint material?					
3. leakage?					
9. OUTLET WORKS – STILLING BASIN/POOL					
a. If concrete, do surfaces show:					
1. spalling or scaling?					
2. cracking?					
3. erosion?					
4. exposed reinforcement?					
b. If concrete do joints show:					
1. displacement or offset?					
2. loss of joint material?					
3. leakage?					
c. Do the energy dissipators show:					
1. signs of deterioration?					
2. debris coverage?					
3. signs of inadequacy?					
10. OUTLET WORKS – OUTLET CHANNEL unlined, concrete, riprap, other					
a. Eroding or backcutting?					
b. Sloughing?					
c. Obstructed?					
d. Poorly riprapped?					
e. Tailwater elevation and flow conditions:					
11. EMERGENCY SPILLWAY – APPROACH CHANNEL unlined, concrete, riprap, other					
a. Eroding or backcutting?					
b. Sloughing?					
c. Restricted by vegetation?					
d. Obstructed with debris?					
e. Silted in?					
12. EMERGENCY SPILLWAY – CONTROL STRUCTURE					
a. If concrete, do surfaces show:					
1. spalling or scaling?					
2. cracking?					
3. erosion?					
4. exposed reinforcement?					
b. If concrete do joints show:					
1. displacement or offset?					
2. loss of joint material?					
3. leakage?					
c. If spillway is unlined:					
1. are slopes eroding?					
2. are slopes sloughing?					
3. is crest eroding?					
d. Is weir in poor condition?					
e. Where is control structure?					
13. EMERGENCY SPILLWAY – CHANNEL unlined, concrete, riprap, other					
a. Obstructions or restrictions?					
b. If concrete, do surfaces show:					

1. spalling or scaling?					
2. cracking?					
3. erosion?					
4. exposed reinforcement?					
c. If concrete do joints show:					
1. displacement or offset?					
2. loss of joint material?					
3. leakage?					
d. If an unlined channel, does it show:					
1. erosion?					
2. slopes sloughing?					
3. poor protection with vegetation/riprap?					
14. EMERGENCY SPILLWAY – TERMINAL STRUCTURE					
a. If concrete, do surfaces show:					
1. displacement or offset?					
2. loss of joint material?					
3. leakage?					
4. exposed reinforcement?					
b. If concrete, do joints show:					
1. displacement or offset?					
2. loss of joint material?					
3. leakage?					
c. Do the energy dissipators show:					
1. signs of deterioration					
2.debris cover?					
3. signs of inadequacy?					
15. EMERGENCY SPILLWAY – OUTLET CHANNEL unlined, concrete, riprap, other					
a. Eroding or backcutting?					
b. Sloughing?					
c. Obstructed or restricted?					
16. RESERVOIR					
a. High water marks?					
b. Erosion/Slides in pool area?					
c. Sediment accumulation?					
d. Floating debris present?					
e. Depressions, sinkholes, or vortices?					
f. Low ridges/saddles allowing overflow?					
g. Structures below dam crest elevation?					
17. INSTRUMENTATION					
a. List types of instrumentation:					
b. Describe condition:					
c. Is it read and/or analyzed regularly?					
d. Is data available?					
18. CONDITION SUMMARY/LICENSE/EAP/NEXT INSPECTION					
a. Dam condition unsafe non-emergency/significant deficiencies/satisfactory					
b. Date of current license:					
c. Should new license be issued?					
d. List current size: accurate?					
e. List current ds hazard: accurate?					
f. Is there a current EAP? If so, list latest revision date:					
g. List normal inspection frequency:					
h. Recommend date for next inspection:					

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Guidelines for Inspection of Existing Dams
Delaware Department of Natural Resources and Environmental Control
Division of Soil and Water Conservation
Dover, Delaware

Delaware Dam Safety Inspection Program

The Delaware Dam Safety Program is implemented by the Delaware Department of Natural Resources and Environmental Control Division of Soil and Water Conservation. The objective of the program is to protect lives and property from the consequences of a dam failure or the improper release of impounded water. A primary means of achieving this goal through the maintenance and periodic inspection of in-service dams.

The Delaware Dam Safety inspection program is intended to identify conditions that may adversely affect the safety and functionality of a dam and its appurtenant structures; to note the extent of deterioration as a basis for long term planning, periodic maintenance or immediate repair; to evaluate conformity with current design and construction practices; and to determine the appropriateness of the existing hazard classification. The Professional engineer performing the inspection should, where appropriate, recommend subsequent investigations required to resolve certain conditions and corrective measures to enable the dam to continue to perform its intended functions.

Inspection Guidelines

The Delaware Dam Safety inspection guidelines are designed to assist the dam owner to better understand the requirements, responsibilities, and duties inherent with dam ownership and to assist the professional engineer by providing a consistent approach to dam inspection and in-service evaluation.

Several different types of dam inspections can be performed. Dams and appurtenances should be inspected regularly to identify conditions that may adversely affect the safety of a dam and its ability to perform intended functions. An inspection may include the periodic evaluation of the as-built dam to ensure conformity with current design and, construction practices.

Dam Classifications

The State of Delaware recognizes three (3) classes of dams. Class I dams are high hazard structures which, should they fail, would likely cause loss of life. Class II dams are significant hazard structures which, should they fail, would likely cause substantial downstream property damage but are not considered to be a threat to life. Class III dams are low hazard structures which would cause little or no downstream damage should they fail.

When Should Dams be Inspected?

Class I high hazard dam owners are required to have a regular inspection performed every year. Class II significant hazard dam owners are required to have a regular inspection performed every two years. Class III low hazard dam owners are required to have a regular inspection performed every five years. All dam inspections shall be performed from March though December.

Types of Inspections

Formal Inspection - The inspection and performance evaluation of Class I, I, and III dams under the supervision of qualified, Delaware licensed professional engineer to review and determine the safety and integrity of the dam and appurtenant structures. Formal inspections require a detailed field examination and should include a thorough review of the records on project design, construction, and performance. Where appropriate, a reanalysis employing advanced methods and modern design criteria and practices should be conducted in order to determine if the structure meets current design criteria. In addition, formal inspections require that the long-term behavioral patterns revealed by instrumentation and spillway discharges be closely examined. Detailed underwater inspections should be included as needed. A Department approved Emergency Action Plan and Operation and Maintenance Manual

should be confirmed and their adequacy determined. Technical experts and specialists may be required to evaluate individual features and conditions; however, a qualified Delaware licensed professional engineer must make the final coordinated evaluation. A review of prior regular and formal inspection reports should be undertaken to evaluate trends in performance.

Regular Inspection - The visual inspection of a dam by a qualified, Delaware licensed professional engineer to detect any signs of deterioration in material, developing weaknesses or unsafe hydraulic or structural behavior. For Class I and Class II dams, a Department approved Emergency Action Plan should be confirmed and its adequacy determined. For all dams a Department approved Operation and Maintenance Manual should be confirmed and its adequacy determined. All instrumentation data should be reviewed and evaluated.

Informal Inspection - The visual inspection of the dam by the dam owner or operator to detect apparent signs of deterioration or other deficiencies of the dam structure or function. Informal inspections require that personnel conducting the inspection be knowledgeable about the dam and its appurtenances.

Emergency Inspection - An emergency inspection is an unscheduled inspection of a dam and its appurtenances necessitated by a potentially adverse natural event such as a large flood, earthquake, landslide or when a condition develops that appears to immediately threaten the safety of the dam. An emergency inspection is applicable to any hazard classification and requires immediate attention. Any required emergency repairs resulting from the emergency inspection should be conducted in compliance with DE.A.C. 7:20 - 1.4 (i).

Inspection Reports and Qualifications of Inspection Personnel

Formal and regular dam inspections must be performed by a qualified, professional engineer. The term "qualified engineer" as used in these standard guidelines is intended to mean an individual who:

1. Is a licensed Delaware professional engineer.
2. Is competent in items related to dam investigation, design, construction, and operation for the type of dam being inspected.
3. Has at least 10 years of relevant experience in dam investigation, design, construction, operation, and evaluation.
4. Understands the effects of adverse dam incidents and failures and the potential cause of failures.

The text of the report on the condition of a dam should be concise and provide all relevant dam and dam related facts, findings, conclusions, analysis, recommendations, and data. In addition, each report should contain clear, color photographs with each photograph indicating the date it was taken, the State dam reference number, and the photograph location. The visual inspection checklist, provided by the Department, should be completed and accompany all inspection reports. At the discretion of the Department, a completed visual inspection checklist, together with relevant color photographs, will be considered the minimum information required for an acceptable inspection report.

Inspection reports for Class I, Class II and Class III dams should be submitted to the Department within 30 days of the completion of the inspection.

Informal inspections may be performed by the dam owner or operator and the resulting inspection report shall be part of the owner's or operator's permanent file. Unless specifically requested, informal inspection reports are not to be submitted to the Department. The Department may require the owner or operator of any dam to perform an inspection of any type at any time.

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VISUAL INSPECTION CHECKLIST

This general checklist should be used as an aid when examining all dams. This checklist may not, however, include all features conditions found at a specific dam that are relevant to the safety of that dam. All features integral to the safety of the dam being examined should be inspected and their condition reported.

DE INSPECTION YEAR:
TYPE OF INSPECTION: (formal, regular, informal):
DAM NAME:
DAM FILE NO.:
LOCATION:
OWNER:
OPERATOR:
DATE OF INSPECTION:
RESERVOIR INFORMATION
Normal Reservoir Elevation (ft):
Reservoir Elevation at time of inspection (ft)
WEATHER CONDITIONS (including recent rainfall):
INSPECTION PERSONNEL
Delaware Licensed Professional Engineer(s).

Name	Affiliation	Area of Expertise

Non-Licensed technical expert(s) and advisor(s):

Name	Affiliation	Area of Expertise

State Representative (s):

Name	Affiliation

Dam Owner Representative (s):

Name	Affiliation

Others:

GENERAL INFORMATION

Name of Dam:
Fed. I.D. No. DE. Dam No.:
Rive Basin:
Town: County:
Block: Lot:
Nearest Downstream City-Town:
Stream Name:
Tributary of:
Latitude (N): Longitude (W):
Type of Dam:
Purpose of Dam:
Hazard Category: Drainage Area (sq. mi.):
Height (ft): Length (ft):
Normal Surface (ac): Normal Capacity (ac. ft.):
Maximum Capacity (ac. ft.): Spillway Capacity (CFAs):

HISTORY

Date Constructed: Dates(s) Reconstructed:
Designer: Constructed By:
Owner & Address:
Owner/Operator present during inspection (yes or no):

PREVIOUS INSPECTIONS (date)

Last Inspection:	Last Regular Inspection:
Phase I Inspection:	Last Formal Inspection:

EMERGENCY ACTION PLAN (Required for all Class I and Class II dams)
Date of Approved Plan:
Date of Plan Revision:
Is the notification flowchart complete and current?
Is inundation mapping or a description included?
Are emergency materials and equipment identified?
When was the plan last tested?

DOWNSTREAM HAZARD CLASSIFICATIONS
Present Hazard Classification:
Changes in Downstream Land Use and Habitation:
Is present classification appropriate?

OPERATION AND MAINTENANCE
Date of Operation and Maintenance Plan:
Are instructions adequate?
Do operating personnel follow instructions?
What are operating personnel capabilities?

EXAMINATION OF EMBANKMENT DAMS AND DIKES

DESCRIPTION OF STRUCTURE

Embankment Material:
Cutoff Type:
Impervious Core:
Internal Drainage System:
Movement (Horizontal and Vertical Alignment):
Junctions with Abutments or Embankments:
Miscellaneous:

CREST
Vertical Alignment:
Horizontal Alignment:
Surface Cracks:
Settlement:
Unusual Conditions:

UPSTREAM SLOPE
Slope (Estimate) (H: V):
Trees, Undesirable Growth or Debris, Animal Burrows:
Sloughing, Subsidence or Depressions:
Slope Protection:
Surface Cracks or Movement at Toe:
Unusual Conditions:

DOWNSTREAM SLOPE
Slope (Estimate) (H: V):
Trees, Undesirable Growth or Debris, Animal Burrows:
Sloughing, Subsidence or Depressions:

Surface Cracks or Movement at Toe:
Seepage:
External Drainage System (Ditches, Trenches, Blanket):
Condition Around Outlet Structure:
Unusual Conditions:

ABUTMENTS AND TOE AREA
Erosion at Contract:
Seepage or Wet Area along Contract:
Signs of Movement:
Depressions, Sinkholes:
Unusual Conditions.

SEEPAGE AND TOE DRAIN / RELIEF WELL FLOW SUMMATION

Location	Estimated Flow	Color (Turbidity)

(Attach additional sheets for facilities with more than one embankment dam or dike)

EXAMINATION OF CONCRETE AND MASONRY DAMS

DESCRIPTION OF STRUCTURE
Type of Dam (Gravity, Arch, etc.):
Internal Drainage System:
Movement (Horizontal and Vertical Alignment):
Miscellaneous:

UPSTREAM FACE
Condition of Concrete or Masonry:
Cracking:

Location	Orientation	Length	Width	Type

DOWNSTREAM FACE
Condition of Concrete or Masonry:
Cracking:

Location	Orientation	Length	Width	Type

Leakage through Dam (Location and Estimated Flow):

CREST
Condition of Concrete or Masonry:
Cracking:

Location	Orientation	Length	Width	Type

Signs of Movement:
Differential Movement (Joint or Crack Separation or Offset):

GALLERIES
Condition of Concrete or Masonry:
Cracking:

Location	Orientation	Length	Width	Type

Differential Movement (Joint or Crack Separation):
Leakage into Galleries (Location and Estimated Flow):
Condition of Gallery Drains:

FOUNDATION
Condition of Rock or Concrete Lining:
Cracking:
Signs of Movement:

Seepage (Location and Estimated Flow):

ABUTMENTS AND TOE AREA
Seepage or Wet Arm:
Signs of Movement:
Cracking:
Erosion:
Unusual Conditions:
(Attach additional sheets for facilities with more than one concrete or masonry dam or dike)

EXAMINATION OF SPILLWAYS AND OUTLET WORKS

TYPE (S) AND DESCRIPTION OF SPILLWAY (S)
Primary:
Secondary (auxiliary):
Emergency:
Other:

FOR EACH SPILLWAY THE FOLLOWING ASPECTS MUST BE EXAMINED WHERE APPROPRIATE

ENTRANCE CHANNEL
Description:
Vegetation (Trees, Bushes):
Debris:
Channel Side-Slope Stability:
Slope Protection/Erosion:
Unusual Conditions:

SPILLWAY CREST
Description:
Condition of Material:
Signs of Movement:
Joints.
Unusual Conditions:

DROP BOX
Description:
Condition of Material:
Signs of Movement:
Joints:
Floor.
Unusual Conditions:

SPILLWAY WING WALLS
Description:
Condition of Material:
Signs of Movement:
Joints:
Drains:
Unusual Conditions:

DOWNSTREAM APRON
Description:
Condition of Material:
Signs of Movement:
Unusual Conditions:

-

CULVERTS
Description:
Condition of Material:
Joints:
Signs of Movement:
Seepage:
Location Estimated Flow Turbidity
Unusual Conditions:

TRASH RACKS
Description:
Condition of Material:
Unusual Conditions:

CHUTES
Description:
Condition of Material:
Signs of Movement:
Unusual Conditions:

STILLING BASIN
Description:
Condition of Material:
Signs of Movement:
Erosion:
Unusual Conditions:

EXIT CHANNEL
Vegetation (Trees, Bushes):
Debris:
Channel Side-Slope Stability:
Erosion:
Unusual Conditions:

LOW LEVEL OUTLET
Description:
Condition:
Trash Rack:
Leakage:
Location Estimated Flow
Unusual Conditions:
Was the low-level outlet operated during the inspection?
Were there difficulties operating the low-level outlet?
When was the low-level outlet last operated and did this conform to the Operation and Maintenance procedures?

Miscellaneous:

STILLING BASIN FOR LOW LEVEL OUTLET
Description:
Condition of Material:
Signs of Movement:
Erosion:
Unusual Conditions:

-

EXIT CHANNEL FOR LOW LEVEL OUTLET
Description (Trees, Bushes):
Debris:
Channel Side-Slope Stability:
Slope Protection Erosion:
Unusual Conditions:

EXAMINATION OF OTHER FEATURES

INSTRUMENTATION (Monumentation/Surveys, Observation Wells, Weirs, Piezometers, Etc.) location, condition:

(A separate report including instrument readings, condition of instruments, observations, and conclusions based upon the collected data should be attached.)

RESERVOIR
Slopes.
Sedimentation:
Unusual Conditions Which Affect Dam:
Unusual Conditions:

APPURTINANT STRUCTURES (Power House, Gatehouse, Penstocks, Water Supply, Other)
Description and Condition of each:

CONCLUSION

I certify that the above dam was inspected by me and found to be in (**safe / unsafe**) condition. (Circle One)

I recommend making the following repairs immediately:

The following long-term improvements should also be undertaken:

The following studies should also be undertaken:

Have the recommendations above included those from the Phase I Inspection Report or previous Regular or Formal Inspection Reports? If not, indicate why.

Does the Emergency Action Plan or the Operation and Maintenance Procedures require revisions?

Name of Professional Engineering Company/Consultant Representing the Owner:

Company/Consultant Address:

Company/Consultant Telephone Number:

Delaware Licensed Professional Engineer representing the dam owner in responsible charge of the inspection:
Sign_____ Date_____

Delaware Professional Engineer License Number_____

(Department use only)
Dam Name_____
DE. Reference No. _____
Hazard Classification_____

Engineer **Date of Inspection**

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Appendix D. Delaware Dam Safety Inventory

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Appendix E. Delaware Dam Safety Library References

Atkinson, R. O. et al. *Training Aids for Dam Safety: Inspection of Concrete and Masonry Dams*. 80 pages.

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Appendix F. Delaware Dam Safety Guidance Committee

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