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Model State Dam Safety Program

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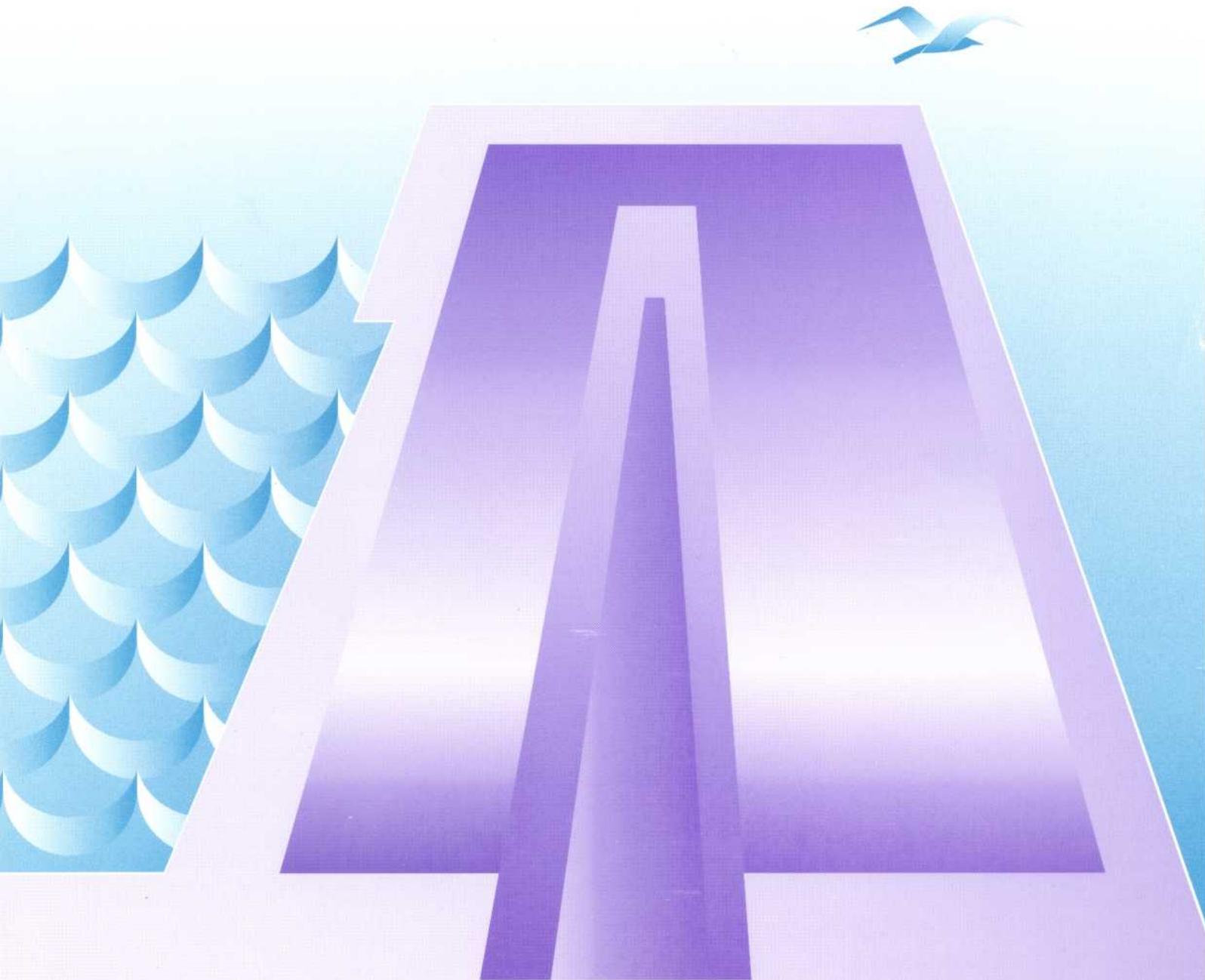


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The 1987 Model Dam Safety Program Advisory Committee, in addition to Mr. James Doody and Mr. Martin Stralow, consisted of:

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INTRODUCTION

The mission of the Association of State Dam Safety Officials (ASDSO) is to improve dam safety by:

- improving the efficiency and effectiveness of state dam safety programs,
- fostering public awareness
- providing leadership through facilitation of interorganizational, intergovernmental and inter-state cooperation,
- providing assistance to the dam safety community and providing a forum for the exchange of information, and
- providing representation of dam safety interests before state legislatures and before Congress.

In the efforts to fulfill this mission, it has become obvious that there is great variance in the effectiveness of the existing state dam safety programs. Some of this variance may be appropriate as each state must address its dam safety needs and responsibilities in its own way. Some state programs, however, are not considered to be adequate. Also many unsafe dams have been identified and the required remedial action has not been implemented.

In an effort to create a guide for state officials initiating or improving state programs, this “Model State Dam Safety Program” was developed originally in 1987 and amended in 1997 to reflect the experience of state programs. It is meant to outline the key components of an effective dam safety program. It does not mirror any particular state program nor does it supplant any state’s existing criteria. It is hoped that it will give guidance in the development of more effective and sustainable state programs that will ultimately eliminate the unnecessary risks created by unsafe dams.

Recent enactment of the National Dam Safety Program Act (NDSPA) by Congress provides the opportunity for states to apply for financial assistance in two ways. Primary assistance is available for states attempting to meet the budgeting requirements and ten criteria outlined in the NDSPA related to legal authority. Advanced assistance is provided for states that meet the primary assistance requirements and are working toward meeting advanced requirements and standards such as the “Model State Dam Safety Program”. The Model should provide many areas for states to request improvement of programs under the NDSPA. States should refer to the NDSPA program for additional details.

The use of several key words and concepts should be addressed to clarify the intent of the Model. The words and associated concepts include:

- “Shall,” “will,” or “must” mean that no option in accomplishment of that item is intended for an agency or person;
- “Should” means that the accomplishment of the item is optional and strongly recommended for the agency or person; and
- “May” means that the accomplishment of the item is optional and permission to accomplish it is granted by statute or regulation.

Each state should tailor the “shall,” “should,” and “may” concepts according to their own circumstances or specific dams.

Appendices are provided in the Model as reference materials and as examples for the state programs. Case studies from various states, where appropriate and available, are included as specific examples.

A bibliography is not provided in the Model due to the constantly changing references in dam safety literature. A current bibliography of sources and additional information is available through ASDSO.

Each state must determine which elements of this model document are appropriate for its current program.

CHAPTER I - LEGISLATION AND REGULATIONS

The foundations of any state dam safety program are the legislative authority and the accompanying administrative regulations that give substance to the statutes. As such, the drafting of legislation and regulations is a critical first step in developing a strong dam safety program. Great care must be taken to include the necessary authority while avoiding the inappropriate verbiage that will direct the program away from its intended course.

Some states prefer to detail specific program requirements within the statute. This approach gives more of the program the "weight of law." Other states prefer to keep the authorizing legislation simple and to include the program specifics with administrative rules and regulations. This approach provides more flexibility. In either case, certain items must be included in the authorizing statutes and/or administrative regulations to create an effective dam safety program.

I. Legislation

A. Legislation must be enacted that provides state dam safety programs with comprehensive statutory authority to regulate the design, construction, reconstruction, modification, breach, removal, abandonment, inspection, operation, monitoring and maintenance of any dam determined to have a potential to cause loss of human life, economic loss (including property damage), and lifeline disruption;

The following specific items must be included:

1. Authority to define those dams within state jurisdiction. [see Appendix A, section 1009];
2. Authority and duty to adopt rules and regulations and establish standards. [see Appendix A, section 1088];
3. Authority to require that the design of initial construction, reconstruction, enlargement, alteration, repair, operation, abandonment, breach, or removal of dams and supervision of construction be in the charge of an engineer [see Appendix A, section 1028];
4. Authority to require that a permit or application approval* be obtained in writing prior to the start of any activity involving the construction, reconstruction, enlargement, alteration, modification, breach, removal, abandonment, repair and operation of a structure. [see Appendix A, section 1100 and section 1104];
5. Authority to approve/deny the impoundment of water. [see Appendix A, section 1152];

* See Glossary for definition.

CHAPTER I - LEGISLATION AND REGULATIONS

6. Authority to inspect dams during construction and periodically during the life of the structure. This includes necessary authority for agency* personnel to enter private lands. [see Appendix A, section 1080, section 1162 and section 1177];
7. Authority to order repairs of a dam or modifications to a dam's operation to assure the dam's safety. [see Appendix A, section 1230];
8. Authority to take such corrective action as required to carry out the purposes of the statute. [see Appendix A, section 1085];
9. Authority to take emergency* action. [see Appendix A, section 1179 and section 1180];
10. Penalties for non-compliance. [see Appendix A, chapter 9];
11. A liability disclaimer for the state and the agencies' personnel. [see Appendix A, section 1028];
12. Responsibility for implementation of the statutory authority should be placed with one agency. [see Appendix A, section 1050];
13. Authority to require the owner to:
 - a. Fully comply with all state laws and regulations. [see Appendix A, section 1086];
 - b. Monitor, [see Appendix A, section 1176 and section 1179] operate or maintain [see Appendix A, section 1175] the dam in a safe condition and make required repairs in accordance with the regulations [see Appendix A, section 1088], terms and conditions of permits or approved applications [see Appendix A, section 1104], approved operating plans and orders of the agency issued pursuant to the statute. [see Appendix A, section 1176];
 - c. Conduct periodic inspections [see Appendix A, section 1176] and analyses [see Appendix A, section 1177] as may reasonably be required by the agency, considering the size and hazard potential* of the dam. In addition, as required by the agency, submit certified reports on the condition of the dam to the agency, provided, that, the agency may accept reports of equivalent inspections prepared by governmental agencies. [see Appendix A, section 1176];
 - d. Immediately notify the state agencies and responsible authorities in downstream communities of any condition which threatens the safety of the dam, and take all necessary actions to protect against loss of human life, economic loss (including property damage), and lifeline disruption, including any action required under an emergency action plan or agency order issued pursuant to the statute. [see Appendix A, section 1078 and section 1179]; and
 - e. Retain records.
14. Authority to establish fee structures that may include application review, and inspection of dams or annual registration fees; and

* See Glossary for definition

15. Authority to require proof of financial responsibility.

B. The statute should also include a section that addresses the following specific item:

1. Responsibility to report dam incidents that occur at dams within the state's jurisdiction to the National Performance of Dams Program (NPDP), a national archive and dam safety information resource (see Appendix L for the definition of dam incidents and how to report incidents to the NPDP).

Appendix A is a "Model State Law." This model uses the detailed statute approach to establish an effective regulatory program. It provides a specific statutory guide for a state program. Corresponding Model Law sections are referenced above.

II. Regulations

The purpose of administrative rules is to establish the specific standards and criteria to be used within a state's dam safety program. In developing such regulations (rules), consideration should be given to the following items:

A. The statutory authority for adopting rules and regulations;

B. Definition of terms;

C. Purposes of regulations;

1. Provide for the comprehensive regulation and supervision of dams determined to have a potential effect upon loss of human life, economic loss (including property damage), and lifeline disruption; and

2. Assure proper planning, design, construction, reconstruction, enlargement, repair, alteration, breach, removal, abandonment, operation, maintenance, monitoring and supervision of dams, including such preventive measures as are necessary to provide an adequate margin of safety.

D. Scope of jurisdiction;

Jurisdiction shall be established by one or more of the following criteria:

1. Height of dam;

2. Maximum storage capacity;; and

3. Hazard potential classification.

E. Classification criteria;

1. Size classification;

2. Hazard Potential Classification; and

3. Purpose.

F. Design criteria;

1. Design criteria specific to the state or region. ASDSO maintains an information clearinghouse for further information regarding specific hydrologic, hydraulic, structural, and geotechnical design criteria; and
2. The regulations should allow the agency to consider a reduced design criteria for any specific dam where it can be demonstrated that such criteria protects against loss of human life, economic loss (including property damage), and lifeline disruption.

G. Permits or application approval requirements for new construction, reconstruction, enlargement, repair, or alteration of dams;

H. Permit or application approval requirements for operation and maintenance of existing dams;

I. Permit or application approval requirements for breach, removal or abandonment of dams;

J. Construction requirements and procedures;

1. Notice in advance of start of work;
2. Approval of personnel for oversight and supervision of construction;
3. Construction reports;
4. Prior approval by the agency of major changes to approved plans and specifications;
5. Agency approval to impound water;
 - a. Certification of construction according to approved plans and specifications by the design engineer;
 - b. Submittal of "as built" documents; and
 - c. Submittal of a filling and monitoring schedule by the design engineer.

K. Requirements for operation and maintenance;

1. Owner's responsibilities — The owner of any dam shall at all times operate and maintain the dam and all appurtenant works* in a safe condition in accordance with all permit or application approval terms and conditions;
2. Regardless of the date of construction of a dam, it shall be the ongoing duty and financial responsibility of the dam owner to evaluate the safety of the dam and all appurtenant works and to modify the dam in accordance with the permit or application approval requirements (as noted above) to ensure protection against loss of human life, economic loss (including property damage), and lifeline disruption in accordance with changed conditions and current dam safety criteria;

* See Glossary for definition.

3. The owner of any dam shall immediately take such steps as the agency may prescribe to protect against loss of human life, economic loss (including property damage), and lifeline disruption; and

4. The owner of any dam shall follow the method and schedule of operation of the dam, any plan for permanent monitoring of instrumentation in the dam, the emergency action plan, and the operation plan approved by the agency.

L. Requirements for inspection by owners;

1. Requirement for owners to submit periodic inspection reports to the agency. These reports are to be prepared by an engineer. The agency will set the frequency of owner inspections based on dam size and hazard classification;

2. Requirement that owners shall retain records of their inspections, including records of actions taken to correct conditions found in such inspections. Copies of such records shall be provided to the agency; and

3. Acceptance of reports of equivalent inspections conducted and prepared by governmental agencies (e.g., reports prepared for/or by the Federal Energy Regulatory Commission (FERC), the Natural Resources Conservation Service (NRCS), etc.), in lieu of inspections conducted by the owner. Also, the agency may accept equivalent inspection reports certified by the owner and submitted to other governmental agencies (e.g., reports to the Mine Safety and Health Administration (MSHA), etc.).

M. Requirements for emergency action procedures. Adopted regulations should generally address what is required of the dam owner. Additional recommendations regarding emergency response for a model state program and what should be included in an Emergency Action Plan are covered in Chapter V. An example emergency action plan is included in Appendix E. What should be addressed in regulations is listed below:

1. All owners of high and significant hazard potential dams shall prepare, update, and periodically test an Emergency Action Plan. The plan must be approved by the state agency. The detail and extent of the plan may vary in accordance with the dam's hazard potential classification;

2. The owner shall immediately notify responsible authorities and the agency of any condition which threatens the safety of the dam or downstream areas; and

3. The owner shall take all necessary actions during an emergency to protect against loss of human life, economic loss (including property damage), and lifeline disruption.

N. Enforcement procedures;

1. Administrative actions;

2. Judicial actions;

3. Penalties;

4. Appeals; and

5. Emergency Action.

CHAPTER I - LEGISLATION AND REGULATIONS

O. Fee Structures; and

1. Fee structure for application/permit review. [see Appendix A - chapter 6, Appendix B and Appendix K]; and
2. Fee structure for inspection of dams by the state agencies' dam safety personnel and/or annual registration fee. [see Appendix A - section 1134, Appendix B and Appendix K];

P. Owner Financial Responsibility.

1. Authority for the agency to require, by regulation, that the permittee demonstrate proof of financial responsibility or surety assuring the proper construction, operation, maintenance and termination of any dam project which may present a substantial risk to human life, or cause economic loss (including property damage), or lifeline disruption. [see Appendix A, section 1088(f)].

CHAPTER II - PERMITTING/APPROVAL OF PLANS/AUTHORIZATION TO IMPOUND

Every state must have the authority to regulate activities that affect the safety of dams*. Authority to regulate these activities must be available through permitting, application approval*, written approval of plans, certification of work, or other regulatory procedures. For convenience, within this chapter all these regulatory activities will be simply identified as "permitting."

Many activities exist for which a dam permit is required. The information that should be included in the application for a permit varies with the type of proposed activity and the size and hazard potential of the structure in question.

This chapter discusses four basic topics. They are:

- activities that require a permit
- information to be included with the permit application
- procedures for permit application review
- grounds and procedures for permit revocation

Appendix B is a listing of typical requirements that can be included in the permit requirement section of administrative rules.

I. Activities that Require a Permit

Any activity related to the safety of dams within the jurisdiction of the legislation/regulations as established in Chapter I must be permitted prior to the start of that activity. Activities that commonly fall within this category include the following:

- construction of a new dam;
 - reconstruction* of an existing dam;
 - enlargement* of an existing dam;
 - modification or alteration* of an existing dam;
 - repair* of an existing dam;
-

* See Glossary for definition.

- removal* of an existing dam;
- abandonment* of an existing dam;
- operation and maintenance of an existing dam;
- impoundment of water; and
- change of ownership.

II. Information to be Included in a Permit Application

A. For new construction, reconstruction, or modification of an existing dam, the following minimum items must be required and approved prior to the initiation of the construction:

1. Construction plans and specifications prepared by an engineer* ;
2. Hazard potential identification;
3. Statement of ownership;
4. Hydrologic and hydraulic design computations;
5. Structural design computations;
6. Geotechnical data and design computations; and
7. Instrumentation plan.
8. Operation Plan;
 - a. During construction; and
 - b. Life of structure.
9. Maintenance plan;
10. Emergency action plan;
11. Agreement to submit as-built plans certified by the design engineer; and
12. Statement of financial capability/performance bond in accordance with statute and regulations.

B. The Repair of Existing Dams;

The repair of existing dams must be coordinated with and approved by the state agency*. The current condition of the dam, the type of repair, and the proposed means to achieve the repair

* See Glossary for definition.

all dictate the timing and detail of review needed. Minor maintenance work should be included in the approval of the original maintenance plan. Emergency repairs will need to be addressed on a case by case basis. Pre-planned, major repairs must be reviewed and approved prior to the initiation of the activity. Information as required in II-A above shall be substituted for the repair of an existing dam as necessary. In all cases, as-built records of the completed repair should be maintained by the owner* and the state agency. All construction plans and specifications must be prepared by an engineer.

C. Removal or Abandonment of an Existing Dam; and

The following items shall be required and approved prior to the initiation of the removal or abandonment of a dam:

1. Method of dewatering, including testing for environmentally sensitive discharges;
2. Method of breaching* or abandonment;
3. Means to control erosion at the site during and after the breach;
4. Means to control sediment transport from the reservoir*, including testing and control of environmentally sensitive material. Means to maintain breach area, upstream and downstream channel, and reservoir bed after the breach;
5. Time schedule and sequence of construction;
6. Requirement to submit as-built plans; and
7. Evaluation and remapping of downstream flood areas (Flood Insurance Rate Maps - FIRM), if necessary.

All construction plans and specifications must be prepared by an engineer.

D. Details of the construction inspection program must be provided for demonstrating an adequate and qualified force for inspection of construction reconstruction, enlargement, repair, alteration, removal, maintenance, operation or abandonment of dams. The regulatory agency must not accept quality control inspection by the contractor.

III. Other Permitting Activities

A. Change in ownership;

Before transfer of ownership, the current owner must notify the agency of the proposed change in ownership in writing. Permits issued under dam safety regulations should be transferred or reissued to the new owner.

B. Operation and Maintenance of Existing Dams;

* See Glossary for definition.

The proper operation and maintenance of existing dams not requiring modification is critical to their short and long term safety. For dams in this category, the following items must be required and approved:

1. A detailed maintenance plan;
2. A detailed operation plan;
3. An emergency action plan; and
4. Statement of financial capability.

C. Impoundment of Water;

1. Upon finding by the agency that a dam and reservoir area are acceptable to impound water, written permission to fill the reservoir must be required. The following items shall be submitted and approved:

- a. Owner's written request for agency final construction inspection;
- b. The design engineer's certification of compliance with approved plans and specifications;
- c. As-built plans; and
- d. Filling and monitoring schedule prepared by the design engineer.

2. Upon receipt and review of this material, final inspection by agency personnel shall be completed and the authorization to fill decision made by the agency.

IV. Procedures for Permit Application Review

Administrative review procedures will vary from state to state. The agency should familiarize itself with any necessary requirements with respect to public participation and the program should address those requirements. Consideration of inter-agency review of all permit applications should also be given.

Upon receipt and approval of a complete application for permit and the resolution of all appropriate objections, a permit for construction, modification, operation, and maintenance should be issued. If an application for permit is not consistent with the requirements, the application should be denied with a listing of the reasons for denial.

V. Permit Revocation

If the conditions of a permit are not adhered to, compliance enforcement must be pursued (see Chapter IV). If compliance cannot be achieved, the permit must be revoked and enforcement should be pursued.

CHAPTER III - INSPECTION

Inspection activities provide the basis for dam* inventories, evaluation of downstream hazards and hazard potential* classification, correlation of approved* construction plans with actual construction, safety evaluation of existing dams, emergency* response planning and execution, and reporting dam incidents to the National Performance of Dams Program (NPDP). Adequate inspection of a dam and the documentation of such inspections are necessary before enforcement can be taken.

This chapter contains a discussion of issues related to implementing a program of inspections and suggestions for improving existing programs.

I. Considerations for Implementing an Inspection Program

A. Staff. Specific aspects of personnel qualifications and staffing levels can be found in Chapter VI and Appendix I. Some of the considerations in determining these qualifications and staffing levels for an inspection program include:

1. The initial task of the inspection program must be to identify, classify and evaluate the existing dams in the state. The hazard potential classification for the dams located will need to be determined during the initial inspection of all the dams in the state. A number of dams may be found in the National Inventory of Dams (NID) compiled by the Corps of Engineers (COE) and Federal Emergency Management Agency (FEMA). The Inventory will have limitations due to its lack of information since 1981 if the state has not participated in the NID updates. Also, the definition of a "dam" between the Corps criteria and a specific state law may not be consistent which will influence the number of dams already located. An adequate number of inspectors* to accomplish this task will be necessary; and
2. Inspection frequency of existing dams must be decided. Geographical areas define whether a central inspection office or a regional office approach is desirable. If inspection frequency is not set by law, annual inspections of high hazard potential dams*, biennial inspections of significant hazard potential dams* and inspection of low hazard potential dams* every five years are recommended. An adequate number of qualified inspectors must be available for inspections and associated enforcement work after the initial inventory is completed. Average time for inspection of permitted/approved dams including travel time, on-site inspection time, and report writing may be as much as four (4) man days for high hazard potential dams, three (3) man days for significant hazard potential dams, and two (2) man days for low hazard potential dams. A detailed inspection, analysis and evaluation of a dam with production of a Phase I report may take as much as two man-months. This inspection* time may vary on proximity and types of dams, etc. It is recommended that one engineer

* See Glossary for definition.

CHAPTER III - INSPECTION

and one inspector comprise each inspection team both initially and with subsequent inspections.

B. Equipment. See Chapter VI for a list of basic inspection equipment;

C. Training. Training is the next step in developing the inspection program. Initially, in-house training is the most feasible method, if there are qualified dam safety personnel available. Use of the 'Training Aids for Dam Safety' (TADS) available from the Bureau of Reclamation is highly recommended. However, training is available from the many organizations, agencies, universities, and private individuals familiar with dam inspection and should be utilized whenever possible. Suggested contacts include:

- Association of State Dam Safety Officials (ASDSO);
- Federal Emergency Management Agency (FEMA);
- Bureau of Reclamation (BOR);
- Natural Resource Conservation Service (NRCS);
- Corps of Engineers (COE);
- National Weather Service (NWS);
- Federal Energy Regulatory Commission (FERC); and
- Mine Safety and Health Administration (MSHA).

Topics which must be included in a training program include: hydrology; hydraulics; soil mechanics, including slope stability; seepage analysis; concrete design; geology; emergency action planning; erosion and sedimentation control; and computer literacy.

Specific areas of training for a beginning program include:

1. Legal entry. The legal requirements and limitations of entry to property must be clearly understood by the inspection team. Each inspection team must have a full understanding of the dam safety statute, rules and regulations for dam safety, and legal liability concerns;
 2. Records. The inspection teams must know how and where to obtain existing records of dams. If state files do not have current owner* information, the inspection team will need to know how to check courthouse records to determine ownership;
 3. Field measurement techniques. The inspection team must know practical methods for determining if the state has jurisdiction over the dam. Location of critical measuring points (such as the downstream toe, or the natural stream bed, or the low point of the crest of the dam) may appear straightforward when reading the law, but may be difficult to locate in the field. Determining dam height, reservoir storage, surface area, hazard potential classification, and other measurements should be demonstrated in the field as part of the training regime;
 4. Visual inspection techniques. The inspection teams must be proficient in hydrology, hydraulics, and slope stability to better evaluate what is routinely seen in the field. Visual inspection of spillway inlet and outlet works, embankment seepage or piping, alignment of structures, vegetation, animal burrows, slumps and slides, and reservoir levels should be covered in training courses;
 5. Emergency inspection techniques. The inspection team must be aware of procedures to be followed in an emergency. Specific agency arrangements for communication, reporting, travel, vehicles, emergency equipment, and coordination with other emergency agencies must be understood. Procedures for determining the freeboard, rate of reservoir rise or fall,
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amount of overtopping, seriousness of embankment seepage or piping, and criteria for recommending evacuations must be covered. Legal responsibilities of the agency and inspection team must be stressed; and

6. Communications skills and public relations (see Chapter VIII).

C. Documentation. After an adequate number of inspection teams have been hired and trained, the actual inspection program should proceed. Because the inspection program will provide the basis for enforcement action, adequate documentation of all inspections is necessary. Documentation will be critical in assessing legal liability;

1. Written documentation of visual inspections shall be filed and provided to dam owners. Inspection reports should detail all visual observations of embankment, spillway, and reservoir conditions at the time of inspection. Any recommendations to, or verbal agreements with, the owner/operator must be documented in the written report to the file. Follow-up letters to the owner/operator should be written without delay;

2. Photographs of the dam, specific observations or problem areas must be filed with site name and date of inspection clearly marked. All negatives must be carefully labeled and preserved in anticipation of possible enforcement action;

3. Any conversation by telephone with the owner, owner's agent, consulting engineer, attorney, or concerned citizen must be documented in a telephone log and placed in the project file;

4. Any conversation on site or in the office with the owner, owner's agent, consulting engineer, attorney, or concerned citizen shall be documented in writing and placed in the project file; and

5. Any legal notice or order must follow all legal requirements of the dam safety statute and legal administrative procedures for the state.

D. Inventory. The results of the beginning inspection program should be maintained in a computerized inventory, which includes basic information necessary to set priorities and goals. The dam name, owner information, specific geographic location, height, storage, hazard potential classification, general condition, and inspection dates of the dam are suggested for the inventory. This data and other data* is used for updating the National Inventory of Dams (NID). The locations of inventoried dams must be plotted on US Geological Survey (USGS) topographic maps for future inspections, planning and emergency response (see Appendix H for sample database fields);

E. Construction Inspections. State inspection during construction provides verification that dams are built in accordance with approved plans and specifications. It might be argued that such inspections are unnecessary when construction sites are overrun with contractor's inspectors, owner's inspectors, and consulting engineer's representatives. In many cases, however, the contractor is disposed to cutting cost and the other on-site inspectors may look to the state for ultimate justification in following the approved plans. Some obvious but often overlooked suggestions for construction inspection include:

* See Appendix H for sample data fields.

1. Certification in writing by the design engineer that the construction of the dam or repair* of the dam was in accordance with the approved plans and specifications will clarify the oversight responsibility for the project;
2. Often the most vulnerable phase in the life of a structure is the construction phase. Cofferdams, diversions, and the main embankment are usually incapable of safely passing floods until sufficient dam height is achieved. An emergency action plan specific to construction activities should be approved prior to starting the project. Inspection teams should ask on-site monitoring personnel to produce copies of the plan and explain emergency procedures;
3. Inspection teams should ensure that construction personnel have copies of the approved plans and specifications, and the state permit or application approval* for construction;
4. The entire site must be examined to check for conformity with the approved plans and specifications, and applicable safety standards. When site personnel dismiss the need to check particular areas of construction, the inspection teams should make it a point to see these areas;
5. Documentation of inspection in photographs and writing of inspection reports while on site is extremely important. Legal notices of violation must conform with statutory requirements; and
6. Monitoring of a new dam should be exhaustive during a restricted filling schedule.

F. Report the Performance of Dams. Findings of periodic inspections that identify violations or conditions at a dam related to dam safety, are defined as dam incidents and should be reported to the National Performance of Dams Program (NPDP). Appendix L summarizes the process for reporting dam incidents.

II. Considerations for Upgrading an Inspection Program

After an inspection program is established, or when the opportunity arises to add to an existing program, the following areas might be considered for improvement:

A. Advanced Inventory. An inventory verification of all dams within state jurisdiction every five years can be an effective tool for determining the overall program status and progress. Inventories should list all pertinent aspects of each dam such as height, storage, and hazard potential classification. Additionally, inventories can list permit or application approval status, inspection priority status, purpose of dam, owner information, enforcement status, and other useful information. Inspection teams must be trained to gather the information necessary from the field including use of global positioning stations to locate dams;

B. Advanced Inspections. Inspection teams should conduct detailed inspections of dams to evaluate dam performance under normal or unusual site conditions. A detailed inspection of all outlet works should be performed a minimum of every five years. The inspection should include direct visual observation where practical and safe, or by remote cameras where necessary. Advanced inspections should take advantage of all available data such as agency and owners' records of construction, instrumentation records, and operation and maintenance records. Field inspections may include accurate measures of watershed and reservoir conditions, spillway configurations, embankment conditions, downstream hazard potential, or other specific problem areas. Wherever possible, gates and other operating equipment should be exercised to demonstrate proper functioning. This information should be used as necessary to evaluate the hydraulic capacity of the spillways and available reservoir storage. A flood routing of the design

storm through the reservoir should result in a detailed outflow hydrograph. It may be necessary or beneficial to develop a breach routing of the dam to verify hazard potential classification and/or to define limits of evacuation in emergency action plans. Stability analysis should be completed based upon visual site conditions, soils analyses, instrument readings, and operational records.

Additional unscheduled inspections should take advantage of unusual site conditions, such as a lowered or drained reservoir, or reservoir levels higher than normal. It may be useful to inspect concrete and masonry dams on a sunny day after heavy ice build-up in the reservoir. Inspections are useful also after record storms, snow melt, and earthquake events.

Annual Inspections are recommended for regulated high-hazard potential dams. Inspections are recommended every two years for significant hazard potential dams and every five years for low hazard potential dams, or whenever the conditions listed in the previous paragraph occur.

The agency should implement a detailed review and re-evaluation of design and construction practices for high-hazard potential dams every five years. The review should evaluate the design hydrology, hydraulics, structural, stability, and construction practices with current "State of the Art" procedures;

C. Owner's Inspections. State laws and legal liability give dam owners a clear obligation to inspect their dams. Many owners should inspect on a regular basis as part of the operation/emergency action plan procedure. In addition to these inspections, dam owners should be encouraged to:

1. Train their personnel in the basics of visual inspection techniques. Any person* employed by the owner who regularly visits or works at the dam should be trained to inspect part or all of the dam and to report any observed problems;
2. Maintain a data file on the dam including all available records regarding application approvals, certificates of approval to impound*, emergency action plan, operation, maintenance, repairs, inspections, flood events, earthquakes, etc;
3. Employ an engineer to inspect the dam in addition to the regular inspection program by the state dam safety staff. The engineer should:
 - a. Review records of design and construction;
 - b. Perform a detailed visual inspection of the dam;
 - c. Operate gates and machinery;
 - d. Read all embankment instruments to verify record keeping and check performance; and
 - e. Write a report of findings with any recommendations for additional investigations and maintenance work as necessary. File a copy of the report with the agency.

* See Glossary for definition.

D. Advanced Inspection Techniques and Equipment. State programs may consider the use of advanced equipment either through direct purchase or cooperative agreement with other states. Some possibilities include the use of:

1. Aerial photography which can be very helpful in inventory programs, documentation of changing conditions through time, and evaluation of downstream hazards. Use of stereo pairs are especially useful in monitoring the erosion of spillways and embankments, or in the progression of slides. Some inventory programs have made use of LANDSAT photographs with varying degrees of success;
2. Nuclear compaction gauges which have proven to be a fast and accurate method for field checks of compaction and moisture content providing the machines are properly calibrated. Nuclear gauges are regulated by the Nuclear Regulatory Commission (NRC) and operating personnel must be properly trained and certified by the NRC or the gauge manufacturer. Information is only valid when the appropriate proctors for the embankment material are available to evaluate the density information; and
3. A program for video inspection of pipes and conduits has been developed by several states. A television camera mounted on a sled is pushed up a conduit while a video cassette and voice recorder document the condition of the pipe. Newer technology involves self propelled television cameras with articulating lenses capable of viewing conduits from 6 inches to 48 inches in diameter. This method provides valuable information about inaccessible or dangerous sections of pipe that otherwise would be a matter of conjecture.

Appendix C contains two example cases of inspection checklists. Additional inspection form examples may be found in the Compendium of State Dam Safety Inspection Forms published by ASDSO in February 1997.

CHAPTER IV - ENFORCEMENT

In order to ensure that dams* function safely, the regulatory agency* must be able to enforce its dam safety statutes and corresponding regulations quickly, uniformly and fairly. Such enforcement authority may be addressed specifically within the dam safety legislation and regulations, within general state enforcement procedures, or within a combination of these two authorities. Each state's enforcement program will be greatly affected by influences outside the dam safety program if the enforcement authority is not clear, concise and evenly practiced. This chapter will address what is needed in order to accomplish the enforcement task effectively. The following general components are addressed:

- enforceable statutes and regulations;
- authority for inspection and enforcement;
- clearly defined and responsive administrative procedures; and
- appropriate penalties.

I. Enforceable Statutes and Regulations

It is important that the laws that govern dam safety in a state be readily enforceable. In order to ensure that a state's laws are enforceable it is recommended that they:

- A. Be clearly written and understandable by the personnel that must enforce them and the regulated dam owners* ;
- B. Be logistically plausible. They must not contradict other state statutes;
- C. Include clauses that will allow for penalties in the event of infractions of the law; and
- D. Be constitutionally valid within the state.

The most effective way for these conditions to occur is to assure the fullest involvement of an agency's or state's legal counsel in the drafting and review of proposed statutes. Most state agencies must follow a set procedure within the agency for the drafting and review of legislation originating from within the agency. The state dam safety officials should comply with the procedures. In the event the legislation does not originate from within the agency, the agency must provide as much technical guidance for the legislation as can be achieved and recommend changes as appropriate. The agency should establish a position on the passage of any piece of legislation affecting the dam safety statutes.

* See Glossary for definition.

II. Clearly Defined Administrative Procedures

An essential feature of any enforcement program is a clear and well defined procedure that is to be followed by the agency and its personnel to implement the objectives of the dam safety statutes. Without a clear delineation of responsibilities it is impossible for a state dam safety agency to enforce the statutes of the state. Additionally, there must be a defined appeals process for any person who is adversely affected by an enforcement action of the state. This process must be conveyed to the affected party at the same time the action is taken. This process is usually set out in the state administrative procedures act.

The following section is organized to describe a possible process for enforcement. A flowchart illustration (Figure 1) shows how these steps follow one another.

A. For most state agencies, the enforcement process will actually begin with inspection. Through the inspection process, problems, violations and inadequacies are found, recorded and reported. On-site inspections are the single most important means by which an agency can determine the level of compliance by dam owners in the maintenance and operation of their dam. On-site inspections provide the agency, on a regularly recurring basis, with an opportunity to evaluate the safety of a dam; and

B. If a problem, violation, or inadequacy is found, a determination must be made whether or not an emergency exists. If the problem, violation, or inadequacy also constitutes an emergency, the emergency situation must be resolved before enforcement procedures begin. A non-emergency problem, violation, or inadequacy should result in a request from the agency for compliance by the owner. If an owner does not comply when requested or when a violation exists, an enforcement order must be issued which could be appealed by the dam owner. If the owner still refuses to comply, legal action must be initiated for compliance. Sometimes, the ultimate resolution to a violation or non-compliance problem is the evacuation of the reservoir* and breaching of the dam by the owner or the state.

III. Penalties

Just as there is a set of actions which the state can pursue when a violation is identified, there must be a set of penalties that adequately deter violations. These penalties must be properly and clearly addressed in the dam safety statutes.

In the course of any enforcement program, there will be violations discovered which are of lesser severity than others. It should be expected that many of these violations can be disposed of in ways not involving formal hearings or litigation, such as consent orders. However, there will also be a certain number of violations which will require a more rigorous enforcement procedure, including the state's attempt to assess civil and/or criminal penalties. These penalties may include incarceration and/or monetary judgments. Any monetary judgement should cover the cost of the enforcement procedure and penalize the owner.

Appendix D includes examples of enforcement procedures in Pennsylvania, California, and North Carolina.

* See Glossary for definition.

IV. Emergency Situations

It is imperative that the regulatory agency have clear authority to take emergency actions in life-threatening situations and that those actions remain in force until the emergency is resolved. Emergency actions can include measures for protection of life and property, lowering the reservoir level, and removal* of all or part of the dam and impoundment. Statutory authority should give the state the right to recover any costs for emergency actions from the owner of the dam by legal action in a court of appropriate jurisdiction where the dam is located or where the owner resides.

* See Glossary for definition.

CHAPTER V - EMERGENCY RESPONSE

The state dam safety program must define the response required in the event of a dam*-related emergency*. An emergency or operation resulting in downstream flooding will require action by the agency* as well as action by the owner* and coordination with the state emergency management agency and local officials. This chapter reviews minimum requirements an agency should address and basic considerations for preparing an Emergency Action Plan. Included in Appendix E are guidelines for developing Emergency Action Plans, including a notification flow chart.

I. State Program Requirements

Legislation and regulation recommendations as they relate to emergency response are covered in Chapter I. Normally an agency will define the requirements of an owner and agency internal policies regarding emergencies. Reaction and responsibilities of local officials regarding evacuation, security, shelter and care will be established by the state and local emergency management agencies.

Suggested State program requirements are summarized below:

- A. Require that owners of high and significant hazard potential* dams prepare, update, and periodically test an Emergency Action Plan;
- B. Require that owners immediately notify the state dam safety agency and responsible authorities in the affected downstream area of any condition which threatens the safety of the dam or downstream areas;
- C. Require that owners take all necessary actions during an emergency to protect life, health, and property; and
- D. Establish an internal emergency response procedure which includes coordination with the state emergency management agency.

II. Basic Considerations for Preparing an Emergency Action Plan

The following basic considerations should be utilized in developing a state program for implementing and monitoring emergency action plans:

* See Glossary for definition.

CHAPTER V - EMERGENCY RESPONSE

A. Many dam owners will have no concept about how an emergency action plan should be developed. A program will be needed to educate owners about the requirements of emergency action plan development and testing. Example plans should be available for owners and engineers to review;

B. Each city, county, or district emergency organization is different. Local input and coordination on monitoring, communication, and evacuation procedures is essential to document how such tasks are handled downstream of each dam;

C. The plan must be kept as simple as possible in both organization and wording. This cannot be accomplished if the plan has lengthy introductions or discussions of authority and scope. Ideally, a novice should be able to read the plan and determine necessary action in the shortest possible time. However, the process of developing an effective emergency action response will require extensive planning and coordination between the state agencies, local agencies and the owner. Training and the performance of EAP exercises is essential to assure timely response and to detect any weakness in the plan. If someone needs to read the plan before taking action, the delay may be critical;

D. In general, the owner's first priority should be to properly operate and maintain the dam, and to implement required structural upgrades. However, it is important that a good emergency plan be available because a dam may be most vulnerable to failure when it is in need of repair and maintenance. When the dam is in good condition the basic plan can be upgraded to include, as necessary, water level monitors, warning sirens, inundation mapping, etc;

E. Plans must be updated frequently. The notification list should be updated as necessary, but not less than once a year. The entire plan should be updated when the required periodic inspection is performed or when the structure is modified. This will help remind the participants of their obligations;

F. Monitoring and evacuation plans are not a substitute for necessary remedial repairs or upgrades of the dam; and

G. Each emergency action plan should include seven basic elements. A more detailed description of these elements is provided in Appendix E.

1. **Emergency Notification Flowchart and Information.** A notification flowchart shows who is to be notified, by whom, and in what priority. The information on the notification flowchart is needed to ensure the timely notification of persons responsible for taking emergency actions;

2. **Statement of Purpose.** The purpose of an emergency action plan is to provide one method for reduction of the risks to loss of life and to minimize damage due to a dam failure or large spillway release;

3. **Emergency Detection, Evaluation, and Action.** Early detection and evaluation of the situation(s) or triggering event(s) that initiate or require an emergency action is crucial. The establishment of procedures for reliable and timely action to reduce the risk to life is imperative and should ensure that the appropriate sequence of steps is taken based on the urgency of the situation;

4. **General Responsibilities.** A determination of responsibility for EAP-related tasks must be made during the development of the plan. The EAP must clearly specify the dam owner's responsibilities to ensure effective, timely action, including notification of state and local emergency management officials, should an emergency occur at the dam. The EAP must be site-specific, since conditions at and downstream of all dams are different. Dam owners are

responsible for developing, maintaining, and implementing the EAP. State and local emergency management officials are responsible for warning and evacuation notification of persons. The owner is also responsible for notification of downstream persons when emergency authorities are unable or unavailable to respond in a timely manner;

5. Preparedness. Preparedness actions are taken to moderate or alleviate the effects of a dam failure or operational spillway release and to facilitate response to emergencies;

6. Inundation Maps. An inundation map should delineate the areas that would be flooded as a result of a dam failure. They may also be developed or used to depict areas that would be flooded by unusually large spillway releases. Inundation maps are used both by the dam owner and emergency management officials to facilitate timely notification and evacuation of areas affected by a dam failure or flood conditions; and

7. Appendix. The appendix contains information that supports and supplements the material used in the development and maintenance of the EAP.

Other sources of information on emergency action planning are listed in Appendix E.

FEMA, Federal Guidelines for Dam Safety, ad hoc Interagency Committee on Dam Safety, Federal Coordinating Council for Science, Engineering and Technology, June 1979 (FEMA 93).

Flood Emergency Plan Guidelines for Corps Dams, HEC Research Document Number 13, June 1980.

FEMA, Emergency Action Planning Guidelines for Dams, Emergency Action Planning Subcommittee, Interagency Committee on Dam Safety (FEMA 64), being revised.

Dam Safety, An Owner's Guidance Manual, Colorado Division of Disaster Emergency Services for FEMA, August 1987 (FEMA 145).

Training Aids for Dam Safety (TADS), How to Develop an Emergency Action Plan, 1989.

FERC, Engineering Guidelines for the Evaluation of Hydropower Project, April 1991.

FERC, Exercise Design Course, Guide to Emergency Management Exercises, SM 170.2, October 1997.

CHAPTER VI - PROGRAM STAFFING AND FUNDING

Staffing and funding requirements for a dam safety program depend primarily on the scope of the state's statutory authority and responsibilities. Some typical factors which also affect these needs include the following:

1. Number, classification and location of dams* subject to state jurisdiction;
2. Type of inspection program, i.e. inspections by state or by owner's* engineer* ;
3. Geography and topography of the state;
4. Overall organizational structure of the state; and
5. Related operation and equipment expenses and requirements.

As part of their total program budget, some states may also wish to consider financing mechanisms for public and private dam repair and rehabilitation projects. However, for any state dam safety program to be effective and accountable, the basic personnel and funding levels must be sufficient to satisfy the statutory mandates.

This chapter provides information which can be used in determining staffing and funding needs necessary to establish new state dam safety programs or expand existing ones. Areas covered include considerations in determining staffing needs, typical job classifications, budgetary considerations, program funding sources, potential funding resources for repair projects and a staffing level example program exercise to assist in budget preparations. Each state must assess its particular needs on the basis of its own set of legislative, organizational, geographic, and political constraints.

I. Staffing Considerations

For new or expanding programs, it is important to identify all factors which may influence personnel needs. Statutory requirements, including those established by administrative rules and regulations, form the basis for this determination.

- A. Identification of staffing need;
-

* See Glossary for definition.

1. Statutory/administrative requirements — All aspects of the permitting and inspection activities including mandatory application* and plans review periods, enforcement actions, and legal proceedings should be clearly identified. Requests for technical assistance, resolution of design problems, and preparation of reports often require more staff effort and time than initially projected. Case preparation and conferences with attorneys, depositions, court testimony, and other aspects of litigation should also be addressed in determining staff needs. The program administrator and possibly others in the program will likely have to devote time to personnel and budget issues, administrative paperwork, strategic planning and other issues pertaining to the overall operation of the program;

2. Inspection Requirements - An inspection team is able to inspect only a finite number of dams within a certain period of time. Because of the wide range of state laws and inspection requirements, it is difficult to identify the number of inspections that any inspection team should be expected to perform. The inspection team's degree of experience will also directly influence the capacity for performing inspections. Average time for inspection of an existing dam including travel time, on-site inspection time, and report writing may be as much as four (4) man days for high hazard potential dams*, three (3) man days for significant hazard potential dams*, and two (2) man days for low hazard potential dams* ;

3. Logistics — The locations of the dams and the required travel time to and from the inspection sites should be considered. For states of larger geographic area and/or with complex topographic conditions, regional or field offices may be necessary; and

4. Other staff duties — Administrative and other duties unrelated to the dam safety program will have a direct bearing on staffing requirements. The administrator may be responsible for overseeing other programs. Selected staff members may be required to devote portions of their time to other duties. An expanding staff will place an added burden on experienced supervisory personnel, particularly with respect to the training of new staff;

B. Organizational structure. Each state will need to assess and fit the dam safety program into the appropriate agency /department in its overall organizational structure. Many states include the dam safety program in water resources agencies. The scope and size of the program as well as the potential need for field offices must be considered in determining the organizational structure. Tables of two possible organizational structures are included in Appendix F;

C. Typical job classifications. Several job classifications are considered essential to meet the various needs of a dam safety program. Recommended classifications include engineers, geologists, technicians, and other professional, technical, and clerical support staff. Although professional support staff do not necessarily need to be part of the actual program organization, clear and ready access to attorneys, computer specialists, and other professionals is an essential staffing consideration. Also, the importance of clerical and administrative support personnel should not be overlooked in assessing staff needs. These persons will contribute substantially to the program's success and effectiveness. Such job classifications may include, but are not limited to:

1. Engineers (both professional engineers and engineers-in-training). An appropriate mix of experienced and junior engineers will enhance any dam safety program. Applicable engineering disciplines include:

* See Glossary for definition.

- a. Water resources (hydrology and hydraulics);
 - b. Geotechnical;
 - c. Structural; and
 - d. Construction;
2. Engineering geologists;
 3. Technicians;
 - a. Construction;
 - b. Inspection;
 - c. Surveying; and
 - d. Drafting;
 4. Professional support; and
 - a. Environmental scientists;
 - b. Computer specialists;
 - c. Emergency management planners;
 - d. Soil scientists;
 - e. Remote sensing specialists; and
 - f. Attorneys.
 5. Clerical and administrative support.
 - a. Secretaries; and
 - b. Fiscal/administrative assistants.

II. Program Funding

Funding of a regulatory dam safety program will depend significantly on its statutory requirements. In developing a new program, potential revenue sources for implementation should be analyzed and any necessary funding mechanisms such as fees should be included in the enabling legislation. Principal funding sources for dam safety programs are direct legislative appropriations and various types of fees.

The logistics for submitting an appropriation request to the administration and the legislature will vary from state to state. Usually before an appropriation is made, administrative, fiscal, and legislative entities will scrutinize and determine the need for such an appropriation. As part of the appropriation process, it will be necessary to develop a detailed program budget including

CHAPTER VI - PROGRAM STAFFING AND FUNDING

appropriate justifications for identified needs. For new or existing programs, several factors must be addressed in determining financial needs and preparing an operating budget. Costs associated with personnel, equipment, facilities, training and education, supplies, and emergency actions are just a few factors which directly influence budget needs. It is important that the program's management and administrative staff be directly involved in the budget preparation to assure that all needs are addressed.

A. Identification of funding needs; and

A detailed budget should include all operating costs necessary to properly implement and enforce the statutory requirements. For any dam safety program to be effective, the level of funding must match the legal and safety mandates. The following items should be considered in developing a budget:

1. Personnel costs;

- a. Staff costs (salaries, fringe benefits, etc.);
- b. Consultant services — Investigations of special problems or third-party opinions may be needed in evaluating safety issues;
- c. Utilities and rent;
- d. Computer specialist charges;
- e. Travel (both in-state and out-of-state); and
- f. Miscellaneous.

2. Equipment;

- a. Office equipment, reference books, and maps;
- b. Four-wheel drive vehicles;
- c. Field equipment (cameras, video equipment, first aid kits, high power lights, rain gear, global positioning system (GPS) equipment, surveying instruments, measuring devices, etc.);
- d. Computers, including laptop computers for field work;
- e. Communication equipment (mobile radios with emergency frequencies, cellular telephones, pagers); and
- f. Special items (pipe inspection cameras, siphon pipe equipment).

3. Training and education (publications, seminars, etc.);

- a. Staff;
-

* See Glossary for definition.

b. Owners; and

c. General public.

4. Funding for emergency actions. As a minimum, a non-lapsing source of easily accessible money should be identified. Some states have a specially designated fund for such actions. The dam safety legislation could require that a portion of civil penalties be earmarked for such a special fund. Some means of recovering the cost of an emergency action from the dam owner should also be provided; and

5. General support allocation for umbrella agency.

B. Funding sources.

As previously indicated, there are two principal funding sources: direct appropriations and fees.

1. Direct appropriations are self-explanatory;

2. Fees;

a. Application, filing, or permitting fees — These charges are typically made to cover the costs of plan review and approval, construction inspection, and associated aspects of new dam construction, reconstruction* or repair. These fees may be charged as a flat rate or as a graduated schedule based on the estimated construction cost;

b. Certificates of approval to impound*, permit-to-operate, or registration fees — These fees are usually charged on an annual basis for the continued operation of the dam. The fee may be in the form of \$X per dam dependent on hazard potential classification or \$Y per foot of height, acre-foot of storage, or other measurement; and

c. Inspection fees — These charges are usually imposed to offset the costs of the state's periodic inspection program. The fees may be similar to the ones noted for a certificate of approval to impound or may be for the actual cost of the inspection.

3. Other sources include federal grants, direct assistance, etc.

III. Funding Resources for Repair Projects

Protection of the public from the failure of dams cannot be assured unless deficiencies and unsafe conditions identified through regulatory inspections are properly corrected in a timely manner. Funding of major dam repair and rehabilitation projects can be a difficult problem in both the public and private sectors.

A large percentage of the high hazard potential dams are owned by federal, state, or local governments. Many high and significant hazard potential private-sector dams are owned by industrial and commercial entities, by homeowners' associations and by private owners. For

* See Glossary for definition.

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large and moderate sized dams, repairs can cost in the hundreds of thousands or millions of dollars. Such costs may well exceed the financial capability of almost any governmental unit or private entity.

Infrastructure deterioration and funding problems have gained a great deal of attention throughout the nation. A few states such as Arizona, New Jersey, Pennsylvania, Massachusetts and New Hampshire have developed funding mechanisms and revenue resources to attempt to address the problem. New Jersey's relatively new (1992) "Dam Restoration Loan Program" is a low interest, revolving loan program specifically for private and public dam owners to fund repair or reconstruction projects. New Hampshire has a "Dam Maintenance Fund" which is, in part, funded by revenues generated from the lease of state owned dams for hydroelectric power production with the balance funded through the sale of bonds. This non-lapsing dedicated fund is used to finance the repairs and reconstruction of all the state owned dams using the state's Water Resources Division - Maintenance Bureau.

The Federal Emergency Management Agency (FEMA) has prepared a report entitled "Financing Dam Safety Projects." This report is a good source of information on repair financing for those states interested in exploring that aspect of dam safety.

See Appendix I for more details on budget preparation.

CHAPTER VII - PROGRAM STAFF AND DAM OWNER - EDUCATION AND TRAINING

Education and training of the agency* staff and the dam owner* are important elements of any program. Because state-of-the-art technology for dam design, construction, and inspection activities is constantly changing, professional and technical staffs must be continually educated in these new techniques and trained in their use. Various levels and types of education and training can be employed to keep staff personnel up to date in their particular areas of expertise. Likewise, there are different vehicles and resources available for informing the dam owner about the proper techniques of maintenance and operation of their dams.

I. Staff Education and Training Needs

In both new and well-established dam safety programs, it is of paramount importance that professional and technical staff possess the necessary skills to investigate and assess the safety of dams. For new programs, this is a particularly critical consideration. Ideally, a state dam safety program will encourage its staff to improve their skills through pursuit of continuing educational opportunities and advanced degrees, attendance at seminars, short courses and conferences, and participation in professional societies and associations. States are strongly encouraged to provide opportunities as well as funding for staff to enhance their engineering and other skills through ongoing educational efforts.

Education and training can be provided to staff in different forms and through various media. These include:

- on the job training;
- continuing education and graduate-level programs at universities;
- seminars, short courses, workshops, and conferences;
- federal and state dam safety training programs; and
- film and video training sessions.

Often underestimated and overlooked, on-the-job training constitutes the best form of education and training that program staff can receive. Knowledge and expertise shared by experienced engineers through field and office activities are invaluable to the successful training and professional development of new staff. Program managers are encouraged to develop in-house training sessions which may include presentations by staff and outside consultants on the hydrologic, hydraulic, geotechnical, and structural engineering aspects of dam safety, legal and enforcement proceedings, and other elements of dam safety practices.

* See Glossary for definition.

Seminars, short courses, workshops, and conferences are significant sources of information on new and innovative programs and techniques being developed or employed by the public and private sectors. Additionally, conferences provide staff with the opportunities to meet persons in similar positions in other states or agencies and to discuss and share experiences and learn about state-of-the-art methods. Professional contacts made at these meetings may be useful in helping to resolve future dam safety problems.

Certain federal agencies such as the U.S. Army Corps of Engineers (COE), Department of Interior - Bureau of Reclamation (BUR), Department of Agriculture, Natural Resources and Conservation Service (NRCS) and the Federal Emergency Management Agency (FEMA) have developed training programs and resources which are available to state dam safety personnel. These training opportunities include classroom-type courses, films, and videotape instructional materials. A listing of available training courses as prepared by the Interagency Committee on Dam Safety (ICODS) and published by FEMA is included as Appendix G.

II. Education and Training of Dam Owners

Dam owners and operators must be made aware of their state's dam safety laws and regulations, the associated responsibilities and liabilities, and the proper operation, maintenance and inspection of their dams. Usually, the best education and training for the dam owner is provided through their contacts with the state's dam safety personnel. These individual contacts can be supplemented by publications such as operation and maintenance manuals which describe the owner's various responsibilities. Public awareness workshops and seminars conducted by the state dam safety staff are other effective means for communicating with dam owners.

Many states have already developed and published manuals describing operation, maintenance, inspection, and emergency preparedness and action procedures for use by dam owners and operators. These manuals are intended to be of assistance to the dam owner in becoming familiar with the general principles and features of their dams as well as developing adequate skills of observation and safety inspection. See Appendix G for a list of sample dam owners manuals.

States should sponsor workshops, seminars, and training sessions which are designed to instruct owners about dams, necessary monitoring, operation, maintenance and inspection procedures, liability, emergency action plans, and financing for rehabilitation. These workshops can be conducted to raise the awareness level of dam owners for a relatively small investment of state resources. The Association of State Dam Safety Officials (ASDSO) and the Federal Emergency Management Agency (FEMA) can provide assistance to states in conducting workshops and seminars to instruct dam owners about their liabilities and responsibilities.

* See Glossary for definition.

CHAPTER VIII - DAM SAFETY PROGRAM - PUBLIC RELATIONS PLAN

I. Introduction

Every government agency needs public relations. The choice is only between good public relations and poor public relations (Starr 1968 and Marshall 1974). Dam safety programs are no exception to this rule.

What is meant by public relations?

By definition, public relations include all of the activities that build good relations with audiences. Public relations attempts to reinforce positive opinions, to increase understanding and support for programs and issues, and to involve the public in the development of policies, programs, and projects.

Administrators of state agencies, although they may recognize the desirability of good public relations, generally make no conscious effort to reach out to the public through a well-planned effort. This is especially true for dam safety programs that perceive themselves as generating media attention only in the case of dam incidents.

In fact, many dam safety activities, such as permit issuance, public hearings, and meetings with dam owners, community representatives and public officials, can be used as public outreach opportunities to promote two-way communications with the agency and the public.

A public relations program will not turn public opinion around overnight. To be effective, public relations must be an on-going and long range effort that involves program staff. In addition, a conscious effort must be made to integrate a public relations effort with year-round planning and operations as outlined in an organization's strategic plan.

The best approach to any public outreach effort is a planned one. A carefully developed public relations plan will result in a strategy for making others aware of what the organization is doing, why it is doing it, and why it contributes to the welfare of the community. The plan provides the road map to exchange information, ideas and concerns regarding program issues and activities. Once a plan is developed, materials needed to interest the audiences and the media should be assembled.

II. Dam Safety Public Relations Plan

A public relations plan should include the following elements:

Objectives: Setting objectives provides direction to a public relations plan. Long-term objectives for state dam safety programs could include:

- Promotion of program awareness among the general public, elected officials, and other state and federal organizations;

- Promotion of program awareness among the regulated community;
- Involvement of the public in the permitting process; and
- Development of a public relations contingency/emergency plan in case of dam incident.

Short-term objectives could include:

- Advertisement of workshops, seminars or hearings to potential attendees; and
- Release of professional and timely information to the media during and after dam incidents.

Target audiences: Defining the audiences will be a great help in planning activities and evaluating which activities best match both the selected audiences and objectives. Examples of potential target audiences for dam safety communication efforts include:

- the general public;
- the media;
- persons and communities below dams;
- dam owners;
- state and local elected officials;
- government officials;
- consulting engineers;
- emergency services officials;
- federal agencies;
- other state organizations; and
- and individuals or groups whose support is necessary for the program's success.

Strategies: Strategies include developing activities and materials to meet the communication objectives for selected audiences.

These activities may include workshops, seminars, conventions, publicity campaigns, and awards programs. Materials that can further the objectives include brochures, fact sheets, displays, slides, media kits, newsletters, questionnaires and news releases.

Timetable: A timetable lists deadlines that the organization can realistically meet to carry out assignments.

Budget: Budgeting comes down to making choices about where and how the program will spend available money. If a program operates under a tight budget, careful prioritization of public relations objectives will maximize results.

A good way to summarize objectives, audiences and strategies is through the use of a table.

Table 1 - Sample Dam Safety Public Relations Plan

Objectives	Audiences	Strategies	Timetable	Cos
Raise program awareness	Elected officials	Hold informational meeting, exhibit dam safety display at legislature	During legislative session	Budget to develop display and informational materials
Raise program awareness	Media, general public	1) Issue news releases, 2) exhibit display at public events, 3) develop media contacts	1) As needed 2) Conventions, fairs, youth events 3) Ongoing	Funding of public info office, entrance fees, budget for printing, graphic services
Obtain public input to the permit process	Affected public, regulated community, engineering firms	Publish public notices, issue news release, hold public hearings/ meetings	Within specified number of days or as law requires	Budget for newspaper advertisement, public service announcements, meeting rooms.
Provide information about program activities and promote two-way communications	Regulated community, public, elected officials, emergency personnel	Develop questionnaires newsletter, hold public meetings about program activities, hold an open house	Short-term: print newsletter; Long-term: solicit feedback, conduct public meetings	Budget for graphic artist, printing, newsletter cost, room and meeting expenses
Be prepared for a dam incident	Media, public, elected officials	Assemble press kit, develop public relations emergency response action plan	Short-term: prepare press kit; Long-term: Prepare type and amount of emergency information in advance	Budget to assemble press kit; public announcements

III. Developing Informational Materials

Below are a number of recommended materials a dam safety program may develop for a public outreach program.

BROCHURE

A brochure that outlines a program's purpose, activities, and services is a must for every dam safety organization.

The publication need not be expensive. A black and white brochure printed on a 11- x 17-inch or 8½- x 11-inch sheet should accomplish the objectives.

Brochures may be included in press kits; inserted in responses to Freedom of Information Act (FOIA) requests or general correspondence; provided as handouts at hearings or public meetings; placed on display racks at agency offices or public libraries; and passed out at conventions, state fairs and other public events.

Tip: The writing should be brief, descriptive, clear, free of technical jargon or bureaucratic terminology. Use simple and attractive graphics. The simpler the brochure, the more it will be read.

If more than one brochure is produced, make sure to use similar paper sizes, matching or complementary colors, type faces, and layouts.

FACT SHEETS

Fact sheets are a way to provide in-depth information on specific issues and to present topics that are subject to frequent questions. Possible topics include dam ownership information, explanation of specific permit issues, classifications of dams, size of dams, clarification of technical topics, aspects of emergency planning, and the roles of external agencies during emergencies.

Fact sheets can be printed on a 8½- x 11-inch sheet. They are inexpensive and easy to update and distribute.

NEWSLETTER

A newsletter can improve public understanding and participation in the dam safety program. The publication will serve as a means of direct communication to inform and update audiences regarding organizational developments, regulations, concerns, and goals. A newsletter need not be elaborate or expensive. Most newsletters are printed on an 8½- x 11-inch sheet or 11- x 17-inch sheet and folded in half for an 8½- x 11-inch page.

A newsletter can reach dam owners, engineering consultants, emergency services personnel, legislators, media contacts, agency administrators, agency field staff, and other interested persons.

A typical newsletter issue may contain: guidance about procedural matters, applications received, permits issued, construction projects completed, new employee profiles, interesting statistics, question and answer section, recent emergency situation, reprints or synopsis of major changes in regulations, calendar of events, and an ASDSO news corner.

Tip: Develop an attractive design and layout; maintain graphic continuity and provide a few regular features such as a question and answer section. Be aware of the informational needs of the audiences. Publish regularly and maintain an informative style.

NEWS RELEASE

A basic element of any public information plan is the news release. Program activities that include dedication of new dams, repair of popular dams, new or revised regulations, public comment periods, or awards are newsworthy.

In drafting a news release, stick to the facts, use complete names, write with an emphasis on community benefits and be timely. Be aware of the newspaper's deadlines and write the news release as far in advance of publication day as possible.

If a public information office is available in the agency, dam safety personnel should answer the questions: who, what, when, where and why to help the public information officer compose the release.

DISPLAY

A display can be an effective and flexible tool to draw attention to a dam safety program. Displays can be set up at trade shows, legislative halls, libraries, and other public events. Display materials may be found in existing files and materials. For example, if the display is to be set up at a construction-related exhibition, before and after pictures of dam safety construction projects may be found in existing files.

Tip: Decide on the best representative pictures, enlarge to display size and arrange the pictures on the display backdrop. The display arrangement should be uncluttered, easy to see at a distance, and provide simple picture captions.

Consult with a graphic artist or public information specialist to plan the "look" of the display. Once a visitor approaches the display, there should be handouts available including brochures, fact sheets, summaries of the displayed projects (with additional pictures), current and previous issues of the dam safety newsletter, and copies of the press kit for appropriate target individuals. Staff the display booth with people knowledgeable about the dam safety program. Keep approaches to the display open so that free circulation of visitors is possible.

PRESS KIT

Dam Safety administrators should always have materials available that will provide background information to reporters, to an interviewer on a radio talk show, or television story. A press kit can also be used to introduce the program to the legislature and local elected officials.

Materials include: Brochures and fact sheets, an agency's organizational chart, copies of recent newsletters, photographs of program activities, editorials or any articles that demonstrate the benefits that the program brings to the community. When assembled in a folder, these materials will comprise a Press Kit.

PLANNING FOR INCIDENTS

Every Dam Safety program is subject to the possibility of a dam incident. If an incident occurs, an emergency/crisis communication plan can pay dividends by managing critical information quickly and efficiently. A emergency/crisis plan should include:

CHAPTER VIII - DAM SAFETY PROGRAM - PUBLIC RELATIONS PLAN

1. The general policy should be to disseminate objective and accurate information regarding the incident, and to provide agency officials, press and radio representatives with timely answers to questions;
2. The plan should consider the probable communications situation and radio or cellular telephone security and procedures. Communications with key personnel on a 24-hour basis may be necessary;
3. To function effectively, only designated agency officials should take questions and provide answers. The officials must state only established facts without any guessing or speculation;
4. Press Kits should be available to provide information regarding the dam safety program's operations;
5. In addition to providing incident information about the immediate situation, the agency should have a qualified person available to persons inquiring about policy or current issues involving the program; and
6. Shortly after a major emergency incident is resolved, a press conference should be called to summarize the incident and agency actions taken to protect life and property.

If the Dam Safety program plans for incidents during routine times, the transition to an emergency/crisis plan will be much smoother. The result should be an accurate and timely information flow from the agency to the media.

References

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GLOSSARY OF TERMS

“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 drainway around the site.

“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.

“Agency” means that agency, department, office, or other unit of state government designated by state law to be responsible for implementation or direction of this Act. (This section to be replaced in enactment of the law by a reference to the state unit created or selected to implement and direct the Act which may be regular state employees or specialists and consultants, including consulting engineering firms or organizations, for any or all of the provisions of this Act.)

“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.

“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.

“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.

“ASDSO” means the Association of State Dam Safety Officials.

“BOR” means the Bureau of Reclamation.

“Breach” means partial removal of a dam, creating a channel through the dam to the original stream bottom elevation.

“Certificate of Approval to Impound” 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.

“COE” means the U.S. Army Corps of Engineers.

“Dam” means any artificial barrier, including appurtenant works, with the ability to impound water, wastewater, or liquid borne materials and which (a) 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

GLOSSARY OF TERMS

watercourse, to the maximum water storage elevation; or (b) has an impounding capacity at maximum water storage elevation of 50 acre-feet or more.

(a) This definition does not apply to any such barrier which 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.

(b) No obstruction in a canal used to raise or lower water shall be considered a dam.

(c) 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 in this definition are found applicable and is classified as a high hazard potential dam.

“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.

“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;

(a) Is a licensed engineer;

(b) Is competent in areas related to dam investigation, design, construction, and operation for the type of dam being investigated, designed, constructed or operated;

(c) 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;

(d) Understands adverse dam incidents, failures and the potential causes and consequences of failures.

“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.

“FEMA” means the Federal Emergency Management Agency.

“FERC” means the Federal Energy Regulatory Commission.

“FOIA” means the Freedom of Information Act.

“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 mis-operation of the dam or appurtenances. The hazard potential classification of a dam does not reflect in any way on the current condition of the dam and its appurtenant structures (e.g., safety, structural integrity, flood routing capacity).

“High Hazard Potential Dam” means a dam assigned the high hazard potential classification where failure or mis-operation will probably cause loss of human life.

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

"Inspection" means a comprehensive review of the design and performance of a dam and appurtenant structures; site evaluation of dam, appurtenant structures and reservoir area; approval of an emergency action plan, if required; all in accordance with the Training Aids for Dam Safety modules on Safety Inspection of Dams, or equivalent, conducted by or under the supervision of an engineer as defined in the ASDSO Model State Dam Safety Program.

"Inspector" means a person under the direct supervision of an engineer.

"Low Hazard Potential Dam" means a dam assigned the low hazard potential classification where failure or mis-operation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

"Maximum Storage Capacity" means the reservoir volume measured at the maximum elevation of water surface which can be obtained by the dam or reservoir.

"MSHA" means the Mine Safety and Health Administration.

"NID" means the National Inventory of Dams.

"NPDP" means the National Performance of Dams Program.

"NRCS" means the Natural Resources Conservation Service.

"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:

- (a) The state and its departments, institutions, agencies, and political subdivisions.
- (b) Every municipal or quasi-municipal corporation.
- (c) Every public utility.
- (d) Every district.
- (e) Every person.
- (f) The duly authorized agents, lessees, or trustees of any of the foregoing.
- (g) 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.

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

"Probable" means likely to occur; reasonably expected; realistic.

GLOSSARY OF TERMS

“Reconstruction” means removal and replacement of an existing dam.

“Removal” means complete elimination of the dam embankment or structure to restore the approximate original topographic contours of the valley.

“Reservoir” means any basin which contains or will contain impounded water, wastewater, or liquid-borne materials by virtue of its having been impounded by a dam.

“Significant Hazard Potential Dam” means a dam assigned the significant hazard potential classification where failure or mis-operation results in no probable loss of human life but can cause major economic loss, environmental damage, disruption of lifeline facilities, or impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

“USGS” means the United States Geological Survey.

“Water Storage Elevation” means the maximum elevation of water surface which can be obtained by the dam or reservoir.

APPENDIX A - MODEL STATE LAW

(The Model State Law was originally developed by the United States Committee on Large Dams (USCOLD) as a public service. ASDSO acknowledges the great contribution of USCOLD in crafting the original law in 1970. The Model Law is included in this document for reference purposes.)

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MODEL LAW FOR STATE SUPERVISION OF SAFETY OF DAMS AND RESERVOIRS

Chapter 1. Definitions

1000. Unless the context otherwise requires, the definitions in this chapter govern the construction of this Act.

1001. "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 drainway around the site.

1002. "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.

1003. "Agency" means that agency, department, office, or other unit of state government designated by state law to be responsible for implementation or direction of this Act. (This section to be replaced in enactment of the law by a reference to the state unit created or selected to implement and direct the Act which may be regular state employees or specialists and consultants, including consulting engineering firms or organizations, for any or all of the provisions of this Act.)

1004. "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.

1005. "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.

1006. "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.

1007. "Breach" means partial removal of a dam, creating a channel through the dam to the original stream bottom elevation.

1008. "Certificate of Approval to Impound" 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.

1009. "Dam" means any artificial barrier, including appurtenant works, with the ability to impound water, wastewater, or liquid borne materials and which (a) 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 (b) has an impounding capacity at maximum water storage elevation of 50 acre-feet or more.

(a) This definition does not apply to any such barrier which 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;

(b) No obstruction in a canal used to raise or lower water shall be considered a dam; and

(c) 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.

1010. "Days " used in establishing deadlines, means calendar days, including Sundays and holidays.

1011. "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.

1012. "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;

(a) Is a licensed engineer;

(b) Is competent in areas related to dam investigation, design, construction, and operation for the type of dam being investigated, designed, constructed or operated;

(c) 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

(d) Understands adverse dam incidents, failures and the potential causes and consequences of failures.

1013. "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.

1014. "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 mis-operation of the dam or appurtenances. The hazard potential classification of a dam does not reflect in any way on the current condition of the dam and its appurtenant structures (e.g., safety, structural integrity, flood routing capacity).

1015. "High Hazard Potential Dam" means a dam assigned the high hazard potential classification where failure or mis-operation will probably cause loss of human life.

1016. "Incremental" means under the same conditions (e.g., flood, earthquake, or other event), the difference in impacts that would occur due to failure or mis-operation of the dam over those that would have occurred without failure or mis-operation of the dam and appurtenances.

1017. "Low Hazard Potential Dam" means a dam assigned the low hazard potential classification where failure or mis-operation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

1018. "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:

- (a) The state and its departments, institutions, agencies, and political subdivisions;
- (b) Every municipal or quasi-municipal corporation;
- (c) Every public utility;
- (d) Every district;
- (e) Every person;
- (f) The duly authorized agents, lessees, or trustees of any of the foregoing; and
- (g) 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.

1019. "Person" means any person, firm, association, organization, partnership, business trust, corporation, or company.

1020. "Probable" means likely to occur; reasonably expected; realistic.

1021. "Reconstruction" means removal and replacement of an existing dam.

1022. "Removal" means complete elimination of the dam embankment or structure to restore the approximate original topographic contours of the valley.

1023. "Reservoir" means any basin which contains or will contain impounded water, wastewater, or liquid-borne materials by virtue of its having been impounded by a dam.

1024. "Significant Hazard Potential Dam" means a dam assigned the significant hazard potential classification where failure or mis-operation results in no probable loss of human life but can cause major economic loss, environmental damage, disruption of lifeline facilities, or impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

1025. "Water Storage Elevation" means the maximum elevation of water surface which can be obtained by the dam or reservoir.

Chapter 2. General Provisions

1026. 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.

1027. 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 (a) are not within the state's jurisdiction; and (b) 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.

1028. 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.

1029. 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:

(a) Design and construction application approval of the dam or approval of flood handling plans during construction, reconstruction, enlargement, repair, alteration, breach, removal, or abandonment;

(b) The issuance or enforcement of orders relative to maintenance or operation of the dam or reservoir;

(c) Control and regulation of the dam or reservoir;

(d) Measures taken to protect against failure of the dam during an emergency; or

(e) Failure to act.

1030. 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.

1031. 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.

1032. 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.

1033. Records of official actions of the agency and its correspondence pertaining to the supervision of dams and reservoirs are public documents.

1034. 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.

1035. The agency may report all dam incidents as defined by the National Performance of Dams Program (NPDP), to the NPDP archive.

Chapter 3. Administrative Provisions

1050. 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.

1051. 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.

Chapter 4. Powers of the Agency

Article 1. Powers in General

1075. 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.

1076. All dams and reservoirs in the state shall be under the jurisdiction of the agency, except those dams which are federally owned and operated.

1077. 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.

1078. 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:

- (a) Emergency notification plan with flowchart;
- (b) Statement of purpose;
- (c) Project description;
- (d) Emergency detection, evaluation, and classification;
- (e) General responsibilities;

- (f) Preparedness;
- (g) Inundation maps or other acceptable description of the inundated area; and
- (h) Appendices.

1079. 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.

1080. 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.

1081. 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.

Article 2. Investigations and Studies

1082. 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.

1083. 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.

1084. 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.

Article 3. Administrative and Legal Actions

1085. The agency may take any administrative or legal action necessary for the enforcement of this Act.

1086. An action or proceeding under this article may be initiated whenever any owner or any person acting as a agent of any owner is:

(a) 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

(b) 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.

1087. Any action or proceeding under this article shall be initiated either administratively or by appropriate legal filing in a court of appropriate jurisdiction in which:

- (a) the dam, area of hazard potential, or some part thereof exists;

- (b) the owner or person complained of has its principal place of business; or
- (c) the person complained of resides.

Article 4. Regulations and Standards

1088. 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:

- (a) 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;
- (b) Requirements for operation of dams including operational plans to be prepared and implemented by owners;
- (c) Requirements for monitoring, inspection and reporting of conditions affecting the safety of dams;
- (d) Requirements for emergency action plans to be prepared and implemented by owners, in cooperation with civil authorities;
- (e) 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
- (f) Proof of financial responsibility.

1089. 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:

- (a) 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;
- (b) water management and the impacts of development in watersheds and;
- (c) the state of scientific and technological knowledge at the time the regulations are adopted.

1090. In promulgating regulations pursuant to this Act applicable to water obstructions and encroachments which do not present substantial potential risks to life or property, the dam safety agency shall consider:

- (a) the state of scientific and technological knowledge and good engineering practice relating to various types of water obstructions and encroachments;
- (b) the economic impact upon the state and its citizens;
- (c) the relationship of water obstructions and encroachments in hydrologic management in the watershed as a whole; and
- (d) the impacts of water obstructions and encroachments upon water quality and the environment.

Chapter 5. Applications

Article 1. New Dams or Enlargements of Dams

1100. 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.

1101. 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.

1102. The application shall provide the following information:

- (a) The name and address of the owner;
- (b) The location, type, size, purpose, and height of the proposed dam and reservoir and appurtenant works;
- (c) The storage capacity and reservoir surface areas for normal pool and maximum water storage elevation;
- (d) Plans for proposed permanent instrument installations in the dam;
- (e) As accurately as may be readily obtained, the area of the drainage basin, rainfall and streamflow records, flood-flow records and estimates;
- (f) 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
- (g) Such other pertinent information as the agency requires.

1103. The agency shall, when in its judgment it is necessary, also require the following:

- (a) Data concerning subsoil and rock foundation conditions and the materials involved in the construction, or enlargement of the dam or reservoir;
- (b) 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;
- (c) 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
- (d) Such other appropriate information as may be necessary.

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

1104. 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.

(a) The application shall give such pertinent information or data concerning the dam, as may be required by the agency;

(b) 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;

(c) 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

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

Article 3. Application Approval

1105. Upon receipt of an application the agency shall approve or disapprove the application within the time provided in Section 1107.

1106. 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.

1107. 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.

1108. Application approval shall be granted with terms, conditions, and limitations necessary to safeguard life and property.

1109. 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.

1110. The agency may, upon written application and for good cause shown, extend the time for commencing construction, reconstruction, repair, alteration, breach, removal, or abandonment.

1111. 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.

Chapter 6. Fees

1125. 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 regulations based upon the estimated cost.

1126. 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.

1127. 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:

- (a) The cost of all labor and materials for the dam, appurtenant works and reservoir;
- (b) The cost of preliminary investigations and surveys;
- (c) The cost of the construction plant properly chargeable to the cost of the dam and reservoir; and
- (d) Any and all other items entering directly into the cost of the dam and reservoir.

1128. Excluded from the cost listed in Section 1127 shall be:

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

1129. 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.

1130. 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.

1131. 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.

1132. 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 expenditure, for the purposes authorized by this Act.

1133. The fees provided for in this article shall be required of all owners as defined in Chapter 1 of this Act.

1134. Annual Registration Fees and Inspection Fees

(a) 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 45 days of the date due; and

(b) 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.

Chapter 7. Inspection and Certificate of Approval to Impound

Article 1. New, Reconstructed or Enlarged Dams and Reservoirs

1150. 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:

(a) A record of all geological boreholes and grout holes and grouting;

(b) A record of permanent location points, benchmarks and instruments embedded in the structure;

(c) A record of tests of concrete or other material used in the construction, reconstruction, or enlargement of the dam and reservoir; and

(d) A record of initial seepage flows and embedded instrument readings.

1151. In connection with the enlargement of a dam and reservoir, the supplementary drawings and descriptive matter need apply only to the new work.

1152. 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.

Article 2. Certificates of Approval to Impound

1153. Each certificate of approval to impound issued by the agency under this Act shall contain such terms and conditions as the agency may prescribe.

1154. 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.

1155. 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.

Article 3. Repaired or Altered Dams and Reservoirs

1156. 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.

1157. 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.

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

1158. 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.

1159. 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.

1160. 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).

Article 5. Complaints of Unsafe Conditions

1161. 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.

1162. 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.

Article 6. Inspection During Progress of Work

1163. 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.

1164. 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.

1165. If 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.

(a) 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

(b) The agency may order that no further work be done until such compliance has been effected and approved by the agency.

1166. 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.

Chapter 8. Maintenance, Operation and Emergency Actions

Article 1. Maintenance and Operation

1175. The agency shall regulate the maintenance and operation of dams and reservoirs as necessary to safeguard life and property from a dam failure.

1176. 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 which may affect the safety of the dam and reservoir.

1177. 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.

1178. The agency may report the results of dam inspections that determine unsafe conditions or non-compliance to the National Performance of Dams Program (NPDP).

Article 2. Emergency Actions

1179. 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:

(a) 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

(b) Passing or imminent floods or any other condition threatens the safety of any dam or reservoir.

1180. In applying the remedial means provided for in this article, the agency may in an emergency with its own forces, or by other means at its disposal, do any or all of the following:

(a) Take full charge and control of any dam or reservoir;

(b) Lower the water level by releasing water from the reservoir;

(c) Completely drain the reservoir;

(d) Perform any necessary remedial or protective work at the site; or

(e) Take such other steps as may be essential to safeguard life and property.

1181. 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.

1182. 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.

Article 3. Emergency and Nonemergency Funding

1183. The cost and expense of the remedial means provided in this article, 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 such bills are not promptly paid by the owners, the cost shall be recovered by the state from the owner by action brought by the agency in a court of appropriate jurisdiction.

1184. The agency may spend monies from the emergency dam repair fund established by Section 1185 with the following provisions:

(a) 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;

(b) 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;

(c) 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;

(d) 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

(e) 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.

1185. 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.

1186. 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:

(a) 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

(b) Monies in the nonemergency dam repair fund are exempt from lapsing.

1187. 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:

(a) The loans granted by the agency shall be for a term of not more than twenty years;

(b) The loans shall bear interest at rates set by the agency in the regulations;

(c) 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;

(d) 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

(e) 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.

1188. 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:

(a) 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.

Chapter 9. Offenses and Penalties

1200. 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.

1201. 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 chapter.

1202. 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 chapter.

1203. Cease and Desist Order; Temporary Cease and Desist Order; Hearing; Injunctive Relief

(a) 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.

(b) 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.

(c) 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.

(d) 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.

1204. 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:

(a) The agency shall bring an action to recover penalties under this section in a court of appropriate jurisdiction in which the violation occurred;

(b) 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

(c) All penalties collected pursuant to this section shall be deposited in the state nonemergency dam repair fund authorized in Section 1186.

1205. 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:

(a) The public interest will be adversely affected by a stay;

(b) The stay will harm others;

(c) There is a high probability that the appellant will succeed on the merits;

(d) The appellant will suffer irreparable harm before a decision on the merits can be rendered;

(e) For the benefit of the people of this state, appeals under this article have precedence, in every court, over all other civil proceedings; and

(f) 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.

Chapter 10. Dams and Reservoirs Existing Prior to the Effective Date of this Act**Article 1. Dams and Reservoirs Completed Prior to Effective Date of this Act**

1225. 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.

1226. 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.

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1227. 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 article, and a failure to file within 60 days after such notice shall be punishable as provided in this Act.

1228. The notice provided for in this article 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.

1229. The agency shall make inspections of such dams and reservoirs.

1230. 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 owner's 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.

1231. 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.

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

1232. 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.

1233. 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.

1234. All laws and parts of law in conflict with this Act are hereby repealed.

APPENDIX B - EXAMPLE PERMIT REQUIREMENTS

CASE 1: ARIZONA

ARIZONA DEPARTMENT OF WATER RESOURCES
FLOOD WARNING AND DAM SAFETY SECTION
500 North Third Street, Phoenix, Arizona 85004-3903
Telephone (602) 417-2445
Fax (602) 417-2423



FIFE SYMINGTON
Governor

RITA P. PEARSON
Director

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 Arizona 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 corner, a space approximately 4" high x 5" wide in
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proximity to the lower right hand corner 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 trashrack, 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.
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Appendix B - Example Permit 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.
 - 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
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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 Arizona Department of Water Resources, Surface Water Unit at (602) 417-2442 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 State Land Department at (602) 542-4621 for details of their requirements.
- 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 Arizona Department of Water Resources, Groundwater Management Support Section at (602) 417-2470.

Appendix B - Example Permit Requirements

- Dewatering Wells** - If dewatering of the dam foundation is required, contact the Arizona Department of Water Resources, Groundwater Management Support Section at (602) 417-2470.

- Floodplain Management** - Any activity in a floodplain requires a floodplain use permit from the local flood control district. Any structure which 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 which involves ground disturbance requires prior clearance regarding cultural resources sensitivity and treatment from the State Historic Preservation Officer. Contact the Arizona State Parks at (602) 542-4174.

STATE OF ARIZONA
DEPARTMENT OF WATER RESOURCES
SAFETY OF DAMS & FLOOD ENGINEERING UNIT

INSTRUCTIONS FOR FILING AN APPLICATION

MARCH, 1995

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 Department of Water Resources upon forms which will be furnished free on request. Completed applications should be sent to the Safety of Dams & Flood Engineering Section at the following address: Department of Water Resources, 500 North 3rd Street, Phoenix, Arizona 85004-3903, Attention: Safety of Dams & Flood Engineering Unit.

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 Arizona 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 which 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.
- For the next \$500,000, one (1.0 %) percent.

Appendix B - Example Permit Requirements

- For all costs in excess of \$1,000,000, one-half of one (0.5 %) percent.
Example fee calculation (fee must accompany the application):

<i>ESTIMATED COST</i>	\$6,420,000.00
2% x \$100,000	2,000.00
1.5% x \$400,000	6,000.00
1% x \$500,000	5,000.00
0.5% x \$5,420,000	27,100.00
	<hr/>
<i>TOTAL FEE</i>	\$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 corner, 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 trashrack 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.

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.

Appendix B - Example Permit Requirements

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 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 which 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 Arizona Department of Water Resources, Surface Water Rights Unit at (602) 417-2470 for details.

Appendix B - Example Permit Requirements

- **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.
- **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 State Land Department at (602) 542-4621 for details of their requirements.
- **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 Arizona Department of Water Resources, Groundwater Permitting Unit at (602) 417-2470.
- **Dewatering Wells:** If dewatering of the dam foundation is required and the dam is to be constructed within an Active Management Area, contact the Arizona Department of Water Resources, Groundwater Permitting Unit at (602) 417-2470.
- **Floodplain Management:** Any activity in a floodplain requires a floodplain use permit from the local flood control district. Any structure which 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 which 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 which 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., 3rd Edition, 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-Hill Book Co., Inc., 1963.

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- SHERARD, J.R., R.J. WOODWARD, S.F. GIZIENSKI and W.A. CLEVINGER, 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, TR-46, 1982.
- U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE (NRCS), Guide for Design and Layout of 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.
- 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.
- U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE (NRCS), Chute Spillways, NEH-14, 1977.
- U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE (NRCS), Drop Spillways, NEH-11, 1968.
- U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE (NRCS), Structural Design of SAF Stilling Basins, TR-54, Revised 1981.
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U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE (NRCS), Structural Design of Monolithic Straight Drop Spillways, TR-63, 1977.

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE (NRCS), Structural Design of Underground Conduits, TR-5, 1958.

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.

Appendix B - Example Permit Requirements

STATE OF ARIZONA
DEPARTMENT OF WATER RESOURCES
SAFETY OF DAMS & FLOOD ENGINEERING UNIT

REQUIREMENTS DURING DAM CONSTRUCTION

MARCH, 1995

Arizona 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 which 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 Safety of Dams and Flood Engineering Unit 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 which 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.

Appendix B - Example Permit Requirements

STATE OF ARIZONA
DEPARTMENT OF WATER RESOURCES
SAFETY OF DAMS & FLOOD ENGINEERING UNIT

REQUIREMENTS FOLLOWING COMPLETION OF DAM CONSTRUCTION

MARCH, 1995

AFTER COMPLETION

As soon as possible after completion of the work and final inspection by an engineer from the Safety of Dams & Flood Engineering Unit, 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 sized 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 bench marks.
- 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 final 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 \$500,000, one (1 %) percent.
 - For all costs in excess of \$1,000,000, one-half of one (0.5 %) percent.
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Appendix B - Example Permit Requirements

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):

<i>ESTIMATED COST</i>	\$6,420,000.00
2% x \$100,000	2,000.00
1.5% x \$400,000	6,000.00
1% x \$500,000	5,000.00
0.5% x \$5,420,000	27,100.00
	=====
<i>TOTAL FEE</i>	\$40,100.00

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

<i>ACTUAL COST.</i>	\$6,482,500.00
2% x \$100,000	2,000.00
1.5% x \$400,000	6,000.00
1% x \$500,000	5,000.00
0.5% x \$5,482,500	27,412.50
	=====
<i>RECOMPUTED FEE</i>	\$40,412.50
Original Fee	- 40,100.00
	=====
<i>DIFFERENCE</i>	\$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.

Appendix B - Example Permit Requirements

SAMPLE AFFIDAVIT OF TOTAL COST - PLEASE USE YOUR OWN LETTERHEAD

Arizona Department of Water Resources, Safety of Dams and Flood Engineering Unit
 500 North Third Street, Phoenix, Arizona 85004-3903

Gentlemen:

I, _____ am the _____
 (Name) (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 _____, Arizona.

 (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.

CASE 2: GEORGIA REQUIREMENTS

This guide has been developed to assist you in understanding what documentation is required on a Category I dam design. This document is to be used as a guide and is not meant to be all encompassing. Your design engineer may feel it is necessary to provide additional information.

DESIGN REPORTS

Geotechnical:

- Subsurface Exploration Records
- Borrow Study
- In-situ Tests
- Lab Tests
- Seepage Analysis
- Settlement Analysis
- Stability Analysis
- Instrumentation Recommendations
- De-watering Recommendations

Hydraulics & Hydrology:

- Watershed Delineation
- Inflow Hydrograph including supporting data
- Spillway Rating Curve
- Tailwater Calculations
- Reservoir Routing
- Freeboard Calculations
- Earth Spillway Attack Calculations
- Energy Dissipation Design
- Proposed Filling Schedule
- Time to Drain Reservoir
- Design Evaluation & Recommendation
- Surface Water Control Recommendations

Structural/Civil:

- Concrete Design Calculations
- Up-lift Calculations
- Seismic Calculations
- Structural Calculations
- Steel
- Operating Equipment
- Plans and Specifications:
 - Construction Methodology
 - Materials

Permits:

- Emergency Action Plan
- Land Disturbing Permit
- 404 Permit
- NPDES
- Easements/Property Ownership

Correspondence:

- Correspondence relative to dam

Appendix B - Example Permit Requirements

CASE 3: 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 investigation(s) 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 which meets the requirements of the State Board of Professional Engineers and Land Surveyors.

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

Appendix B - Example Permit Requirements

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

Appendix B - Example Permit Requirements

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.

Appendix B - Example Permit Requirements

(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 - INSPECTION CHECKLIST

CASE 1: ARIZONA

ARIZONA DEPARTMENT OF WATER RESOURCES - SAFETY OF DAMS & FLOOD ENGINEERING UNIT
 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 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. Additional sheet(s) may be used for any items not listed and additional comments.

DAM NO.:		DAM NAME:		TYPE:	NOT A P P L I C A B L E	NO	YES	MONITOR	REPAIR	INVESTIGATE
CONTACTS:		DATE:		PAGE 1 of _____						
INSPECTED BY:		DATE:								
REVIEWED BY:		TOTAL FREEBOARD:		PHOTOS? YES/NO						
STORAGE LEVEL: ft. Above/below Spillway Crest	Item	Comments								
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. Inadequate 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. Inadequate ground cover?										
c. Adverse vegetation?										
d. Longitudinal/Transverse cracking?										
e. Inadequate riprap?										
f. Settlements, slides, depressions, bulges?										
g. Soft spots or boggy areas?										
h. Movement at or beyond toe?										
j. Animal burrows?										

Appendix C - Inspection Checklist

EMB DAM INSP. CHECKLIST / REPORT		PAGE 88 of	DAM NO.					
INSPECTED BY:		DATE	N	N	Y	M	R	I
Item	Comments		A	O	S	N	P	N
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. Do the joints show:								
1. Displacement or offset?								
2. Loss of joint material?								

EMB DAM INSP CHECKLIST / REPORT		PAGE 88 of	DAM NO.:					
INSPECTED BY:		DATE:	N	N	Y	M	R	I
Item	Comments	A	O	S	O	E	E	N
3. Leakage?								
f. Are the trash racks:								
1. Broken or bent?								
2. Corroded or rusted?								
3. Obstructed?								
g. Sluice/Drain gates:								
1. Broken or bent?								
2. Corroded or rusted?								
3. Leaking?								
4. Not seated properly?								
5. Not operational?								
6. Not periodically maintained?								
7. Date last operated?								
8. OUTLET WORKS-CONDUIT		Concrete, Metal, or 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 deficient?								
3. Misalignment or spilt 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?								

Appendix C - Inspection Checklist

EMB. DAM INSP. CHECKLIST / REPORT		PAGE 88 of	DAM NO.:					
INSPECTED BY:		DATE:	N/A	NO	YES	MON	REP	INV
Item	Comments							
2. Cracking?								
3. Erosion?								
4. Exposed reinforcement?								
b. If concrete, do joints show:								
1. Displacement?								
2. Loss of joint material?								
3. Leakage?								
c. Do the energy dissipators show:								
1. Signs of deterioration?								
2. Covered with debris?								
3. Signs of inadequacy?								
10. OUTLET WORKS-OUTLET CHANNEL Unlined, Concrete, Riprap or Other								
a. Eroding or backcutting?								
b. Sloughing?								
c. Obstructed?								
d. Poorly riprapped?								
e. Tailwater elevation and flow condition:								
11. EMERGENCY SPILLWAY-APPROACH CHANNEL Unlined, Concrete, Riprap or 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?								

EMB. DAM INSP. CHECKLIST / REPORT		PAGE 88 of	DAM NO.:				
INSPECTED BY:		DATE:	N	Y	M	R	I
Item	Comments	A	O	S	N	P	N
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 or 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. Poorly protected w/ vegetation/riprap?							
14. EMERGENCY SPILLWAY - TERMINAL 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. Do the energy dissipators show:							
1. Signs of deterioration?							

Appendix C - Inspection Checklist

EMB. DAM INSP. CHECKLIST / REPORT		PAGE 88 of	DAM NO.					
INSPECTED BY:		DATE:	N/A	NO	YES	NO	R/P	I/N/V
Item	Comments							
2. Covered with debris?								
3. Signs of inadequacy?								
15. EMERGENCY SPILLWAY - OUTLET CHANNEL	Unlined, Concrete, Riprap or Other?							
a. Eroding or backcutting?								
b. Sloughing?								
c. Obstructed or restricted?								
16. RESERVOIR								
a. High water marks?								
b. Erosion/Slides into 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 type(s) of instrumentation:								
b. In poor condition?								
c. Not read or analyzed regularly?								
d. Is data available?								
18. CONDITION SUMMARY / LICENSE / EAP / NEXT INSPECTION								
a. Dam condition:	Unsafe Nonemergency / Significant Deficiencies / Satisfactory							
b. List 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:								

ADDITIONAL COMMENTS and RECOMMENDATIONS

CASE 2: NEW JERSEY

Guidelines for Inspection of Existing Dams

New Jersey
Department of Environmental Protection
Dam Safety
Trenton, NJ 08625

February, 1997

**Guide for the Inspection and Preparation of a Report
on the Condition of a Dam**

New Jersey Dam Safety Inspection Program

State law relating to the construction, repair, modification, and inspection of existing and proposed dams has been in existence since 1912. The law was amended in 1981 and cited as the Safe Dam Act, N.J.S.A. 58:4-1 et seq. The Dam Safety Standards N.J.A.C. 7:20-1 et seq. were promulgated in May, 1985 and have been readopted with minor modifications in May, 1990 and in May, 1995.

The New Jersey Dam Safety Program is implemented by the Department of Environmental Protection, Division of Engineering and Construction, Dam Safety Section. 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 is through the maintenance and periodic inspection of in-service dams.

The New Jersey 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 uncertain conditions and corrective measures to enable the dam to continue to perform its intended functions.

Inspection Guidelines

The New Jersey 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 insure conformity with current design and construction practices.

Dam Classifications

The State of New Jersey recognizes four (4) classes of dams. Class I dams are those structures which, should they fail, would likely cause loss of life. Class II dams are 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 structures which would cause little or no downstream damage should they fail. Class IV dams are structures which are less than 15 feet in height, impound less than 15 acre feet of water to the top of dam, and drain less than 150 acres. No dam may be included in the Class IV category if failure of the dam could cause downstream property damage or loss of life.

When Should Dams be Inspected

Class I and Class II dam owners are required to have a regular inspection performed every two years and a formal inspection performed every six or ten years respectively. Class III and Class IV dam owners are required to have a regular inspection performed every four years but are not normally required to perform periodic formal inspections. On those years a formal inspection is performed, a regular inspection will not be required. All dams over 70 feet in height or which can potentially store more than 10,000 acre feet of water, regardless of hazard classification, are required to be inspected every year with a formal inspection conducted every third year. All dam inspections shall be performed from March through December.

Types of Inspections

Formal Inspection - The inspection and performance evaluation of Class I and Class II dams under the supervision of a qualified, New Jersey 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 New Jersey 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, New Jersey 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 N.J.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 New Jersey 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. Reports for Class IV dams are to be submitted to the county and/or municipality which has jurisdiction over the dam structure.

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.

VISUAL INSPECTION CHECKLIST

This general checklist should be used as an aid when examining all dams. This checklist may not, however, include all features or 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.

NJ 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

New Jersey Licensed Professional Engineer(s):

<u>Name</u>	<u>Affiliation</u>	<u>Area of Expertise</u>
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Non-Licensed technical expert(s) and advisor(s):

<u>Name</u>	<u>Affiliation</u>	<u>Area of Expertise</u>
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State Representative(s):

<u>Name</u>	<u>Affiliation</u>
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Dam Owner Representative(s):

<u>Name</u>	<u>Affiliation</u>
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Others:

Name

Affiliation

GENERAL INFORMATION

Name of Dam:

Fed. I.D. No.

N.J. Dam No.:

River 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 (sqr mls):

Height (ft):

Length (ft):

Normal Surface (ac):

Normal Capacity (af):

Maximum Capacity (af):

Spillway Capacity (cfs):

HISTORY

Date Constructed:

Dates(s) Reconstructed:

Designer:

Constructed By:

Owner & Address:

Owner/Operator present during inspection (yes or no):

PREVIOUS INSPECTIONS (date of)

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:

Appendix C - Inspection Checklist

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:

Appendix C - Inspection Checklist

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

<u>Location</u>	<u>Estimated Flow</u>	<u>Color (Turbidity)</u>
-----------------	-----------------------	--------------------------

(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:

<u>Location</u>	<u>Orientation</u>	<u>Length</u>	<u>Width</u>	<u>Type</u>
-----------------	--------------------	---------------	--------------	-------------

DOWNSTREAM FACE

Condition of Concrete or Masonry:

Cracking:

<u>Location</u>	<u>Orientation</u>	<u>Length</u>	<u>Width</u>	<u>Type</u>
-----------------	--------------------	---------------	--------------	-------------

Leakage Through Dam (Location and Estimated Flow):

CREST

Condition of Concrete or Masonry:

Cracking

<u>Location</u>	<u>Orientation</u>	<u>Length</u>	<u>Width</u>	<u>Type</u>
-----------------	--------------------	---------------	--------------	-------------

Signs of Movement:

Differential Movement (Joint or Crack Separation or Offset):

Appendix C - Inspection Checklist

GALLERIES

Cracking

<u>Location</u>	<u>Orientation</u>	<u>Length</u>	<u>Width</u>	<u>Type</u>
-----------------	--------------------	---------------	--------------	-------------

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 Areas:

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:

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:

Appendix C - Inspection Checklist

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 with 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:

APPURTENANT STRUCTURES (Power House, Gatehouse, Penstocks, Water Supply, Other)

Description and Condition of each:

CONCLUSION

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

I recommend the following repairs be made 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:

New Jersey Licensed Professional Engineer representing the dam owner in responsible charge of the inspection:

Sign _____ Date _____

New Jersey Professional Engineer License Number _____

SEAL

(Department use only)	
Dam Name _____	
N.J. Reference No. _____	Hazard Classification _____
Engineer _____	Date of Inspection _____

APPENDIX D - PENALTIES FOR VIOLATIONS

CASE 1: PENNSYLVANIA

Appendix D - Penalties for Violations

Section 19. Civil Remedies.

(a) Any activity or condition declared by this act to be unlawful conduct shall be restrained or prevented in the manner provided by law or equity for abatement of public nuisances, and the expense thereof shall be recoverable from the violator in such manner as may now or hereafter be provided by law.

(b) In addition, suits to restrain or prevent any unlawful conduct as defined in this act or to compel action to discontinue any unlawful conduct may be instituted in equity or at law in the name of the Commonwealth upon relation of the Attorney General, or upon relation of any district attorney of any county or upon relation of the solicitor of any municipality affected after 30 days notice has first been served upon the Attorney General of the intention of the district attorney or solicitor to proceed. Such proceedings may be prosecuted in the Commonwealth Court, or in the court of common pleas of the county where the activity has taken place, the dam, water obstruction or encroachment is maintained or the public is affected, and to that end jurisdiction is hereby conferred in law and equity upon such courts: Provided, That except in cases of emergency where, in the opinion of the court, the exigencies of the cases require immediate abatement of said unlawful conduct, the court may, in its decree, fix a reasonable time during which the person responsible for the unlawful conduct may make provision of the same. The expense of such proceedings shall be recoverable from the violator in such manner as may now or hereafter be provided by law.

Section 20. Enforcement Orders.

(a) The Department may issue such orders as are necessary to aid in the enforcement of the provisions of this act. Such orders shall include, but shall not be limited to, orders modifying, suspending or revoking permits and orders requiring persons to cease any activity which is in violation of the provisions of this act. Such an order may be issued if the Department finds that a person is in violation of any provision of this act, or any rule or regulation issued hereunder. The Department may, in its order, require compliance with such terms and conditions as are necessary to effect the purposes of this act.

(b) An order issued under this section shall take effect upon notice, unless the order specifies otherwise.

(c) Any person violating or failing to comply with any order of the Department from which no appeal has been taken or which has been sustained on appeal, or which has been appealed but where no supersedeas has been granted for the period in which the order has been violated shall be deemed to be in contempt of such order. Upon petition and certification of such order by the Department or the hearing board, the Commonwealth Court or the court of common pleas of the county where the unlawful conduct occurred or is occurring, shall, if it finds, after hearing or otherwise, that the respondent is not in compliance with the order, adjudge the respondent in contempt of the order and shall assess civil penalties of an amount not less than \$100 nor greater than

\$10,000 per violation plus \$500 for each continuing day of violation. Where the respondent has not as of the date of hearing before the court complied with the order of the Department or board, the court shall specifically order the respondent to immediately and fully comply with such order, and may issue any further order as may be appropriate.

(d) The right of the Department to issue an order under this section is in addition to any penalty which may be imposed or any action taken pursuant to this act. The failure to comply with any such order is hereby declared to be unlawful conduct and a nuisance.

Section 21. Civil Penalties.

(a) In addition to proceeding under any other remedy available at law or equity for:

(1) a violation of a provision of this act or any rule or regulation issued hereunder;

(2) a violation of any order of the Department; or

(3) engaging in any unlawful conduct of the provisions of this act the hearing board, in an action instituted before it by the Department, may assess a civil penalty upon any person for such violation or unlawful conduct. Such a penalty may be assessed whether or not the violation was willful. The civil penalty so assessed shall not exceed \$10,000, plus \$500 for each day of continued violation. In determining the amount of the civil penalty, the board shall consider the willfulness of the violation, damage or injury to the stream regimen and downstream areas of the Commonwealth, cost of restoration, the cost to the Commonwealth of enforcing the provisions of the act against such person, and other relevant factors. The assessment of the civil penalty shall be made after hearing, unless hearing is specifically waived by the respondent.

(b) Civil penalties shall be payable to the Commonwealth and shall be collectible in any manner provided by law for the collection of debts. If any person liable to pay any such penalty neglects or refuses to pay the same after demand, the amount, together with interest and any costs that may accrue, shall be a lien in favor of the Commonwealth upon the property, both real and personal, of such person but only after the amount of the lien has been entered and docketed of record by prothonotary of the county where the property is situated. The board may, at any time, transmit to the prothonotaries of the respective counties certified copies of all such liens, and it shall be the duty of each prothonotary to enter and docket the same of record in his office, and to index the same as judgments are indexed, without requiring the payment of costs as a condition precedent to the entry thereof.

(c) Any officer of any corporation, association, municipality or county, who knowingly, willfully, recklessly or with gross negligence engages in or authorizes unlawful conduct as defined in this act shall be subject to the imposition upon civil penalties in accordance with subsection (a). Any civil penalty imposed upon such officer shall be in addition to and separate

Appendix D - Penalties for Violations

from any civil penalty imposed upon the corporation, association, municipality or county. Nothing in this subsection shall be construed to affect the liability or duty of any officer of a corporation, association, municipality or county for the purposes of criminal penalties imposed under this act, or for the purposes of any other rights or remedies now or hereafter existing or herein provided.

Section 22. Criminal Penalties.

(a) Any person who engages in unlawful conduct as defined in this act is guilty of a summary offense and, upon conviction, shall be sentenced to pay a fine of not less than \$100 nor more than \$1,000 for each separate offense, and, in default of the payment of such fine, to imprisonment for a period of not more than 60 days.

(b) Any person who, within two years after a conviction in a summary proceeding as provided in subsection (a) engages in unlawful conduct as defined in this act is guilty of a misdemeanor of the third degree and, upon conviction, shall be sentenced to pay a fine of not less than \$500 nor more than \$5,000 for each separate offense or to imprisonment for a period of not more than one year, or both.

(c) Each day of continued violation of any provision of this act or any rule or regulation or order of the Department issued pursuant to this act shall constitute a separate offense under subsections (a) and (b).

Some states may find it advisable to add a provision for injunctive relief (i.e., a court order to repair or breach a dam).

Section 23. Summary proceedings.

All summary proceedings under the provisions of this act may be brought before any magistrate, alderman, or justice of the peace of the county where the unlawful conduct has occurred or the dam, water obstruction or encroachment is maintained, or the public affected, and to that end jurisdiction is hereby conferred upon said magistrates, aldermen or justices of the peace, subject to appeal by either party in the manner provided by law. In the case of any appeal from any such conviction in the manner provided by law for appeals from summary conviction, it shall be the duty of the district attorney of the county to represent the interests of the Commonwealth.

Section 24. Administrative and judicial review.

(a) Any person who shall be aggrieved by any action of the Department under this act shall have the right within 30 days of receipt of notice of such action to appeal to the Environmental Hearing Board. Any appeal of a general permit issued pursuant to section 7 shall be filed within 30 days of the date of publication of the general permit in the Pennsylvania Bulletin. Hearings under this subsection any subsequent appeal shall be in accordance with section 1921 (a) of the act of April 9, 1929 (P.L. 177, No. 175), known as "The Administrative Code of 1929", and the "Administrative Agency Law" .

Appendix D - Penalties for Violations

(b) An appeal to the hearing board of any action of the Department shall not act as a supersedeas. A supersedeas may be granted by the hearing board upon a showing by the petitioner:

(1) the irreparable harm to the petitioner or other interested parties will result if the supersedeas is denied;

(2) that there is a likelihood of the petitioner's success on the merits; and

(3) that the grant of a supersedeas will not result in irreparable harm to the Commonwealth. The board may grant such a supersedeas subject to such security as it may deem proper.

Section 25. Preservation of existing rights and remedies.

The collection of any penalty under the provisions of this act shall not be construed as estopping the Commonwealth, or any district attorney or solicitor of a municipality, from proceeding in courts of law or equity to abate conduct forbidden under this act, or abate nuisances under existing law. It is hereby declared to be the purpose of this act to provide additional and cumulative remedies to abate unsafe dams, water obstructions or encroachments in this Commonwealth, and nothing in this act shall in any way abridge or alter rights of action or remedies now or hereafter existing in equity, or under the common law or statutory law, criminal or civil, nor shall any provision in this act, or the granting of any permit under this act, or any act done by virtue of this act, be construed as estopping the Commonwealth, persons or municipalities, in the exercise of their rights under the common law or decisional law or in equity, from proceeding in courts of law or equity to suppress nuisances, or to abate any unsafe dam now or hereafter existing, or enforce common law or statutory rights.

The division of penalties into several categories reflects the fact that in most cases penalties that follow violations will be different according to not only severity but also nature. That is, it should be possible to distinguish between civil violations and criminal violations of the law.

CASE 2: CALIFORNIA

Offenses and Punishment

(California 1995)

6425. Every person who violates any of the provisions of this part or of any approval, order, rule, regulation, or requirement of the department is guilty of a misdemeanor and punishable by a fine of not more than two thousand dollars (\$2, 000) or by imprisonment in the county jail not exceeding six months, or both. In the event of a continuing violation, each day that the violation continues constitutes a separate and distinct offense.

6426. Any person who willfully obstructs, hinders, or prevents the department or its agents or employees from performing the duties imposed by this part or who willfully resists the exercise of the control and supervision conferred by this part upon the department or its agents or employees is guilty of a misdemeanor and punishable as provided in this article.

6427. Any owner or any person acting as a director, officer, agent, or employee of an owner, or any contractor or agent or employee of a contractor who engages in the construction, enlargement, repair, alteration, maintenance, or removal of any dam or reservoir, who knowingly does work or permits work to be executed on the dam or reservoir without an approval or in violation of or contrary to any approval as provided for in this part or any inspector, agent, or employee of the department who has knowledge of such work being done and who fails to immediately notify the department thereof is guilty of a misdemeanor and punishable as provided in this article.

6428. Any owner who fails to pay any annual fee or any part of any annual fee required to be paid pursuant to Section 6307 within the time required shall pay a penalty of 10 percent of the annual fee or part of the annual fee, plus interest at the rate of one-half of 1 percent per month, or fraction thereof, from the date on which the annual fee or the part of the annual fee became due and payable to the state until the date of payment.

CASE 3: NORTH CAROLINA

Appendix D - Penalties for Violations

(North Carolina 1994)

143-215.36. Enforcement procedures.

(a) Criminal Penalties.

Any person who shall be adjudged to have violated this Article shall be guilty of a Class 3 misdemeanor and shall only be liable to a penalty of not less than one hundred dollars (\$100.00) nor more than one thousand dollars (\$1,000) for each violation. In addition, if any person is adjudged to have committed such violation willfully, the court may determine that each day during which such violation continued constitutes a separate violation subject to the foregoing penalty.

(b) Civil Penalties.

(1) The Secretary may assess a civil penalty of not less than one hundred dollars (\$100.00) nor more than five hundred dollars (\$500.00) against any person who violates any provisions of this Part, a rule implementing this Part, or an order issued under this Part.

(2) If any action or failure to act for which a penalty may be assessed under this Part is willful, the Secretary may assess a penalty not to exceed five hundred dollars (\$500.00) per day for each day of violation.

(3) In determining the amount of the penalty, the Secretary shall consider the factors set out in G.S. 143B-282.1(b). The procedures set out in G.S. 143B-282.1 shall apply to civil penalty assessments that are presented to the Commission for final agency decision.

(4) The Secretary shall notify any person assessed a civil penalty of the assessment and the specific reasons therefor by registered or certified mail, or by any means authorized by G.S. 1A-1, Rule 4. Contested case petitions shall be filed in accordance with G.S. 150B-23 within 30 days of receipt of the notice of assessment.

(5) Requests for remission of civil penalties shall be filed with the Secretary. Remission requests shall not be considered unless made within 30 days of receipt of the notice of assessment. Remission requests must be accompanied by a waiver of the right to a contested case hearing pursuant to Chapter 150B and a stipulation of the facts on which the assessment was based. Consistent with the limitations in G.S. 143B-282.1(c) and G.S. 143-282.1(d), remission requests may be resolved by the Secretary and the violator. If the Secretary and the violator are unable to resolve the request, the Secretary shall deliver remission requests and his recommended action to the Committee on Civil Penalty Remissions of the Environmental Management Commission appointed pursuant to G.S. 143B-282.1(c).

(6) If any civil penalty has not been paid within 30 days after

Appendix D - Penalties for Violations

notice of assessment has been served on the violator, the Secretary shall request the Attorney General to institute a civil action in the Superior Court of any county in which the violator resides or has his or its principal place of business to recover the amount of the assessment, unless the violator contests the assessment as provided in subdivision (4) of this subsection. If any civil penalty has not been paid within 30 days after the final agency decision or court order has been served on the violator, the Secretary shall request the Attorney General to institute a civil action in the Superior Court of any county in which the violator resides or has his or its principal place of business to recover the amount of the assessment. A civil action shall be filed within three years of the date the final agency decision was served on the violator.

(7) The Secretary may delegate his powers and duties under this section to the Director of the Division of Land Resources of the Department.

(c) Injunctive Relief. - Upon violation of any of the provisions of this Part, a rule implementing this Part, or an order issued under this Part, the Secretary may, either before or after the institution of proceedings for the collection of the penalty imposed by this Part for such violations, request the Attorney General to institute a civil action in the superior court of the county or counties where the violation occurred in the name of the State upon the relation of the Department for injunctive relief to restrain the violation or require corrective action, and for such other or further relief in the premises as said court shall deem proper. Neither the institution of the action nor any of the proceedings thereon shall relieve any party to such proceedings from the penalty prescribed by this Part for any violation of the same. (1967, c. 1068, s. 14; 1973, c. 1262, s. 23; 1975, c. 842, s. 3; 1977, c. 771, s. 4; 1987, c. 827, ss. 154, 180; 1989 (Reg. Sess., 1990), c. 1036, s. 5; 1991, c. 342, ss. 10, 11; 1993, c. 394, s. 9; c. 539, s. 1021; 1994, Ex. Sess., c. 24, s. 14(c).)

APPENDIX E - SAMPLE EMERGENCY ACTION PLAN

GUIDELINES FOR DEVELOPING
AN
EMERGENCY ACTION PLAN

MAY 1996

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Appendix E - Sample Emergency Plan

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Attachment A - Standardized Format and Text for an Emergency Action Plan

Attachment B - Sample - Emergency Operations Center Location Map

Attachment C - Sample - Surveillance Checklist

Attachment D - Sample - Inundation Mapping

Attachment E - Guidelines for Dam Breach Analyses

Introduction

The FEMA publication *ICODS Guidelines for Developing an Emergency Action Plan (EAP)* was developed to assist dam owners in the preparation of an EAP. It is the responsibility of each dam owner to develop an EAP tailored to his or her respective dam.

In an effort to further assist the owners of smaller dams, a standardized EAP format and text (Attachment A - "Standardized Format and Text for an EAP") is provided. Please keep in mind, however, that since an EAP is useful only if it accurately reflects site conditions, some modifications to the standardized text may be required. Accordingly, the standardized format should be used with care. Authorization to use the standardized EAP format and text will be provided on a case-by-case basis. For larger dams, the standardized format may not be applicable since there are often additional requirements and considerations which need to be addressed. For clarity, the requirements that pertain only to the larger dams have been written in bolded italics.

Instructions

The "Standardized Format and Text for an EAP" (Attachment A) has been divided into eight (8) sections with the cover page and emergency notification section. The following is a text outline with instructions:

Cover Page. The Cover Page of the EAP must include the name of the dam, the State ID Number, the name and address of the owner/operator, the name and address of the person/entity preparing the document, the date the document was prepared along with any revision dates. Since each dam must have its own EAP with its own specific procedures to be followed, title pages or cover sheets are essential so personnel can be sure they are using the correct EAP for the circumstances.

Table of Contents. The Table of Contents should outline the information contained in the EAP.

I. Emergency Notification

Emergency Notification Flowchart. The emergency notification flowchart should include individual names, offices, and 24-hour telephone numbers. The number of persons to be notified by each individual on the notification flowchart should be governed by what other responsibilities the person has been assigned. It is recommended that no individual be responsible for contacting more than three or four other parties.

The notification list should contain the following:

- Dam owner.
- Local emergency management officials and related organizations.
- Appropriate state emergency management agencies.
- State Dam Safety Agency
- Residents and property owners that are located immediately downstream of the dam within the boundary of potential inundation where available warning time is limited.
- Operators of other dams or water-retention facilities which may affect or be affected by an emergency.

Appendix E - Sample Emergency Plan

- Managers and operators of recreational facilities
- National Weather Service (NWS)
- News Media
- Others, as appropriate.

Although the list may not be all inclusive or represent a prioritization of those entities listed, the preparer of the EAP should understand that the dam owner and emergency management authorities are typically given top priority.

The Emergency Notification Flowchart should be easy to follow for each emergency condition level (see Section IV). Although one flowchart that represents all levels is preferred, for clarity, it may be necessary to develop a flowchart for each condition level. Narrative information supplementing the flowchart may be provided on the page following the flowchart. Copies of the flowchart should be readily available to each individual having responsibilities under the plan and should be kept up-to-date through exercises and revisions.

For large dams, separate notification flowcharts should be provided for each emergency condition. Not all entities may need to be notified for a dam advisory or warning condition.

Emergency Notification Information. Following the Emergency Notification Flowchart is a Notification Information form which should be utilized if an emergency condition is identified. This form is intended to aid the person reporting the emergency condition in relating all pertinent information.

II. Statement of Purpose

Outline the **Purpose and Scope** under which the EAP is being prepared.

III. Project Description

Project Site Description. Provide a description of the project and its location. Include a project vicinity map and a drawing showing project features. List any significant upstream or downstream dams. List downstream communities which would potentially be affected by a dam failure or by flooding resulting from abnormal operational releases.

IV. Emergency Detection, Evaluation, and Classification

The EAP document should include a discussion of procedures for timely and reliable detection, evaluation, and classification of an existing or potential emergency condition.

The conditions, events or measures for detection of an existing or potential emergency should be listed. Procedures, aids, instruction, and provisions for evaluation of information and data to assess the severity and magnitude of any existing or potential emergency should be discussed.

Emergencies are classified according to their severity and urgency. An emergency classification system is one method to classify emergency events according to the different times at which they occur and to their varying levels of severity. The classification system indicates the urgency of the emergency condition.

Titles for emergency classifications have been chosen carefully so that everyone will understand what each classification level means when notifications are issued and received. The following four (4) emergency classifications are provided: Advisory Condition, Warning Condition, Emergency Condition, and Breach Condition. ***In addition, for Large Dams, an additional classification, Non-Failure Emergency Condition, is provided.***

Dam Advisory Condition is a situation where an unusual problem or situation has occurred, but a failure of the dam is not imminent. All appropriate parties should be notified periodically with regard to status and should be on stand-by for emergency actions should conditions deteriorate.

Dam Warning Condition is a situation or circumstance which may affect the integrity of the dam but is considered controllable. This condition may lead to a failure of the dam. All appropriate parties should be notified periodically with regard to status and should be on stand-by for emergency actions should conditions deteriorate.

Dam Emergency Condition is a situation where the dam is being overtopped or rapid deterioration is occurring. A failure may eventually occur; however, pre-planned actions taken during certain events (major floods, earthquakes, evidence of piping, etc.) may moderate or alleviate failure. Even if failure is inevitable, more time is generally available than in a Dam Breach Condition to issue warnings and/or take preparedness actions. All appropriate parties should be notified to commence their emergency operations and evacuation (if necessary).

Dam Breach Condition is a situation where the dam is failing. Dam failure is imminent and there is no longer any time available to attempt corrective measures. All appropriate parties should be notified to commence emergency operations and evacuation.

Dam Non-failure Emergency Condition applies to Large Dams and is a situation in which there may be no apparent threat to the integrity of the dam; however, an unusually large release at the dam, due to a gate malfunctioning or other unforeseen event, could cause downstream flooding. All appropriate parties should be notified to commence their emergency operation and evacuation (if necessary).

V. General Responsibilities Under the EAP

Dam Owner/Operator Responsibilities. The duties of the dam owner or owner's designated representatives under the EAP should be clearly described. The operator should be advised of the importance of the EAP and why the EAP is necessary. The operator's duties under the EAP should be described in detail. Specific actions that the operator is to take after implementing the EAP notification procedures should be described. Instructions for the operation of the dam during the anticipated emergency should be provided. The person responsible for notification and for periodic updates should be identified.

Responsibility for Notification. The person(s) authorized to notify local officials should be clearly identified in the EAP. If time allows in an emergency situation, onsite personnel should seek advice and assistance. However, under certain circumstances, such as when failure is imminent or has occurred, the responsibility and authority for notification may have to be delegated to the dam operator or a local official. Such situations should be specified in the EAP. The person who is responsible for disseminating information to the media and the public on a periodic basis throughout the emergency should be

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designated. Also, a means to keep local authorities advised of developing conditions at the dam should be described.

EAP Coordinator Responsibilities. The dam owner should specify in the EAP the designated EAP coordinator who is responsible for EAP related activities, including (but not limited to) the preparation of required revisions to the EAP, the establishment of training seminars, the coordination of EAP exercises, etc. This person would be the EAP contact if any involved parties have questions concerning the EAP.

Responsibility for Evacuation. Warning and evacuation planning are the responsibilities of local authorities who have the statutory obligation. Under the EAP, the dam owner is responsible for notifying the appropriate emergency management officials when flooding is anticipated or a failure is imminent or has occurred. Dam owners should not assume the responsibility of government entities for evacuation. However, there may be situations in which routine notification and evacuation will not suffice, as in the case of a resident located just below the dam. In this case, the dam owner should arrange to notify that person directly. This procedure should be coordinated with the appropriate public officials prior to the development of an emergency situation.

Responsibility for Termination and Recovery. An owner's representative should be designated for monitoring the situation at the dam and keeping local authorities informed of developing conditions from the time an emergency starts until the emergency has been terminated. This person, in coordination with the State Dam Safety Agency, should be responsible for declaring that the emergency at the dam is terminated. The applicable state or local emergency management officials are responsible for termination of the disaster response activities. A follow-up evaluation after an emergency by all participants should be specified. The results of the evaluation must be documented in a written report by the dam owner. Provisions for security measures at the dam during the emergency should be specified.

VI. Preparedness

Preparedness actions are taken to help reduce or eliminate the effects of a dam failure or abnormal operational releases and to facilitate response to emergencies. A few of the preparedness actions that a dam owner may take include providing emergency flood operating instructions and arranging for equipment, labor, and materials for use in emergency situations.

The EAP should describe preparedness actions taken both prior to and following the onset of emergency conditions. Preparedness actions involve the installation of equipment or the establishment of procedures for one or more of the following purposes:

- Preventing emergency conditions from developing or warning of the onset of emergency situations.
- Facilitating the operation of the dam in an emergency situation.
- Minimizing the extent of damage resulting from any emergency situations that do develop.

The need for timely action in an emergency situation cannot be overemphasized. The EAP should contain a discussion of provisions for surveillance and evaluation of an emergency situation and should clearly indicate that emergency response procedures can be implemented in a timely manner. An important factor in the effectiveness of the EAP is the prompt detection and evaluation of information obtained from instrumentation and/or physical inspection procedures.

There are several types of preparedness actions that should be considered when developing an EAP. These actions include:

- Surveillance.
- Response during various times such as darkness, weekends, holidays and inclement weather.
- Access to the site.
- Alternative systems of communication.
- Emergency supplies and information.
- Preplanned location of the Emergency Operations Center

Surveillance. The EAP should contain a provision for surveillance, detection and evaluation of an emergency situation. When a dam is not continuously attended and dam failure or abnormal operational releases would endanger human life or cause significant property damage, it is imperative that procedures be developed to identify conditions requiring emergency action and to promptly alert emergency management officials responsible for warning and evacuation. In order to be able to promptly notify responsible officials of emergency conditions, a dam owner must be able to detect and evaluate developing emergency conditions. Regular inspection intervals should be specified along with persons responsible for the inspection. Special attention should be given to actual or forecast periods of flooding.

Response During Adverse Weather, Weekends, Darkness, and Holidays. A discussion of emergency response during periods other than office hours should be included in the EAP. Actions should be described in detail. The effects on response time should also be included.

Access to the Site. A discussion of the primary and secondary access routes should be included in the EAP. Also describe the means for reaching the site under various conditions.

Alternative Systems of Communication. Alternative channels of communication to be used in case of failure of the primary system or failure of other systems immediately available should be listed.

Emergency Supplies and Information. There are certain planning and organizational measures that can help the dam owner and local officials manage an emergency situation more safely and effectively. These measures include stockpiling materials and equipment for emergency use and the dissemination of relevant information. Also, alternative sources of power for spillway gate operation and other emergency uses should be provided.

Dam Emergency Operations Center (DEOC). The DEOC is the location where personnel will report for instructions and updates during an emergency. The location and directions to the owner's DEOC from the nearest State or County highway should be provided. The DEOC should be located upstream of the dam away from any potential inundation area. A sample DEOC location map is enclosed as Attachment B.

Other Site Specific Actions. Describe any other site-specific actions devised to moderate or alleviate the extent of potential emergencies.

VII. Inundation Maps

Inundation maps should be developed by the dam owner in coordination with the appropriate State and local emergency management agencies. Since those agencies will rely heavily on the

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inundation maps during an emergency, it is important that they contain information required by those agencies. Inundation mapping criteria required for dams:

- The inundation map should be developed at a scale sufficient to be used for identifying downstream inhabited areas subject to possible danger. Potential inundation areas should be clearly identified. It may be appropriate to supplement the inundation maps with water surface profiles showing the elevation prior to failure, the peak water surface elevation after failure, and the elevation of structures at critical locations. Inundation maps should be a foldout preferably no larger than 11"x 17" in size.
- County and Municipal boundaries should be indicated.

Inundation areas should be clearly marked for sunny day failure, design storm, and design storm with failure. The following should be reflected on the map (or on an accompanying data chart) at each municipal boundary line:

- Distance downstream from the dam to the nearest tenth of a mile.
- Time of arrival of the first flood waters at that point. The time should be reflected in hours and minutes.
- Time of arrival of the peak flood level at that point. The time should be reflected in hours and minutes.
- Depth of water measured from bottom of stream bed to the maximum inundation elevation along with the corresponding flow rate.

A sample inundation mapping is enclosed as Attachment D.

A dam breach analysis performed by a licensed professional engineer using methods approved by the State Dam Safety Agency will be required to identify potential inundation areas. Prior to proceeding with the dam breach analyses and inundation mapping, the owner/operator's engineer should contact the State Dam Safety Agency. Guidance for performing a breach analysis is enclosed as Attachment E.

A narrative description of the areas affected by the dam break may be included to clarify unusual conditions. The narrative should describe the specific area threatened and include information on the extent of expected flooding relating it to known landmarks and historical flood heights. Whenever possible, major streets, railroads, and other well known features should be indicated.

The map lines delineating the potential inundation areas should be drawn in such thickness or form (solid line, dashed line, dotted line) to identify the inundation limits as the main feature of the map but not obliterate the location of houses or features which are to be shown as being inundated. Clarity is important. When plotting inundation limits between cross sections used for analysis, the lines should reasonably reflect the change in water levels with consideration given to topographic patterns and both natural and man made features. When inundation lines enter the area of an existing lake or reservoir, they should be drawn to represent an increase in the water level of the lake or reservoir. should this increased water level overtop the downstream dam, the appropriate inundation lines should be drawn below this dam in order to represent expected inundation to the point where an increase in water level will no longer represent danger to life or property. The area between the inundation lines representing the water level may be shaded to distinguish the area of inundation. Care should be taken to select a shading which will not obliterate the background information shown on the map.

The accuracy and limitation of the information supplied on the inundation maps and how best to use the

maps should be described. Since local officials are likely to use the maps for evacuation purposes, a note should be included on the map to advise that, because of the method, procedures, and assumptions used to develop the flooded areas, the limits of flooding shown and flood wave travel times are approximate and should be used only as a guideline for establishing evacuation zones. Actual areas inundated will depend on actual failure or flooding conditions and may differ from areas shown on the maps. The owner should review the inundation maps with the local jurisdictions and resolve any problems.

If inundation maps are to be shown on several pages, a map index should be included to orient the individual pages.

Inundation maps should be updated periodically to reflect changes in downstream areas and should include any pertinent information resulting from coordination with appropriate emergency management authorities.

In some instances, the cost of developing an inundation map may not be justified. The State Dam Safety Agency should be consulted if this is thought to be the case.

VIII. Appendices

Following the main body of the EAP, an appendix section should be included that contains information that supports and supplements the basic EAP.

Appendix E-1

Investigations and Analysis of Dam Break Floods

Several factors usually have to be evaluated whenever dam failures are postulated. The type of dam and the mechanism which could cause failure require careful consideration if a realistic breach is to be assumed. Size and shape of the breach, time of breach formation, hydraulic head, and storage in the reservoir contribute to the dam failure hydrograph. Most of the methods for estimating dam break hydrographs require the choice of size, shape, and time of dam breach. There are also several available procedures for routing dam failure hydrographs to determine information on area inundated by the flood as it travels downstream.

Several different assumptions on inflow conditions should be made regarding the appropriate conditions prevailing at the time of a dam failure in order to ensure that the EAP includes all communities that need to be notified. A "fair weather" dam failure is generally considered to have the most potential for loss of human life, primarily due to the element of surprise. A failure at the inflow design flood is considered to show the upper limit of inundation.

Dam break analysis printouts should be included in this section.

Appendix E-2

Plans for Training, Exercising, Updating and Posting

Training - Training of personnel involved in implementation of the EAP should be conducted to ensure that they are thoroughly familiar with all elements of the plan, the availability of equipment,

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and their responsibilities and duties under the plan. Technically qualified personnel should be trained in problem detection and evaluation and appropriate remedial (emergency and non-emergency) measures. This training is essential for proper evaluation of developing situations at all levels of responsibility which, initially, is usually based upon onsite observations. A sufficient number of people should be trained to ensure adequate coverage at all times. A training plan should be included in the appendix to the EAP. Cross-training in more than one responsible position for each individual is advisable in order to provide alternates. A careful record should be kept of training completed and refresher training conducted.

Exercising - Exercises simulating emergency conditions are excellent mechanisms for ensuring readiness. Prepare scenarios for the various emergency conditions and test the state of training and readiness of key personnel responsible for actions during an emergency to guarantee an understanding of the procedures to be followed and actions required. Any special procedures required for nights, weekends, and holidays should be included. The exercises should involve an annual drill and periodic comprehensive (tabletop, functional, or full-scale) exercises. Testing of remote sensing equipment at unattended dams should be included. Coordination and consultation with state and local emergency management officials and other organizations when developing a comprehensive EAP exercise program is important in order to enhance realism. Their early involvement will help in developing the close coordination necessary for a successful execution of emergency procedures during an actual emergency. The exercises should include participation by both the dam owner and the affected state and local emergency management officials. The exercises should be discussed, evaluated and the findings and conclusions recorded. The EAP should be revised to correct any deficiencies noted.

The exercises range from simple to complex and from low to high realism. The four standard types of exercises include Drill, Tabletop, Functional, and Full Scale. The following is a brief discussion of each:

Drill - A Drill is the lowest level exercise that involves an actual test and has the following components and characteristics:

- Tests, develops, or maintains skill in a single response procedure.
- Usually is an in-house test.
- Is part of on-going training.

Tabletop - A Tabletop exercise has the following components and characteristics:

- Higher level exercise than a drill.
- Involves various levels of personnel.
- Is held in an informal conference room environment.
- Low stress, no time constraints.
- Actions are taken and discussion is based on a described emergency situation, plus a series of messages to participants.
- Provides an opportunity to discuss the EAP and response procedures, and to resolve questions throughout the exercise.
- Allows for the practice of problem-solving for emergency situations.
- Participants practice a coordinated, effective response.

Functional - A Functional exercise has the following components and characteristics:

- Involves various levels of personnel without full activation of field personnel.
- Simulates emergency operations center environment.
- Stressful, with time constraints.
- Simulates dam failure and response.
- Participants "act out" their roles.
- Tests both dam owner and agency responses, including coordination.

Full Scale - A Full Scale exercise has the following components and characteristics:

- Interactive, stressful, with time constraints.
- Actual mobilization of personnel and resources.
- Adds a field component that interacts with a functional exercise through simulated messages.
- Tests deployment capabilities.

Updating - A regular review of the adequacy of the EAP should be conducted at intervals not to exceed one year. The review should include the flood inundation area, downstream development, the reservoir, and the EAP text. The review should determine whether any revisions to the current EAP are necessary. If, as a result of the annual review, no revisions are necessary, a written statement to this effect should be provided to each recipient of the original EAP. The EAP should be updated promptly when changes are required. EAP personnel or telephone number changes should be recorded as they occur.

Posting of the Notification Flowchart - An up-to-date copy of the Notification Flowchart should be posted in prominent locations at the dam site and local emergency operation centers (essential for unattended dams). The flowchart should be posted at each phone and radio transmitter at the dam, powerhouse (if applicable), and at all other desirable locations. The locations of the posted flowcharts should be indicated in the EAP.

Appendix E-3

Definitions

Definitions section for those people not familiar with the terms used in the EAP.

Appendix E-4

Site Specific Considerations

This section of the appendix should provide a discussion of any site specific concerns that provide valuable information affecting the EAP.

Appendix E-5

Approval and Distribution of the EAP

Once the EAP has been developed, the owner/operator shall submit the completed EAP with inundation mapping and dam breach analyses to the State Dam Safety Agency for review and

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approval. Once the State Dam Safety Agency approves the EAP, the EAP must be distributed by the owner to all individuals who will be involved during an emergency. Any revisions to the EAP should be furnished to all individuals to whom the original EAP was distributed. Each party receiving an EAP must sign and return a receipt to the distributor (owner/operator) of the EAP. The signed receipt should help to assure that all parties are aware of and understand the EAP and agree to their assigned roles should an emergency occur. A standard distribution letter and receipt are included for reference in the standardized format.

Attachment A

STANDARDIZED FORMAT AND TEXT

FOR AN

EMERGENCY ACTION PLAN

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EMERGENCY ACTION PLAN

for

_____ Dam

State ID Number _____

National ID Number _____

Owner/Operator: _____

Address: _____

Prepared By: _____

Address: _____

Date: _____

Revision Dates:*

1st Revision: _____

2nd Revision: _____

3rd Revision: _____

* THE DAM OWNER/OPERATOR IS RESPONSIBLE FOR THE ANNUAL REVIEW AND UPDATING OF THE EAP.

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Attachment B

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EMERGENCY NOTIFICATION FLOWCHART

Example to be supplied by State Dam Safety Agency

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I. Emergency Notification

Emergency Notification Information

Dam emergency information for the four emergency conditions

Name of person reporting the emergency: _____

Affiliation: _____

Phone Number: _____

Name & State ID number of dam: _____

Location of dam

County: _____

Municipality: _____

Stream: _____

Road(s): _____

Time and date of dam emergency: _____

Type of Emergency: _____

Phone appropriate parties: *(refer to the Emergency Notifications Flow Chart, page X)*

"This is (your name, title & affiliation).

There is a Dam (Advisory, Warning, Emergency, or Breach) condition at (name of dam).

Observation was at (time).

The situation is (explain the condition).

What is your anticipated time of arrival at the dam and what are my instructions?"

(refer to Site Description, page X, for directions to the dam)

Communication priority list:

1. Municipal Office of Emergency Management
2. County Office of Emergency Management
3. State Office of Emergency Management
4. State Dam Safety Agency
5. Owner's Engineer

II. Statement of Purpose

Purpose

To establish procedures necessary to protect life and property in areas affected by the failure of a dam or the uncontrolled release of stored water.

Scope

This Emergency Action Plan:

1. Establishes a monitoring system which can activate the Plan.
2. Identifies the officials, organizations, agencies, and their respective responsibilities for implementing the plan.
3. Identifies those areas, residences, facilities and roads which might be affected by a dam failure.

III. Project Description

Project Site Description

Dam Name: _____ Hazard Potential Classification: _____

ID No: _____

City/Town: _____ County: _____

Location & Access (provide a location map & directions to the dam from a major highway):

Latitude: _____ Longitude: _____

River/Stream: _____

Quad Sheet: _____ Nearest City/Town: _____

Height (ft): _____ Normal Surface (ac): _____

Length (ft): _____ Normal Capacity (ac-ft): _____

Dam Type: _____ Maximum Capacity (ac-ft): _____

Spillway: _____ Spillway Capacity (cfs): _____

Drainage Area: _____

Outlet Other Than Spillway: _____

Instrumentation (if any): _____

Significant Upstream or Downstream Dams (if any): _____

Overview of Inundation Area _____

Method of Emergency Drawdown: _____

*PROVIDE/ATTACH PROJECT SITE DRAWINGS.

IV. Emergency Detection, Evaluation, and Classification

Emergency Condition Identification

Since the goal of dam emergency planning is to protect lives and property, the timely identification of emergency conditions by trained personnel is paramount. Four (4) dam emergency conditions of varying severity have been identified and are described below.

Dam Advisory Condition A Dam Advisory Condition is a situation where an unusual problem or situation has occurred, but a failure of the dam is not imminent. Examples of a Dam Advisory Condition are:

- Instrumentation readings reach predetermined numerical limits.
- Any undocumented or unusual spring.
- Any sign of piping.
- Any sign of slumping.
- Any sinkhole.
- Any unusual crack.
- Any unusual wet spot or boggy area.
- Any seismic event regardless of severity.
- Any obstruction in the spillway.
- Evidence of damage due to vandalism at any structure(s).
- Bomb threat.
- A civil disorder near the reservoir structure(s).
- Any aircraft accident near the reservoir structure(s).

Required responses are: *(refer to Emergency Notification Flow Chart, page X)*

- Notify Municipal Office of Emergency Management.
- Notify County Office of Emergency Management.
- Notify State Office of Emergency Management.
- Notify State Dam Safety Agency.
- Investigation.
- Assessment and response.

Dam Warning Condition

A Dam Warning Condition is any developing or occurring event or circumstance which may adversely affect the integrity of the dam but is considered controllable. The Dam Warning Condition has the potential of evolving into a Dam Emergency or a Dam Breach condition. Examples of a Dam Warning Condition are:

- Water level of the lake is at an unsafe level and is threatening to overtop the dam.
- Any developing erosion, settlement or upheaval occurring on the downstream slope or at the toe of the dam and is considered to be controllable.
- Any undocumented leakage through any dam structure considered to be controllable.

Required responses are: *(refer to Emergency Notification Flow Chart, page X)*

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- Notify Municipal Office of Emergency Management.
- Notify County Office of Emergency Management.
- Notify State Office of Emergency Management.
- Notify State Dam Safety Agency.
- Investigation.
- Assessment and response.

Dam Emergency Condition

A Dam Emergency Condition is defined as one or more of the following situations:

- Water has overtopped or will overtop any dam or dike.
- Any uncontrollable erosion, settlement or upheaval occurring on the downstream slope or at the toe of the dam.
- Any uncontrollable leakage through any dam structure.

Required responses are: *(refer to Emergency Notification Flow Chart, page X)*

- Notify Municipal Office of Emergency Management.
- Notify County Office of Emergency Management.
- Notify State Office of Emergency Management.
- Notify State Dam Safety Agency.
- Commence emergency actions.
- Issue public warning and begin evacuation.

Dam Breach Condition A Dam Breach Condition is defined as:

- A dislocation or failure of any structure which allows for an expanding, uncontrollable discharge of water through the spillway, dam or dikes indicating a breach is occurring.

Required responses are: *(refer to Emergency Notification Flow Chart, page X)*

- Notify Municipal Office of Emergency Management.
- Notify County Office of Emergency Management.
- Notify State Office of Emergency Management.
- Notify State Dam Safety Agency.
- Commence emergency actions.
- Issue public warning and begin evacuation.

V. General Responsibilities Under the EAP

Dam Owner/Operator Responsibilities:

During an emergency condition:

1. Identification of the emergency condition.
2. Notification of the Office of Emergency Management (OEM) and State Dam Safety Agency (DSA).
(refer to the Emergency Notification Flow Chart on page X)

Person responsible for the notification: _____

3. Implementation and direction of emergency repairs.
4. Update the emergency status to the OEM and State Dam Safety Agency.

Person responsible for the updates: _____

5. Provisions for security measures at the dam.
6. Provision of technical assistance to OEM officials, when necessary.
7. Reporting termination of emergency situation on-site at the dam.

In non-emergency conditions, owner/operator must also provide for:

8. Routine maintenance and operations of the dam.
9. Routine surveillance of the dam.
10. Routine inspection of the dam.
11. Annual review, updating, and distribution of the EAP.

Owner/Operator's EAP Coordinator Responsibility

Once the dam owner/operator has designated an EAP Coordinator, that person shall be responsible for EAP related activities including:

1. Inclusion and distribution of document revisions.
2. Establish training seminars.
3. Coordinate EAP exercises.
4. Contact person for any EAP related inquiries.

EAP Coordinator Name: _____

Phone Number: _____

Municipal Office of Emergency Management Responsibilities:

1. Warn the public of emergency conditions at the dam.

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2. Implement and direct required evacuations of threatened areas.
3. Establish reception centers for evacuated people.
4. Secure and control access to evacuated areas.
5. Conduct rescue and recovery operations as required.
6. Determination and declaration of termination of an emergency/disaster response activities off-site.

County Office of Emergency Management Responsibilities:

1. Pass warning of emergency conditions at the dam to all affected municipalities.
2. Provide assistance to municipalities to help fulfill the emergency responsibilities.

State Office of Emergency Management (OEM) Responsibilities:

1. Assumption of control and coordination (when appropriate) of all emergency actions in accordance with Public Law.
2. Provision of assistance to the affected municipalities and counties (when requested and beyond their capabilities).
3. Coordination of specialized assistance.
4. Notification of appropriate State agencies.
5. Notification of appropriate counties of any declared emergency condition.
6. Periodic testing of the emergency notification procedures

State Dam Safety Agency (DSA) Responsibilities:

1. Provide technical assistance to the dam owner/operator.
2. Assist in the evaluation and resolution of potential emergency conditions.
3. Has the authority to direct the owner/operator to take necessary safety measures.

Termination

The owner/operator is responsible for evaluating a declared emergency condition. The State DSA is responsible for making the decision, when appropriate, that an emergency condition no longer exists on-site at the Dam. The Office of Emergency Management (OEM) representatives are responsible for declaring termination of an emergency condition off-site. As such, it will be the responsibility of the owner/operator to notify the OEMs of an emergency condition termination promptly.

As part of the termination phase, the County/Municipal OEM will be responsible to conduct a critique of the overall emergency response and to prepare a report documenting emergency procedures and actions. The critique process will be a discussion of the events that occurred prior to, during, and after a dam emergency. Participants review and evaluate their particular actions. The purpose of the critique is to determine what, if any, practicable improvements could be made for potential future emergencies, and conversely to identify deficiencies in procedures, manpower, materials and equipment.

Recovery

The basic goal of the recovery phase is to demobilize and return to the pre-emergency situation. The owner/operator is responsible for implementing all actions necessary to achieve this goal on-site at the dam. The Office of Emergency Management (EMM) has the responsibility to effectuate recovery off-site in the affected communities.

The Owner/Operator is responsible for directing all on-site recovery activities. The basic recovery actions common to the four dam emergency conditions are:

- Secure access to emergency site,
- Restore basic facilities and services, and
- Assess damage.

An additional activity that could be part of a high level dam emergency with associated physical actions would be a disaster declaration. Official disaster declarations would be made by designated local and state agencies, not by the owner of the dam.

VI. Preparedness

Emergency Notification Directory

1. Dam Owner: _____

Contact Person: _____

Address: _____

Phone No: _____ 24-Hr No: _____

2. Dam Operator:

Address: _____

Phone No: _____ 24-Hr No: _____

3. EAP Development Crew: _____

Coordinator: _____

Phone No: _____

4. Maintenance and Operations Crew: _____

Supervisor: _____

Phone No: _____

5. Inspectors:

Name: _____ Phone No: _____

Name: _____ Phone No: _____

Name: _____ Phone No: _____

6. Owner's Engineers: _____

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Contact Person: _____

Address: _____

Phone No: _____ 24-Hr No: _____

7. Municipalities:

Municipality _____ Phone No: _____ Police No: _____

Municipality _____ Phone No: _____ Police No: _____

8. Counties:

County _____ Phone No: _____ Police No: _____

County _____ Phone No: _____ Police No: _____

9. State Agencies:

Agency _____ Phone No: _____ 24 Hr No: _____

Agency _____ Phone No: _____ 24 Hr No: _____

Dam Emergency Operation Center (DEOC)

DEOC should be located upstream of the dam

Address: _____

Direction to the Dam Emergency Operations Center from the nearest State or County highway:

*Include a location map of the Dam Emergency Operations Center.

Dam EOC Location Map

Refer to Attachment B for a sample EOC location map.

Surveillance Checklist

The surveillance checklist must be specific to the site conditions of the dam and must be prepared in cooperation with the State Dam Safety Agency.

The surveillance checklist should be utilized by the Inspectors listed on the Emergency Notification Directory during their inspections. A record of these inspections and their findings should be kept by the owner/operator for ready reference.

Regular inspection intervals should be specified and individuals responsible for the inspection identified.

Refer to Attachment C for a sample surveillance checklist.

Access to the Site

A narrative description of primary and secondary access routes should be included. Attach map if necessary.

Response During Adverse Weather, Weekends, Darkness, and Holidays.

Supply a discussion of emergency response during periods other than office hours and during periods of adverse weather. Actions should be described in detail. The effects on response time should also be included.

Alternative Systems of Communications

Alternative channels of communication to be used in case of failure of the primary system or failure of other systems immediately available should be listed.

List of Contractors

It will be the responsibility of the owner to maintain a current list of contractors that may be contacted during an emergency condition for equipment, materials, and repairs.

For each contractor on the list, the following must be provided:

- Contractor name.
- Contact person.
- Address.
- Phone number.
- Scope of its contracted services.

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1. Contractor:

Contact person: _____ Phone No: _____

Address: _____

Services contracted for: _____

2. Contractor:

Contact person: _____ Phone No: _____

Address: _____

Services contracted for: _____

3. Contractor:

Contact person: _____ Phone No: _____

Address: _____

Services contracted for: _____

Available On-Site Materials

Material	Location	Quantity
-----------------	-----------------	-----------------

Available On-Site Equipment

Equipment	Location	Quantity
------------------	-----------------	-----------------

Available Off-Site Materials

Material	Company & Location	Phone No	Arrival Time To Dam (Min)
-----------------	-------------------------------	-----------------	--------------------------------------

Available Off-Site Equipments

Equipment	Company & Location	Phone No	Arrival Time To Dam (Min)
------------------	-------------------------------	-----------------	--------------------------------------

Other Site Specific Actions

Describe any other site-specific actions devised to moderate or alleviate the extent of potential emergencies.

VII. Inundation Maps

Description of Inundated Area

Index of Maps List attached maps by name and number:

This section will contain a detailed map of inundated areas, including dwellings if applicable, and the precise location of the dam.

The official inundation map attached to the EAP should be, whenever possible, in fold-out format, no larger than 11 inches by 17 inches, and provide the most accurate, up-to-date data available. As such, it may be necessary to reduce the map scale once the inundated areas are identified.

Refer to-

- *Attachment D for a sample inundation map; and*
- *Attachment E for guidance in performing the dam breach analysis.*

VIII. Appendices

Appendix E-1. Investigations and Analysis of Dam Break Floods

Input data, printouts, and survey information from the dam failure analysis should be included in this section.

Appendix E-2. Plans for Training, Exercising, Updating, & Posting

The owner of the dam is responsible for the training of personnel, and the exercising and updating of the EAP.

Training

The owner of the dam is responsible for the training of all personnel involved in the implementation of the EAP. Training of personnel involved in implementation of the EAP is to ensure that they are thoroughly familiar with all elements of the plan, the availability of material and equipment, and their responsibilities and duties under the EAP.

Technically qualified personnel should be trained in problem detection and evaluation and appropriate remedial (emergency and non-emergency) measures. This training is essential for proper evaluation of developing situations at all levels of responsibility which, initially, is usually based on on-site observations. A sufficient number of personnel should be trained to ensure adequate coverage at all times.

Training courses should be held within two (2) months of the implementation of the EAP. Follow-up training sessions should be held annually. The following should be part of the training:

1. For Normal Operations:

- Instruction on the location, purpose, and operations of the dam structure components.
- Demonstration of normal dam conditions and operations.
- Instruction on visual inspection procedures for the weekly/monthly inspections.
- Hands-on training of communications equipment.

2. For Emergency Condition Identification:

- Review of Emergency Action Plan.
- Instruction on visually detecting an emergency warning sign.
- Review of the conditions which would indicate an emergency including proper identification of the type of emergency.
- Instruction on interpreting the surveillance checklists to detect an emergency situation.

3. For Emergency Communications:

- Instruction on proper use of communications equipment.
- Instruction on appropriate individuals to contact, as well as the time to call them and the order in which calls should be made.
- Instruction on appropriate message to convey.

Appendix E - Sample Emergency Plan

4. For Emergency Response Actions:

- Instruction on the role of each worker in response actions.
- Instruction on dam emergency response actions to be taken for each type of emergency situation.

Appendix E-2. Plans for Training, Exercising, Updating, & Posting

- Instruction on obtaining and utilizing on and off-site emergency supplies.
- Instruction on determining the end of a dam emergency.
- Instruction on proper communications for notifying the appropriate individuals of the emergency termination.
- Instruction on the appropriate dam emergency recovery activities.

Exercising

Develop scenarios for the various emergency conditions and test the level of training and readiness of key personnel responsible for actions during an emergency to make sure they understand the procedures and actions required.

Emergency response exercises should be held annually and should simulate an emergency situation in which the worker is tested on emergency condition notification, emergency communications, and emergency response skills. The exercise, whenever possible, should include participation by both the dam owner and the affected state and local emergency management officials. The exercises should be evaluated both orally and in writing and the EAP should be revised to correct any deficiencies noted.

Updating

The EAP should be updated promptly after each change in involved personnel or their telephone numbers or after the completion of a scheduled exercise review which revealed required changes. A review of the adequacy of the EAP should be conducted at intervals not to exceed one year. If no revision is necessary, a statement that the review was made and no revision to the EAP was necessary should be provided to each recipient of the original EAP.

Posting of the Notification Flowchart

An up-to-date copy of the Notification Flowchart should be posted in prominent locations at the dam site and local emergency operations center (essential for unattended dams).

The flowchart should be posted at each phone and radio transmitter at the dam, powerhouse (if applicable), and at all other desirable locations. The locations of the posted flowcharts should be indicated below.

List of Location of Notification Flowchart:

Appendix C. Definitions

Definitions

The words and terms listed below, as used in this plan, shall have the following meanings, unless the context clearly indicates otherwise:

Dam - As defined by State legislation

Dam Emergency Operation Center (DEOC) - The command post from which emergency operations are coordinated. This location must contain a telephone/communication line or be close to one.

Drawdown - Lowering of lake/reservoir level through the use of flood gates, low level outlets, etc.

Emergency - A condition in which a significant hazard to life or property is occurring.

Emergency Action Plan (EAP) - Established procedures necessary to minimize threat to life and damage to property in the event of a dam failure related release.

Emergency Condition - Any of the four conditions identified in the Emergency Condition Identification section.

Emergency Management Service (EMS) - All Offices of Emergency Management (State, County or Local) which would be involved in an emergency response.

Failure - An incident resulting in the uncontrolled release of water from an operating dam.

Hazard Potential Classification - As defined by State legislation

Inundation - The area that would be directly affected by flood waters resulting from a catastrophic dam failure.

OEM - Office of Emergency Management.

Outlet - An opening through which water can be freely discharged from a lake/reservoir for a particular purpose.

Owner/Operator - Person or entity who owns, controls, operates, maintains, or manages the dam.

Piping - The progressive development of internal erosion by seepage, appearing downstream as a hole or seam discharging water that contains soil particles.

Sinkhole - Any unusual subsidence.

Slumping - The movement of a mass of earth down a slope. In embankments and abutments, this involves the separation of a portion of the slope from the surrounding material.

Appendix E - Sample Emergency Plan

Spillway - A waterway/structure designed to convey excess water from a reservoir/lake without endangering the safety of the dam

Spillway Design Flood - The flood associated with the spillway design storm upon which the hydraulic capacity of the spillway structure is designed.

Appendix E-4. Site Specific Concerns

This section should provide a discussion of any site specific concerns that provide valuable information affecting the EAP.

Appendix E-5. Approval & Distribution of the EAP

Approval and Distribution

Once the EAP has been developed, the owner/operator shall submit the completed EAP with inundation mapping and dam breach analyses to the State Dam Safety Agency for review and approval. Once the State Dam Safety Agency approves the EAP, the EAP must be distributed by the owner to all individuals who will be involved during an emergency. Any revisions to the EAP should be furnished to all individuals to whom the original EAP was distributed.

Each party receiving an EAP must sign and return a receipt to the distributor (owner/operator) of the EAP. The signed receipt is to assure that all parties are aware of and understand the EAP and agree to their assigned roles should an emergency occur.

A standard distribution letter and receipt is included for reference.

Document Distribution

The document holder and location of each copy of the up-to-date EAP should be included in this section of the EAP.

Controlled Document Holder	Document Number
1. State Dam Safety Agency	1
2.	2
3.	3

Approval & Distribution of the EAP

Standard Distribution Letter & Receipt

(Date)

(Name of EAP document holder)
(Company or affiliation)
(mailing address)

Re: EAP for (name of dam) Dam ID No.

Dear (Name of EAP holder):

(Name of the owner/operator) has (prepared or revised) the Emergency Action Plan for (name of the dam) Dam located within (name of township), (name of county). The EAP is a public safety regulatory required document. The (year) revisions are described in the REVISION SUMMARY.

Please insert the new material with the revision date in your controlled copy and remove the obsolete material (the effective dates generally are printed at the lower right corner of the pages). Please acknowledge your receipt of the controlled copy distribution by returning the obsolete pages to the undersigned with the attached acknowledgment, signed and dated.

We appreciate your continued cooperation in the revisions of the EAP. should you have any recommendations or questions regarding the EAP, please do not hesitate to contact the undersigned.

Sincerely,

(Your Name)
(Affiliation)

Appendix E - Sample Emergency Plan

I acknowledge receipt of the (revision date) revision to the (name of dam) EAP and have inserted the revision pages in my controlled copy. This EAP will be maintained at the designated location for use in the event of a drill or actual emergency declaration.

Controlled Document holder name:

Document No:

Signature:

Date:

Attachment B

Sample-Dam Emergency Operations Center (DEOC) Location Map

To be provided by State Dam Safety Agency

Attachment C

Sample-Surveillance Checklist

To be provided by State Dam Safety Agency

Attachment D

Sample-Inundation Map

To be provided by State Dam Safety Agency

Attachment E

Guidelines For Dam Breach Analyses

To be provided by State Dam Safety Agency

APPENDIX F - ORGANIZATIONAL CHARTS

Appendix F gives examples of different ways dam safety sections can be organized. These examples show sections organized by function or by expertise.

The first example is of a state, such as California, with a large section organized by function. The Permit/Engineering Review Unit would consist of a number of people with different expertise tasked with handling all the office review needed for new permit or existing dam modifications applications. The Safety/Construction Inspection Unit would also consist of people of different expertise who would handle safety inspections of existing dams and construction inspection of new dams and dam modifications. While it may be desirable to have the same engineer in charge of construction who supervised the design review, efficiency can be increased by separating staff by function. To round out expertise and experience, staff may be rotated periodically between functions. The third unit in the first example would contain all Administrative Support personnel, including, if necessary, legal support. In most states, however, legal support is separate and has a broader environmental/natural resource function.

In the California example another unit handles the specific problems earthquakes and geology cause for dams in this state. In a large state field offices may offer some efficiency in coverage for safety/construction inspections.

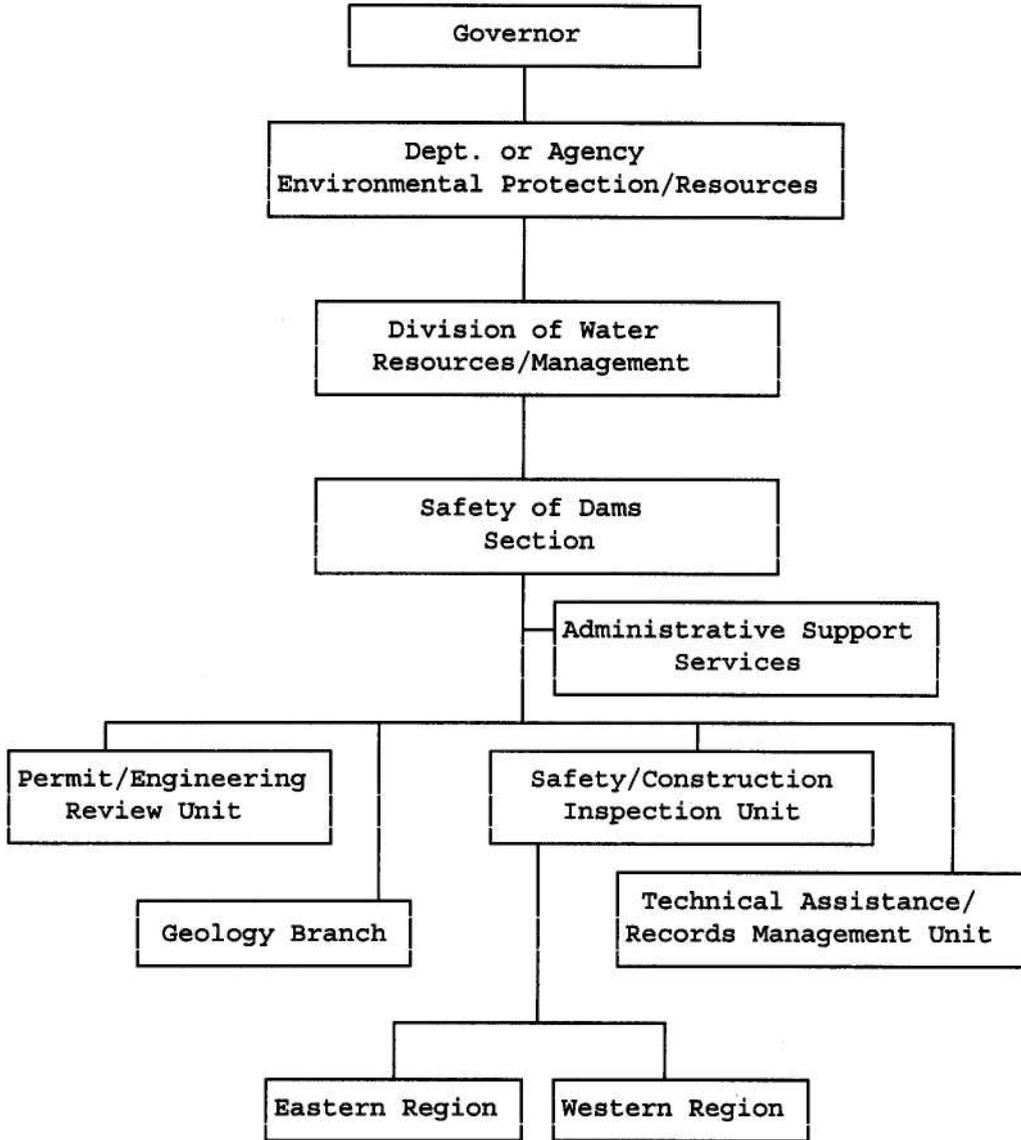
This organization structure could be used for states with large or small programs or engineers could be assigned to specific projects and work across functions.

The second example chart is set up by field of expertise and would generally be applied to smaller programs where coverage of all aspects of dam safety is desirable. A team approach is used for design review with construction of safety inspections being handled by one or more field inspectors or all staff would participate in field work.

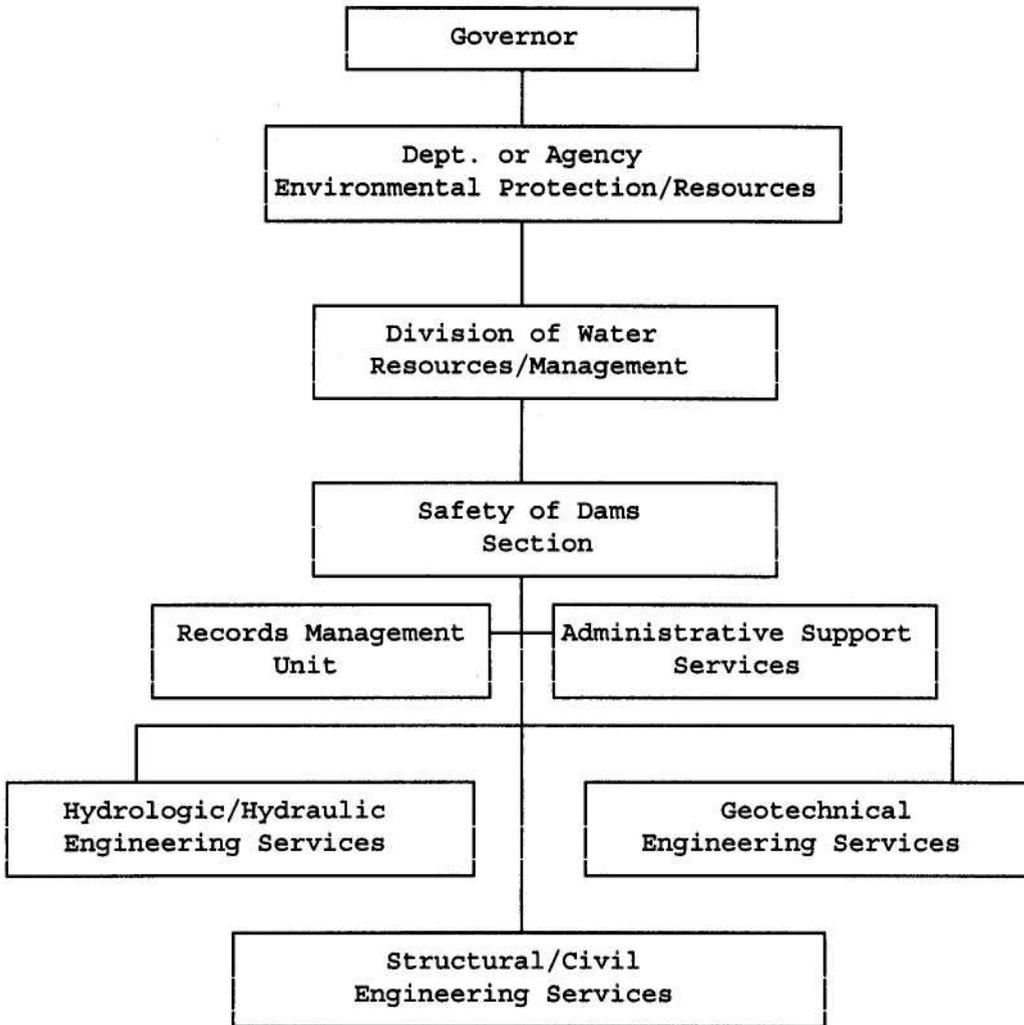
Modifications of either of the above examples may be required depending on the personnel and expertise available. For example a state could have a permits unit with engineers who are assigned projects and have responsibility for design review and construction inspection. Similarly, the safety inspection unit engineers would handle the periodic inspections, modification design reviews and construction inspections for all dams assigned to them. Engineers could be rotated between units for further cross-training.

State programs which require the owner to hire a qualified civil engineer to perform inspections and attend a percentage of inspections for quality control would result in a smaller organization and would probably require engineers to perform a variety of tasks.

SAMPLE ORGANIZATIONAL CHART



SAMPLE ORGANIZATIONAL CHART



APPENDIX G - TRAINING COURSES AND MATERIALS

A. FEDERAL DAM SAFETY TRAINING COURSES AND MATERIALS

1. TRAINING AIDS FOR DAM SAFETY (TADS)

Inspections of Embankment Dams
Inspections of Mechanical Equipment
Inspections of Concrete Dams
Inspections of Spillways & Outlet Works
Inspections of Foundation & Abutment Works
Identification of Visual Deficiencies
Material Deficiencies
Organization of a Dam Safety Program
Organization of an Operation & Maintenance Program
Emergency Action Planning
Evaluation of Hydrologic Adequacy
Evaluation of Hydraulic Adequacy
Embankment Seismic & Static Stability
Concrete Seismic & Static Stability
Evaluation of Seepage Adequacy
Instrumentation

2. BUREAU OF LAND MANAGEMENT

Design of Small Dams
Small Earth Dams Construction Inspection

3. BUREAU OF RECLAMATION (BOR)

Safety Evaluation of Existing Dams
Instrumentation and Monitoring of Dams
Risk-Based Analysis in Dam Safety Decisionmaking
Concrete Dams: A Self-Study Course in the Comprehensive Construction Training Program
Embankment Dams: A Self-Study Course in the Comprehensive Construction Training Program

4. CORPS OF ENGINEERS (COE)

Concrete Construction Inspection
Concrete Engineering Technology
Concrete Maintenance and Repair
Construction of Earth and Rockfill Dam for Resident Engineers
Construction Quality Management
Dam-Break Analysis
Drilling and Sampling for Engineering Purposes
Dynamic Analysis for Earthquake Engineering
Earthquake Analysis of Concrete Dams & Appurtenant Structures
Earthquake Soils Response

Appendix G - Training Courses and Materials

- Electrical Inspection
 - Engineering Geology I
 - Engineering Seismology
 - Finite Element Analysis of Structures
 - Flood Frequency Analysis
 - Flood Plain Hydrology and Hydraulics
 - Foundations of Expansive Clay Soils
 - Grouting & Foundation Treatment
 - Hydraulic Design of Flood Control Channels
 - Hydraulic Design of Locks and Dams
 - Hydraulic Design of Spillways and Outlet Works
 - Hydrographic Survey Techniques
 - Hydrologic Analysis of Floods
 - Inspection and Evaluation of Safety of Non-Federal Dams
 - Seepage Analysis & Control for Dams
 - Structural Design and Analysis System (STRUDL)/Advanced Applications
 - Structural Design and Analysis System (STRUDL)/Basic Applications
 - Unsteady Flow Analysis
 - Water Surface Profile Computation Using HEC-II(Advanced)
 - Water Surface Profile Computation Using HEC-II (Basic)
5. MINE SAFETY AND HEALTH ADMINISTRATION (MSHA)
- Construction Inspection of Dams and Coal Refuse Embankments
 - Design Guidelines for Impoundments
6. NATIONAL WEATHER SERVICE (NWS)
- Dam-Break Model Symposium Workshop
7. NATURAL RESOURCES CONSERVATION SERVICE (NRCS - formerly Soil Conservation Service)
- Contract Administration - Construction Contracts
 - Engineering - Concrete
 - Engineering - Construction Inspection
 - Engineering - Hydrology (Level III)
 - Engineering - Structural Design (Level II)
8. TENNESSEE VALLEY AUTHORITY
- Dam Safety Training Program for Operations and Maintenance Personnel
9. U.S. FOREST SERVICE
- Basic Aerial Photo Interpretation
 - Dams Workshop
 - Elementary Slope Stability

Geotechnical Workshop
Inspector Workshop
Material Sampling and Testing

10. FEDERAL EMERGENCY MANAGEMENT AGENCY

Emergency Action Plan (EAP) for Dams Development Course
Emergency Action Plan (EAP) for Dams Exercise Course

B. DAM OWNER OPERATION AND MAINTENANCE MANUALS

1. Georgia
2. Ohio
3. Wisconsin
4. New Hampshire
5. Texas
6. Wyoming
7. Virginia
8. Dam Safety and Owners Guidance Manual (FEMA #145)

POINTS OF CONTACT FOR TRAINING MATERIALS & COURSES

Bureau of Land Management
Denver Service Center
Building 50, D-420
Denver, Colorado 80225
(303) 234-2264

Bureau of Reclamation (BOR)
Code D-7510
P.O. Box 25007
Denver, Colorado 80225

Corps of Engineers (COE)
Training Management Division
Training Center for Professional
Development
P.O. Box 1600
Huntsville, Alabama 35807
(205) 772-5800

Mine Safety and Health Administration
(MSHA)
ATTN: Chief of Mine and
Geotechnical Engineering Division
Bruceton Center
4800 Forbes Avenue
Pittsburgh, PA 15213
(412) 675-6903

Federal Emergency Management Agency
(FEMA)
NETC/EMI Mitigation Branch
16825 South Seton Avenue
Emmitsburg, Maryland 21727
(301) 441-1356

Association of State Dam
Safety Officials
450 Old Vine Street, 2nd Floor
Lexington, KY 40507
(606) 257-5140

National Weather Service (NWS)
Tulsa River Forecast Center
333 W. 4th Street
Room 3031
Tulsa, Oklahoma 74103
(918) 581-7121

Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, TN 37902
(615) 632-6130

USDA, Forest Service
Engineering Division
P.O. Box 2417
Washington, DC 20013
(703) 235-8030

National Employee Development Staff
National Technical Center
U.S. Department of Agriculture
NRCS
P.O. Box 6567
501 W. Felix, FWFC,
Building 23
Ft. Worth, Texas 76115
(817) 344-5401

APPENDIX H - SAMPLE DATABASE FIELDS

CASE 1: COLORADO

DESCRIPTIONS & DEFINITIONS of Fieldnames in DAMS: Dam Inventory Database

- * **DAMNAME** - This is the official or legal name for the dam.
- * **AKANAMES** - Other popular names for the dam or reservoir.
- * **DAMID** - State of Colorado ID number for the dam, six characters, the first two of which refer to the water district within which the dam is located. A five (5) in the third character denotes that this dam was previously assigned to another district.
- * **NATID** - National Inventory of Dams ID number for the dam. This is the Army ID assigned to the dam during the original dam inventory program, or is newly assigned if this dam is being added to the inventory database.

- FORESTID** - The US Forest Service ID number assigned to the dam. This is an eight character field, the first two characters refer to the forest number, the second two identify the ranger district within that forest. A key is provided to identify the forest and ranger districts in the appendix.

- RESID** - Reservoir ID number. This number links the structure to water rights information. This field is not in active use for dam safety purposes at this time.

- DIV** - The Colorado water division where the dam is located.

- WD** - The Colorado water district where the water to fill the reservoir is administered from. In general, this will be the district where the dam is located.

- * **LATDEG, LATMIN, LATSEC** - Latitude of the dam. These three fields define the latitude of the dam in degrees, minutes and seconds of latitude. All fields are integer numeric. NOTE - Colorado lies between about 37° and 41° north latitude.

- * **LONGDEG, LONGMIN, LONGSEC** - Longitude of the dam. These three fields describe the longitude location for the dam. Each field is integer numeric for the respective degrees, minutes, and seconds of longitude. NOTE- Colorado lies between about 102° 2' and 109° 3' west longitude.

- * **PM** - Prime Meridian from which the township and range are defined. Originally a single character, this field now holds the meridian name, 10 characters.

- * **TOWNSHIP, RANGE, SECTION** - Location fields for township, range, and section where the dam is located. The location of the outlet structure is defined in these fields. The township and range fields are each character fields, with a width of 4, and data must be right justified. The section field is 2 characters wide.

* Denotes fields required for the National Inventory of Dams.

- * **COUNTY** - Name of the county where the dam is located. This field was originally a two character code which has been modified to accept the full alpha name of the county.

- TOPOMAP** - The topomap upon which the dam may be found. This field is described by a numeric and alpha code corresponding to the filing system utilized by the dam safety branch. The coding for this field, however, is subject to the preference of the user.

- * **STREAM** - This is the official name for the river or stream that the dam is built across. If the stream is unnamed, enter the name for the stream for which it is a tributary. The following field will denote a code for designating offstream structures. **NOTE: This field has previously been used to note where water is diverted FROM for 'offstream' structures. The field is to now describe the stream to which water would flow INTO.**

- * **STRCODE** - Stream code to denote whether the dam is on or offstream, or is tributary to another stream. This is a single character field using the following codes:
 - N** - dam is located on the stream noted in the field "STREAM"
 - O** - dam is located offstream of "STREAM"
 - T** - dam is located on a tributary of the designated "STREAM"

- STRMNO** - Stream number. This field designates the stream corresponding to the Water Data Bank information. This field will eventually be used as a link with the data bank, but is not currently ready at this time. As a note, this record is unique by **Water Division**.

- * **DNSTRTWN** - Name of the nearest downstream town which would most likely be affected by a flood that results from a failure of the dam.

- * **NDTDIST** - Distance to the nearest town referenced in the field "DNSTRTWN". The distance should be given to the nearest mile or tenth of a mile, if less than one mile.

- * **YRCOMPL** - The year of completion of **original** construction of the main dam. Enlargements and modifications to the original structure do not affect this data.

- * **PURPOSES** - The purpose or use code for this dam. As many codes as are necessary to describe the purpose for the dams existence may be entered, in descending order of priority.
 - C** - Flood control and Stormwater management
 - D** - Debris Control
 - F** - Fish and Wildlife
 - H** - Hydroelectric
 - I** - Irrigation
 - N** - Navigation
 - P** - Fire Protection, Stock, or Small Farm Pond
 - R** - Recreation
 - S** - Water Supply
 - T** - Tailings

* Denotes fields required for the National Inventory of Dams.

O - Other

- * **FEDLAND** - Code denoting if this is a private dam on federal land. Enter Y for yes, N for no. Generally, this will refer to privately owned structures located on US Forest or BLM property.

FEDREGS - Code denoting if this dam is regulated by a federal agency. ** Originally, this applied to dams licensed by FERC. Strictly defined this field indicates whether a federal agency has regulatory authority over the existence and use of the dam. For example, the US Forest service requires a use permit, which may or may not have any bearing on the safety of the dam.

- * **DAMTYPE** - Code describing the type of dam. Enter one or more of the following codes:

RE - Earth
ER - Rockfill
CN - Concrete
MS - Masonry
ST - Stone
TC - Timber Crib
CB - Buttress
PG - Gravity
VA - Arch
MV - Multi-Arch
OT - Other

Ex. The code CNPG describes a concrete gravity dam.

These codes are for the most part used internationally, and are a combination of French and English abbreviations. These are the official languages for ICOLD, the International Commission on Large Dams.

- * **DAMLENGTH** - Crest length of the dam, to the nearest foot.
- * **DAMHEIGHT** - Height of the dam, measured as the vertical distance from the dam crest to the lowest point in the original streambed under the centerline of the dam. This is measured to the nearest tenth of a foot.

* Denotes fields required for the National Inventory of Dams.

* **STRHEIGHT** - Structural height of the dam. This is defined as the vertical distance from the dam crest to the lowest point of the excavated foundation. If unknown, use the Height of the Dam as defined above. Distance is measured to the nearest tenth of a foot.

* **HYDHEIGHT** - Hydraulic height of the dam. This is defined as the vertical distance from the maximum design water level to the lowest point of the original streambed. If unknown, use the Height of the Dam as defined above. Distance is measured to the nearest tenth of a foot.

CRESTWIDTH - Crest width of the dam, to the nearest tenth of a foot.

CRESTELEV - Crest elevation, enter to the nearest foot using USGS datum. NOTE: As a matter of practicality this value may be estimated from USGS topo maps.

* **MAXSTORAGE** - The maximum storage capacity of the reservoir in acre-feet with the reservoir level at the crest of the dam.

* **NORSTORAGE** - The normal storage capacity of the reservoir in acre-feet with the reservoir at the normal operating level.

* **SURFAREA** - Surface area of the reservoir to the nearest acre with the reservoir at the normal operating level.

* **DRAINAREA** - Drainage basin area in acres.

HYDROLOGY - Logical record to denote whether an approved hydrology study is on file. This could include studies performed in-house to check spillway adequacy, and should be noted in the HYDRONOTES field.

STUDYDATE - Date field reflecting the date of the latest approved hydrology study.

HYDRONOTES - Remarks field to denote details pertinent to the latest approved hydrology study. These notes can be used to identify magnitude of storm, precipitation source data, method of analysis, etc.

* **SPLYTOTCAP** - Total discharge capacity of spillways, in cfs.

Spillway Data - The following fields are provided to define up to three spillways for the dam. Spillway1 is defined as the PRINCIPLE or service spillway, which controls the normal operating reservoir level. Spillway2 is the EMERGENCY spillway, which would operate under flood conditions, and Spillway3 is defined as an AUXILIARY spillway, which would only flow under extreme flood conditions.

SPLYWIDTH# - Floor or channel width of the spillway at the control section. Dimension is measured to the nearest tenth of a foot.

SPLYFRBRD# - Freeboard dimension for the spillway. This dimension is measured from the lowest point on the dam crest to the lowest flowline elevation in the spillway, in tenths

* Denotes fields required for the National Inventory of Dams.

of a foot.

SPLYSSLOP# - Spillway wall side slope. This value should be entered as the average for the two sides. Enter as 1.5 for a slope of 1.5H to 1V.

SPLYCAPY# - Discharge capacity for the particular spillway. The value for this field may be calculated from dimensional data if the design capacity is not known.

SPLYTYPE# - This field defines the type of spillway type and flow control.

UCHAN - ungated open channel spillway
UCOND - ungated conduit, pipe, or tunnel spillway
GCHAN - gated channel spillway
GCOND - gated conduit, pipe, or tunnel spillway
NONE - no spillway

SPLYCODE# - Code to describe the construction of spillway. The construction code should be entered as below:

EARTH-earth or soil
CONC-concrete
ROCK-rock channels
STONE-masonry or placed stone
CMP-corrugated metal pipe
RCP-reinforced concrete pipe
STEEL-steel pipe
TILE-clay tile

OUTLETDESC - Character field to describe the outlet(s) for the dam. The description should include diameter or size of the outlet as well as type of outlet(eg, CMP, clay tile, etc). This field is 30 characters, but may be enlarged if necessary.

OUTLETCAPY - The full head flow capacity of the outlet works at the normal reservoir water surface elevation, in cfs.

OUTLETINSP - Date of last internal inspection of the outlet. This field is in date format.

- * **HAZCLASS** - Hazard classification for the dam. This classification is based on the magnitude of damage which could occur in the event of a failure of the dam. This is a one character code as described below:

- 1 - failure would likely result in loss of life to downstream residents
- 2 - significant property damage is anticipated in the event of a failure, although loss of life is not envisioned
- 3 - minor property damage is expected due to a failure of the dam
- 4 - insignificant property damage would result, or all damage is confined to property of the owner of the dam

* Denotes fields required for the National Inventory of Dams.

N - No structure exists, Natural lake or impoundment, or No hazard(ie, dam has been altered or breached such that no structure or hazard exists)

NABCODE - Abandonment code. This code is used to identify structures that are not included in the routine inspection program. The code is one character, as reflected below:

N - non-jurisdictional (there should be an appropriate "HAZCLASS" defined)
A - abandoned (depending on circumstances, "HAZCLASS" may be defined)
B - breached ("HAZCLASS" should be assigned as N)
E - exempt dam ("HAZCLASS" should be defined); this structure is usually administered by a State agency other than DWR

* **EPLAN** - Code denoting whether an Emergency Preparedness Plan is on file, or required to be on file.

Y - an approved plan is on file
N - no approved plan on file
NR- plan is not required

EPPDATE - The date that the latest EPP was approved.

* **PHASE1** - Code which denotes if a Corps of Engineer's Phase 1 inspection was conducted for this dam. Y for yes, N for no.

* **INSPDATE** - Date when last safety inspection was conducted. This field is in date format.

INSPECTOR - Initials of engineer that performed last safety inspection. Three characters.

* **STAGENCY** - Agency responsible for regulating this structure for the State of Colorado. Codes are defined as below:

DWR - Division of Water Resources(Office of the State Engineer, Dam Safety Branch)
MLR - Mined Land Reclamation
DOH - Department of Health

OWNNO - Owner number, this field links owner information from the owner database.

ENGNO - Engineer number, this field links information for the design engineer from the owner database. Note this field is no longer maintained in the DAMS Database files.

REMARKS - This is a 60 character remark field for noting any details which may be appropriate. The entry should include the year for which the remark is appropriate if useful.

UPDATE - This is a date field that will be modified whenever data is updated within the database record.

* Denotes fields required for the National Inventory of Dams.

INITIALS - A three character field for the initials of the person that performed an update to the database record.

Structure for database: S:\DAMSCOMM\DAMS.DBF

Number of data records: 2747

Date of last update : 04/01/95

Field	Field Name	Type	Width	Dec	Index
1	DAMNAME	Character	40		Y
2	AKANAMES	Character	40		N
3	DAMID	Character	6		Y
4	NATID	Character	5		Y
5	RESID	Character	7		N
6	FORESTID	Character	8		Y
7	DIV	Numeric	1		Y
8	WD	Numeric	2		N
9	LATDEG	Numeric	2		N
10	LATMIN	Numeric	2		N
11	LATSEC	Numeric	2		N
12	LONGDEG	Numeric	3		N
13	LONGMIN	Numeric	2		N
14	LONGSEC	Numeric	2		N
15	PM	Character	10		N
16	TOWNSHIP	Character	4		N
17	RANGE	Character	5		N
18	SECTION	Character	2		N
19	COUNTY	Character	15		N
20	TOPOMAP	Character	8		N
21	STREAM	Character	24		N
22	STRCODE	Character	1		N
23	STRMNO	Numeric	3		N
24	DNSTRTWN	Character	30		N
25	NDTDIST	Numeric	5	1	N
26	YRCOMPL	Character	4		N
27	PURPOSES	Character	12		N
28	FEDLAND	Character	1		N
29	FEDREGS	Character	1		N
30	DAMTYPE	Character	5		N
31	DAMLENGTH	Numeric	5		N
32	DAMHEIGHT	Numeric	5	1	N
33	STRHEIGHT	Numeric	5	1	N
34	HYDHEIGHT	Numeric	5	1	N
35	CRESTWIDTH	Numeric	5	1	N
36	CRESTELEV	Numeric	5		N
37	MAXSTORAGE	Numeric	7		N
38	NORSTORAGE	Numeric	7		N
39	SURFAREA	Numeric	7		N
40	DRAINAREA	Numeric	10		N
41	HYDROLOGY	Logical	1		N
42	STUDYDATE	Date	8		N
43	HYDRONOTES	Character	20		N
44	SPLYTOTCAP	Numeric	7		N

Appendix H - Sample Database Fields

45	SPLYWIDTH1	Numeric	7	1	N
46	SPLYFRBRD1	Numeric	5	1	N
47	SPLYSSLOP1	Numeric	3	1	N
48	SPLYCAPY1	Numeric	7		N
49	SPLYTYPE1	Character	5		N
50	SPLYCODE1	Character	5		N
51	SPLYWIDTH2	Numeric	7	1	N
52	SPLYFRBRD2	Numeric	5	1	N
53	SPLYSSLOP2	Numeric	3	1	N
54	SPLYCAPY2	Numeric	7		N
55	SPLYTYPE2	Character	5		N
56	SPLYCODE2	Character	5		N
57	SPLYWIDTH3	Numeric	7	1	N
58	SPLYFRBRD3	Numeric	5	1	N
59	SPLYSSLOP3	Numeric	3	1	N
60	SPLYCAPY3	Numeric	7		N
61	SPLYTYPE3	Character	5		N
62	SPLYCODE3	Character	5		N
63	OUTLETDESC	Character	30		N
64	OUTLETCAPY	Numeric	10		N
65	OUTLETINSP	Date	8		N
66	HAZCLASS	Character	1		N
67	NABCODE	Character	1		N
68	EPLAN	Character	2		N
69	EPPDATE	Date	8		N
70	PHASE1	Character	1		N
71	INSPDATE	Date	8		N
72	INSPECTOR	Character	3		N
73	STAGENCY	Character	30		N
74	OWNNO	Character	5		Y
75	ENGNO	Character	5		N
76	REMARKS	Character	60		N
77	UPDATE	Date	8		N
78	INITIALS	Character	3		N

DESCRIPTIONS & DEFINITIONS of Fieldnames in OWNERS: Owners Database

OWNNO - The owner number designated for this owner.

* **OWNERTYPE** - Code to designate the type of owner.

F - Federal Government

L - Local Government

P - Private Owner

S - State Government

U - Public Utility

* **NAME** - The name of the owner.

CONTACT - The name of the contact person for the owner.

ADDRESS - Address for this owner.

ADDRESS2 - Second address line if needed.

CITY - City field for address

STATE - State field for address

ZIP - Zip code for address

ZIP2 - Additional field for last four digits for nine character zip code.

PHONE - Telephone number for owner's contact.

CODE - Code to designate if record is for owner data or engineer data.

O - Owner record

E - Engineer record (No longer used)

* Denotes fields required for the National Inventory of Dams.

Appendix H - Sample Database Fields

Page # 1

Structure for database: S:\DAMSCOMM\OWNERS.DBF

Number of data records: 1960

Date of last update : 03/31/95

Field	Field Name	Type	Width	Dec	Index
1	OWNNO	Character	5		Y
2	OWNERTYPE	Character	1		N
3	NAME	Character	45		Y
4	CONTACT	Character	45		N
5	ADDRESS	Character	45		N
6	ADDRESS2	Character	45		N
7	CITY	Character	25		N
8	STATE	Character	2		N
9	ZIP	Character	5		N
10	ZIP2	Character	4		N
11	PHONE	Character	12		N
12	CODE	Character	1		N
13	ACTIVE	Character	1		N

** Total **

237

APPENDIX I - BUDGET PREPARATION

STAFFING LEVEL REQUIREMENTS: EXAMPLE STATE DAM SAFETY PROGRAM

Chapter VI discusses program staffing and funding. This appendix is intended as a supplement to Chapter VI.

For any state dam safety program to be effective and accountable, personnel levels must be sufficient to satisfy the statutory mandates. Each state must assess its particular needs based on its legislative, organizational, geographic, topographic and political constraints, some of which are described above under Chapter VI, section I. Due to the wide range of these constraints from state to state, it is difficult to provide precise guidelines for the number of inspections one engineer should be expected to perform in a year. This is equally true of each of the other functions of a state dam safety program. With these limitations in mind, an attempt has been made to provide guidelines that should provide assistance in the preparation of a budget for a state dam safety program.

INSPECTION¹ OF EXISTING DAMS:

If inspection frequency is not set by law, annual inspections of high hazard potential dams, biennial inspections of significant hazard potential dams and inspections every five years for low hazard potential dams are recommended. Each dam should be inspected at least once every five years. Some states require the owner to hire a qualified engineer to conduct the inspections. When this is the case, a staff of one engineer per 250 - 400 inspections would be required to review the inspection reports and to attend 20 percent of the inspections for quality control purposes. Most state programs conduct safety inspections utilizing state employed engineers. For budget preparation, the recommended time for a detailed visual inspection of one existing high hazard potential dam including file review, preparation, travel time, on-site inspection time, engineering analysis and report writing is four (4) person-days. For significant and low hazard potential dams the recommended time to budget for inspections are three (3) and two (2) days respectively. It is desirable to include more than one person on the inspection team. There are many reasons for including more than one person on the inspection including training, personal safety, and special needs at the dam. Special needs include surveying and the complexities of the particular dam being inspected that may require staff members with different areas of expertise.

APPLICATION APPROVAL:

Chapter II describes the tasks included in the processing of an application. Statutory and internal policy controls may define the time allocated to review and approve or deny an application. The complexity of the application under review, the completeness of the data provided, the experience of the staff assigned to the review, etc., are factors in determining the length of a particular review. The length of the permitting process can vary greatly, however, a recommended engineering review time for a complete application is 20 person days, with an additional 5 days for clerical/administrative tasks. The engineering review should include a site inspection as part of the application review. Reviews should also include the major aspects of the

¹ See Glossary for definition.

engineering design for the dam being proposed. Among these aspects are hydrologic, hydraulic, geotechnical, seismic, and stability considerations. Review and approval of the Emergency Action Plan (EAP), if required, is also part of the application approval.

CONSTRUCTION ASSURANCE:

Although it is the owner's responsibility (through the owner's engineer) in most states to assure that any construction is completed according to the approved application and that all unforeseen conditions are properly handled, review of construction activity by the state is recommended. Inspection and approval of all foundation preparation is essential and is a part of most programs. Inspection of the outlet, the main structure, and the spillway should also be conducted. In addition, many projects include prefinal and final inspections. A recommended inspection length is two (2) person days including preparation, travel and report preparation. The recommended time could double in those states where travel distances are significant. The recommended number of construction assurance inspections per new dam is fifteen (15). Ten (10) construction assurance inspections are recommended for repair of existing dams. The above inspection frequencies include review of quality assurance records of the owner's engineer. Changes to the approved application during construction require additional review. The time required for such additional review is not included in this section but is included in the application approval section above.

FOLLOW-UP ON DEFICIENCIES:

Inspections of operational dams frequently reveal deficiencies that require correction. The inspection report shall identify deficiencies and include an appropriate schedule to complete corrective actions. A program to follow up and assure that these actions are taken should be part of all state programs. The amount of time required to conduct a follow-up inspection can vary, however, for operating dams it can take an average of three (3) persons-days per deficiency. For budget preparation purposes, it should be anticipated that deficiencies will occur at 20 percent of the dams inspected.

Contacts with owners of unsafe dams to bring about the remediation of unsafe conditions is also an essential part of follow-up activities. The actual amount of time required can vary. It is recommended that 15 person-days per unsafe dam be used in budget preparation. The 15 person-days recommended does not include application review time for repair, reconstruction, breach or removal of the dam. In most cases a state will have to prioritize follow-up activity since the time required can easily exceed the available staff.

ENFORCEMENT:

In the event that progress toward correction of deficiencies is not satisfactory, enforcement actions must be pursued. Enforcement can be very time consuming. For budget estimates a recommended time for each enforcement action is 50 person-days for the dam safety engineering staff. The estimated time includes the time of the legal staff as well as that of the engineering staff for preparation, etc. The above estimates assume that actions taken by the technical staff have been properly documented to support the enforcement actions.

TRAINING:

Education and training of staff is an important part of an effective program. It is recommended that a minimum of 5 percent of staff time be devoted to specific training provided by short courses, etc. as described in Chapter VII.

ADMINISTRATION/OVERHEAD:

Depending on the agency within which the dam safety program is placed and the overall state government organizational structure, the administration of the dam safety program can require significant amounts of time. The administrator may be responsible for overseeing other programs as well. The recommended administrative staffing time is 30 percent of the technical staff time described above. The above estimates include supervision and support of the program.

Example Program
Staffing Level Requirements

Example program: 200 Dams:

70 High hazard potential,
60 Significant hazard potential,
70 Low hazard potential

with inspection frequency as follows:

High hazard potential, annual;
Significant hazard potential, every two years; and
Low hazard potential, every five years.

<u>TASK</u>	<u>No. of Tasks (Dams)</u>	<u>Person-Days Per Task</u>	<u>Total Person Days</u>
Average annual inspections ²			
High hazard potential	70/yr	4	280
Significant hazard	60/2 = 30/yr	3	90
Low hazard potential	70/5 = 14/yr	2	28
Special Conditions, Requests	30	2	60
Training new staff	1	15	<u>15</u>

Sub-Total: Annual Inspection Days =473

	<u>Person Tasks per year</u>	<u>Person-Day per Task</u>	<u>Total Person-Days</u>
Application approval:			
New Dams	10	20	200
Repair Existing Dams	10	10	100
Emergency Action Plans (EAP)	25	5	<u>125</u>
Sub-Total: Application Approval Days =			425

² Includes time for file review, documentation, report preparation, inspector training, etc.

Appendix I - Budget Preparation

	<u>Person Tasks</u> <u>per year</u>	<u>Person-Day</u> <u>per Task</u>	<u>Total</u> <u>Person-Days</u>
Construction Assurance:			
New Dams	10	30 ³	300
Repair Existing Dams	10	20 ⁴	<u>200</u>
Sub-Total: Construction Assurance Days =			500
Follow-up on deficiencies:			
114 dams/yr. X 20% =	23	3	69
Unsafe dams	2	15	30
Enforcement:	4	50	200
Summary of Tasks:			
Inspections:	473 days		
Applications:	425 days		
Construction:	500 days		
Follow-ups:	69 days		
Unsafe Dams:	30 days		
Enforcement:	<u>200 days</u>		
TOTAL:	1,697 days		
Professional Development/ Continuing Education:			
	1697 X 5% = 85 days		
Total Engineering/ Technical Staff:			
	$1697 + 85 = 1782 \text{ days} / (225 \text{ days/FTE/yr.}) = 7.9 \text{ FTE}$		
Administrative/ Clerical:			
	$1782 \times 30\% = 535 \text{ days} / (225 \text{ days/FTE/yr.}) = \underline{2.4} \text{ FTE}$		
TOTAL STAFFING REQUIRED:		10.3 FTE	
(For Inventory of 200 dams)			

³ 2 person-days per inspection X 15 inspections per year = 30

⁴ 2 person-days per inspection X 10 inspections per year = 20

Note:

- 1) In geographically large states without regional dam safety offices, a "distance multiplier" of 1.5 may be used to estimate the number of person-days required for field inspections.
- 2) "Construction Assurance" would include site inspections during:
 - A. Foundation Preparation
 - B. Embankment Construction
 - C. Low Level Outlet Structure Construction/Placement
 - D. Spillway Construction
 - E. Final Review
- 3) In states with seismic risk, a "seismic multiplier" of 1.5 may be used to estimate the number of person-days required for application approval.
- 4) Initial inspection of an existing dam and production of a Phase I inspection report will likely take up to between 10 to 15 man-days.
- 5) Other administrative activities must be considered

Chapter VI lists other costs which must be considered in the budgeting process.

APPENDIX J - PUBLIC OUTREACH TOOL SAMPLES

CASE 1: WEST VIRGINIA BROCHURE

CASE 2: SOUTH CAROLINA BROCHURE

CASE 3: OHIO NEWSLETTER

CASE 4: PENNSYLVANIA FACT SHEET

Who are the dam owners?

Dams are owned and operated by a variety of people and organizations including industry, municipalities, counties, homeowners organizations, private agencies and private citizens. The state of West Virginia owns and operates 37 dams. In addition, state Soil Conservation Districts sponsor the operation and maintenance of flood control dams constructed by the U.S. Soil Conservation Service on privately owned land.

What are the responsibilities of dam owners?

Courts have generally held dam owners strictly liable for loss of life and property damage resulting from dam failure. The owner is responsible for monitoring, operating and maintaining his/her dam in a safe condition and in accordance with state regulations.

The cost of a maintenance program in the long run is small compared to the cost of major repairs, loss of life and damage claims. Owners of old dams must comply with the same safety requirements as the owners of new structures.

How many dams are in West Virginia and what is their use?

There are approximately 550 dams in West Virginia. The total is made up of about 150 flood control dams, 50 industrial waste dams, 150 coal waste disposal dams, and 200 dams for water supply, recreation or other purposes.

If you live on the downstream side of a dam, you should become familiar with the monitoring and emergency warning plan developed by the dam's owner. The plan outlines increasing levels of surveillance that are based upon weather conditions and the condition of the dam. In addition, the plan must include an effective notification procedure for downstream residents whenever the safety of the dam is threatened.

Additional information:

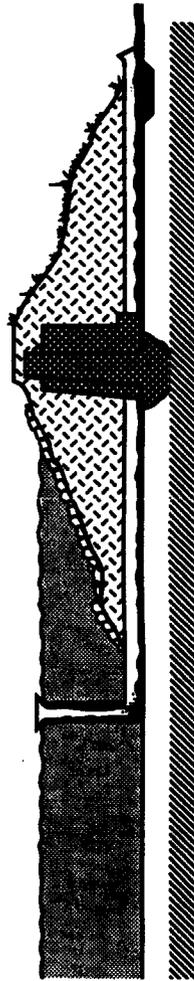
Contact Brian Long, Office of Water Resources, Dam Safety Section, 1201 Greenbrier Street, Charleston, WV 25311-1088. Phone: (304) 558-0320. Fax: (304) 558-5905. TDD: (304) 558-2751. Hotline: 1-800-642-3074.

The state of West Virginia is an equal opportunity employer.

DEP
Division of Environmental Protection
West Virginia

Dam Safety Program

Non-Coal Related Dams



The majority of West Virginia lakes are impounded by earthen dams that look like simple grassy banks. In spite of their unremarkable appearance, earthen dams often contain carefully designed drainage systems, rock riprap that provides protection against wave action, a water-light core of clay or concrete, and spillways for conveying normal stream flow or excessive rainfall past the dam.

Office of Water Resources

0593 ~ Printed on recycled paper

West Virginia's waters include approximately 550 lakes used for fishing and boating, water supply, flood control, flyash disposal and power generation. Virtually all of these lakes are impounded by dams.

More dams are being built as needs for water and flood control increase. At the same time, many existing dams are falling into disrepair posing substantial risk to the lives and property of people who live downstream.

Dam failures can occur due to catastrophic natural events, poor design and construction, or inadequate maintenance.

The occasional failure of a dam causes public dismay, shock and official scrutiny. Often, the disaster is the result of natural events combined with human mistakes.

The safety of West Virginia's dams was brought into sharp focus on February 26, 1972, when a coal refuse dam failed on the Middle Fork of Buffalo Creek, in Logan County. The resulting flood killed 125 people and left total devastation for many miles downstream.

In response to the disaster, the West Virginia Legislature passed the Dam Control and Safety Act. The law places dams under a system of government supervision intended to prevent dam failures.

The Dam Safety Program

The Division of Environmental Protection is responsible for implementing the requirements of the Dam Control and Safety Act. The DEP's Office of Mining and Reclamation regulates coal-related dams. Regulatory authority over non-coal related dams lies within the Office of Water Resources (OWR).

How does the Dam Control and Safety Act define a dam?

A dam is defined as an artificial barrier or obstruction that impounds or will impound water. The law also establishes that a regulated dam must be:

- ◆ 25 feet or more in height and impound 15 acre-feet of water volume.
- ◆ 6 feet or more in height and impound 50 acre-feet of water volume.

The height is measured from the natural bed of the stream on the dry side of the dam, vertically to the dam crest. The volume in acre feet also is measured at the crest of the dam. One-acre foot of water may be visualized as one acre of land covered with water one foot deep. The amount, or volume, of water standing on the one acre of land is one acre-foot. An acre-foot is equal to 325,828 gallons of water.

Who is exempt?

- ◆ Federally owned dams, such as dams owned and operated by the U.S. Army Corps of Engineers. Examples include Summersville Dam, Tygart Lake Dam, and R.D. Bailey Dam.
- ◆ Embankments that do not normally impound water, such as roadfills.
- ◆ Farm ponds. However, farmpond dams that may cause loss of life in the event of failure are not exempt from the requirements of the law.

The 1992 amendments to the Dam Control and Safety Act require that new U.S. Soil Conservation Service dams be issued a certificate of approval without review of engineering plans. These dams are not inspected by the State during construction.

The OWR's dam safety program ensures the structural and operational safety of dams under its jurisdiction by:

- Reviewing the design and construction of new dams and the modification of existing dams.
- Issuing certificates of approval.
- Inspecting dams under construction and conducting periodic safety review of existing dams.
- Requiring monitoring and emergency warning plans to anticipate hazardous conditions.
- Responding to emergency calls from dam owners or the public.
- Enforcing modern safety standards on existing dams not built to today's criteria.

Other essential components of the dam safety program include assisting dam owners with the development of monitoring and emergency warning plans, pursuing legal, criminal or civil penalties for non-compliance and maintaining a computer inventory database of dams.

In issuing certificates of approval, Dam Safety Section geologists and engineers evaluate three basic elements:

- Hazard potential to people and property posed by the dam.
- Structural stability and spillway adequacy of the dam.
- Sufficiency of monitoring and maintenance procedures proposed by the dam owner.

The three categories and abbreviated definitions are:

High Hazard

- Failure likely will cause loss of life or serious property damage.

Significant Hazard

- Failure likely will not cause loss of life, but might cause serious property damage.

Low Hazard

- Failure might cause minimal property damage, but no loss of life would be expected.

Liability

Any person who impounds water or other fluids in South Carolina may be liable for any damage caused by failure of, or improper operation of, a dam or reservoir. Even if a house is built below a dam after the dam is constructed, the owner of the dam is not free from liability.

For More Information, Contact:

For details on Permitting and Constructing/Repairing Dams call George D. Dallortine, Ph.D., P.E., Mgr. Dams and Reservoirs Safety Section, South Carolina Department of Health and Environmental Control, 2800 Bull Street, Columbia, S.C. 29201 (803) 734-9119

For information on inspections, tax credits, etc., relating to dams contact the EGC District Office that covers the county in which the dam is located.

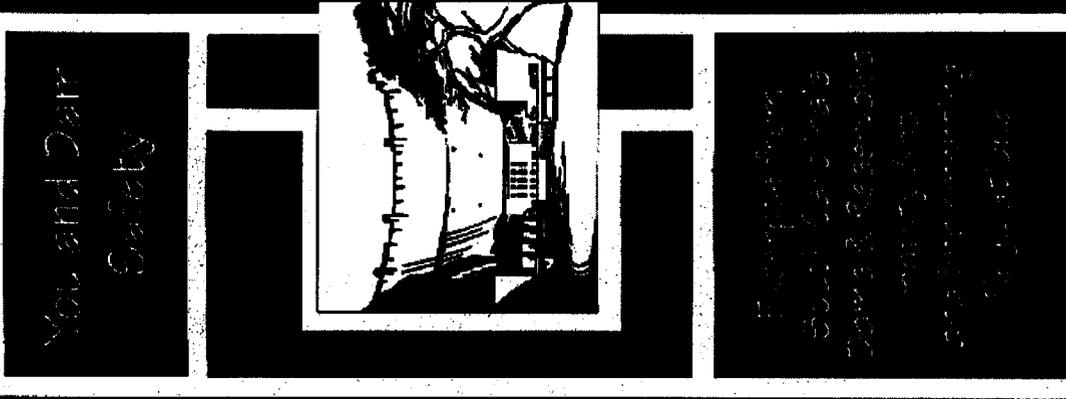
For emergencies involving dams (24 hours) call (803) 253-6488.

EGC District Offices

Appalachia I (Anderson, Oconee)	(864) 260-5669
Appalachia II (Greenville, Pickens)	(864) 241-1090
Appalachia III (Cherokee, Spartanburg, Union)	(864) 586-3900
Catawba (Chester, Lancaster, York)	(803) 226-7461
Central Midlands (Fairfield, Lexington, Richland, Newberry)	(803) 586-7015
Low Country (Beaufort, Colleton, Hampton, Jasper)	(803) 522-9097
Lower Swamph (Alcorn, Marlboro, Sumter, Sumner, Calhoun, Orangeburg)	(803) 641-7670
Pee Dee (Charleston, Darlington, Dillon, Florence, Marion, Marlboro)	(803) 661-4525
Tidlands (Berkeley, Charleston, Dorchester)	(803) 740-1590
Upper Swamph (Aiken, Edgefield, Greenwood, Laurens, McCormick, Saluda)	(864) 225-0885
Waccamaw (Georgetown, Horry, Williamsburg)	(803) 442-4902
Wetlands (Clarendon, Kershaw, Lee, Sumter)	(803) 778-1531



Designed by the Division of Media Services for the Dams and Reservoirs Safety Section
4A-1158 2/06



The Law

South Carolina's law regulating dams and reservoirs safety was passed in 1977 and was amended in 1980 and 1992.

Administration of the law is assigned to the South Carolina Department of Health and Environmental Control. Our highly trained engineers and technicians administer the required day-to-day activities associated with the dam safety program.

The Dam Safety Program

South Carolina's Dam Safety Program is aimed toward increasing the safety of the state's dams and minimizing the hazards they present to the public.

Since dams can be some of the most dangerous structures constructed by man, it is necessary to meet certain minimum standards for their design, construction, and maintenance. The South Carolina law is administered on the basis of those minimum standards.

The Law Excludes:

- Dams owned or operated by the federal government.
- Dams licensed by the Federal Energy Regulatory Commission.
- Dams licensed by the S.C. Public Service Authority.
- Dams traversed by a public road when the road is the only hazard.
- Dams less than 25 feet high and impounding less than 50 acre feet of water, unless life is threatened.

The Dams and Reservoirs Safety Section of DHEC:

- Reviews plans for construction of new dams and for alterations/repairs to existing dams.
- Issues permits for construction work and approves the completed construction.

The Environmental Quality Control (EQC) District Offices of DHEC:

- Perform routine inspections of high hazard and significant hazard dams.
- Perform routine checks of the areas below low hazard dams and reclassify the dams if necessary.
- Issue exemption certificates for dams not requiring permits when needed to qualify the owner for a state tax credit.
- Work with dam owners to assist them in voluntarily correcting problems on existing dams.
- Refer to enforcement any dams that owners decline to repair voluntarily.

Hazard Potential of Dams

South Carolina's dams that come under the state's Dams and Reservoirs Safety Act are classified into three categories according to their hazard potential. This has nothing to do with the condition of the individual dam, but is a measure of the potential damage that would be done if the dam should fail.

SPILLWAY

Vol. 1 Issue 1

A PERIODIC UPDATE ON OHIO'S DAM SAFETY PROGRAM

ADAMS LAKE...DISASTER AVERTED!

Potential disaster averted by quick actions of ODNR staff. Quick action by employees from several ODNR divisions prevented the failure of the dam at Adams Lake State Park during Christmas week. Completed in 1953, Adams Lake Dam is one of 164 dams owned by ODNR.

On the morning of December 21, Park Conservation Aide John Hackworth noticed a hole in the earthen dam about halfway down the downstream slope near the right end of the embankment. Seepage from the lake had eroded a hole through the dam's earth fill, forming a "pipe." The pipe had collapsed, and the ground surface had dropped into the eroded area. Water was flowing through the hole at the rate of about 40 gallons per minute.

Because piping can lead to complete, sudden dam failure, downstream evacuation and emergency dam repair was initiated. Employees from the Divisions of Water, Parks and Recreation, Forestry, and Civilian Conservation; the Office of Chief Engineer; the Ohio Department of Transportation; the Ohio Emergency Management Agency, and several local agencies and businesses helped make the repairs.

Residents of five homes were evacuated while ODNR staff worked to draw the lake down and install a buttress and filter blanket. Because of the

condition of the lake drain, a channel had to be cut around the right end of the embankment to lower the lake and relieve pressure on the dam.

"It was a great team effort," said Ted Lozier, a supervisor in the Division of Water's Dam Safety and Engineering Assistance Section. "We had 30 to



Ohio Department of Natural Resources track-hoe clears emergency relief channel in the right abutment.

40 people and over a dozen pieces of heavy equipment working around the clock. Lights were set up so the equipment operators could work through the night."

The material from the channel was placed along the dam and the natural shoreline to help seal the leak. Once the flow through the sinkhole was

See Inside

THE DAM SAFETY STAFF



From left to right, front row: Mark Ogden, George Mills, Stan Jastrzebsky, Ted Lozier; Middle row: Beth Bailik, Jim Morris (Chief), Beth Pratt; Back row: Jack Wallick, Scot Hindall, Boris Slogar, Jerry Reed, Rick Archer, and Rodney Tornes. Not pictured; Hung Thai.

The Dam Safety & Water Engineering Section of the Division of Water is responsible for implementing and enforcing Ohio's dam, dike and levee safety laws as well as providing water-related engineering services to the Division and other agencies. To accomplish these missions, the Section is divided into four units: Construction Permits, Repair and Emergency Response, Inspection and Inventory, and Hydraulic Operations. There are 82 years of combined engineering experience within the Section. The Construction Permits Unit administers the permit program for construction of new and enlarged dams, dikes and levees. Responding to water-related emergencies and overseeing dam rehabilitation projects is the Repair and Emergency Response Unit. The Inspection and Inventory Unit administers the periodic inspection program for existing dams, dikes and levees and maintains a computerized inventory of Ohio dams. The Hydraulic Operations Unit maintains and operates the two existing canal systems with field offices in St. Marys and Akron, Ohio.

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Department of Natural Resources
OHIO

George V. Voinovich, Governor
Frances S. Buchholzer, Director
James Morris, Chief

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATER

Division of Water
1939 Fountain Square
Columbus, Ohio 43224

SPILLWAY

A periodic newsletter published by the Dam Safety Section

RECYCLED PAPER

RODENT CONTROL

Lakes and ponds provide wildlife habitat for many types of animals. Rodents such as the groundhog, muskrat, and beaver are attracted to these bodies of water and the dams impounding them. If not controlled they can be quite dangerous to the structural integrity and proper performance of the dam. Rodent control is essential in preserving a well-maintained dam.

Groundhog (*Marmota monax*)

The heavily built, short-legged groundhog is the largest member of the squirrel family. Groundhogs originally were scarce in Ohio but gave increased with the clearing of forestland. These animals burrow along the edges of forests, brushy fencerows, creeks, and any other undisturbed area of cover such as an overgrown dam.

This burrowing activity is what effects the structural integrity of a dam. An active groundhog may excavate 500 pounds of material when making its home. These burrows shorten the seepage path for water through the dam and may collapse, weakening the structural integrity of the dam and any surrounding structures.

Groundhogs can be controlled by using fumigants or by shooting. Fumigation is the most practical method of controlling groundhogs. After the animal is removed, the burrow should be backfilled with a well-compacted material. Groundhogs will be discouraged from inhabiting the embankment if the vegetal cover is kept mowed.

Beavers (*Castor canadensis*)

The beaver is the largest rodent in North America. They will try to plug spillways with cuttings and compacted mud to increase the surface area of the pond allowing them a greater area for

gathering food. This causes a loss in available flood storage and increases the likelihood of the dam being overtopped by water during a large storm. Overtopping will cause severe erosion to the downstream slope and may lead to failure of the dam.

To discourage beavers from plugging spillways, it is recommended that the plug be removed as soon as it is discovered and on a regular basis. If this fails, the beaver may have to be removed. Information on trapping beavers is available from the local area wildlife office.

Muskrat (*Ondatra zibethicus*)

The muskrat is a stocky rodent with a broad head, short legs, small eyes, and short ears that barely extend above its fur. Muskrats live in either a lodge or a bank den. The upstream slope of a dam covered with cattails is very attractive to muskrats.

Muskrat burrows start 6 to 18 inches below the water surface and penetrate the embankment on an upward slant. At distances up to

15 feet from the entrance, a dry chamber is hollowed out above the water level. As this den approaches the crest of the embankment they are likely to collapse causing a reduction in the freeboard. When the water level rises during a large storm these dens allow the water to seep further into the dam. Damage is compounded where groundhogs construct their burrows in dams opposite muskrat dens.

Muskrats are generally controlled by trapping and removal of cattails from the upstream slope of the dam. Barriers to prevent burrowing offer the most practical protection to earth dams. A properly constructed riprap and filter layer will discourage burrowing as well as a heavy wire fencing laid flat across the slope. Both barriers should extend several feet below and above normal pool level.



Beaver dam obstructing spillway inlet.

WELCOME !

Welcome to the first periodical produced by the Dam Safety Section of the Division of Water. This publication is intended for all who own, maintain, design, or rehabilitate dams, dikes, or levees in the state of Ohio. The purpose of the periodical is to provide general and technical information regarding dam safety and the many related topics. We hope that each publication provides something useful for everyone. In future issues we would like to address any dam related questions or comments that our readers might have. Please send any questions or comments to:

The Ohio Department of Natural Resources
 Division of Water, Dam Safety Section
 1939 Fountain Square Bldg. E-3
 Columbus, Ohio 43224
 c/o "Spillway"

Adams Lake cont.

reduced, a rock filter blanket and buttress was installed over the seepage area to prevent erosion of the embankment. The filter will allow seepage to flow through the dam while holding the embankment material in place.

The finished buttress measured approximately 70 feet long, 45 feet wide, and 20 feet high. Excavation of the channel to allow for a 6-foot drawdown of the lake was finished on Christmas Eve about 3 p.m., and the families were notified that they could return to their homes.

"I'm really proud of the way everyone worked together and got the job accomplished," Ted said. "If the dam had failed, it would have wiped out four mobile homes, damaged a house, and destroyed a county road and bridge. It would have cost the department at least \$2 million to repair the damages."

A consultant has been hired to prepare construction drawings, specifications, and cost estimates by mid-summer. The repairs will be underway soon after the final plans and specifications are reviewed.

THE ANNUAL FEE

The Ohio Dam Safety Laws were first established in 1963 and have been amended several times since. Most recently, the 117th General Assembly enacted numerous revisions and additions which became effective July 1, 1987. One of these additions was Section 1521.063 which established the collection of an annual fee for all private and state-owned dams subject to inspection. Dams owned by political subdivisions are exempt from the annual fee. Recognizing that protecting Ohio's citizens and their properties from catastrophic failure of unsafe dams is a fundamental state responsibility, the intent of the annual fee was to place a small portion of the program's ongoing cost on the owners of dams - those persons receiving the most direct benefits. These fees generate only about 10 percent of the Dam Safety Program's cost; all other funding comes from the General Revenue Fund.

Approximately 1430 dams are assessed an annual fee. The fee for each dam is initially due on June 30 each year; however, there is a statutory grace period of 60 days before penalties are imposed. Delinquent accounts are turned over to the State Attorney General's Office for collection. The rate for the annual fee was changed in 1990 and is currently as follows:

Class I Dams, \$30 plus \$3 per foot of height of dam;
Class II Dams, \$30 plus \$1 per foot of height of dam;
Class III Dams, \$30.

DID YOU KNOW ?

Currently, the tallest dam in the state of Ohio is Cardinal Fly Ash No.1 Dam in Jefferson County. The dam is 241.5 feet tall!

The Construction Permits Unit is currently overseeing the construction of 30 new dams throughout the state. The cost to build these dams is over 17 million dollars.

CASE 4 - PENNSYLVANIA FACT SHEET

COMMONWEALTH OF PENNSYLVANIA _ DEPARTMENT OF ENVIRONMENTAL PROTECTION LIABILITY AND RESPONSIBILITY OF DAM OWNERS

Dam ownership carries with it significant legal responsibilities. The dam owner should be aware of the responsibilities and how to conscientiously deal with potential liabilities.

This fact sheet addresses general legal matters to help you minimize exposure to liability due to dam ownership and/or operation. This fact sheet does not answer specific legal issues. It is in the dam owner's/operator's best interest to obtain competent legal counsel when dealing with specific issues.

POTENTIAL LIABILITY PROBLEMS FOR DAM OWNERS

A dam owner should first be familiar with the legal obligation to maintain a dam in a safe condition. The dam owner is responsible for flood damage incurred to upstream properties by the storage of flood waters and is responsible for the damage caused by the sudden release of stored water from a failure of the dam or intentional rapid draining of the impoundment. The general rule is that a dam owner is responsible for its safety. Liability may be imposed on a dam owner if he or she fails to maintain, repair, or operate the dam in a safe and proper manner. This liability may apply not only to the dam owner, but also to any company that possesses that dam, or any person who operates or maintains the dam. If an unsafe condition existed prior to ownership of the dam, the new dam owner may not be absolved of liability should the dam fail during his term of ownership. Thus, the owner must carefully inspect the structural integrity of any dam prior to purchase and then provide inspection, maintenance, and repair thereafter.

Since the dam owner is responsible for dam safety, it is important to note what is done to comply with that legal duty. The dam owner must do whatever is necessary to avoid injuring people or property. This usually applies to foreseeable circumstances and situations which can be anticipated with reasonable certainty. A dam owner would generally not be responsible for those circumstances that a reasonable person could not anticipate such as one key action is almost universally recognized: In order to assure owners meet their responsibility to maintain their dam in a reasonable and safe condition, the department requires a dam owner to conduct regular inspections of the dam and correct deficient items. Also, regular inspections by qualified professionals are mandated so a dam owner may identify all problems and correct them.

POTENTIAL PERSONAL INJURY LIABILITY

Dams and impoundments are popular places, even if located in remote areas. A dam may be visited by employees, contractors, invited visitors, or trespassers. The presence of these people is a potential liability to the dam owner. Liability or worker's compensation insurance should cover employees, contractors, or invited guests. However, the trespasser presents a unique problem.

The majority of trespassers at a dam site are probably members of the public who wish to use the site for fishing, boating, or swimming. While they mean no harm, their unauthorized use of the site is a serious liability problem for the dam owner.

Appendix J - Public Outreach Tool Samples

The dam owner is responsible for making and keeping the premises safe. The general rule is that a dam owner must avoid conduct or conditions which could injure any person, even one who trespasses. If the dam owner knows that an unsafe condition exists, he is responsible to correct it and/or post warnings. Typical dangers at a dam site include fast moving water, open spillway (pipes), and thin ice. A particularly dangerous area is the portion of the weir immediately below the spillway. Boaters and swimmers have been trapped in the violent currents and eddies at the base of spillways of dams in Pennsylvania rivers and streams commonly frequented by canoeists, fishermen, and swimmers.

Owners of dams are charged with greater responsibility when the trespassers are children. By reasons of children's inability to understand the danger which a condition may pose, a dam owner is expected to protect children from the dangers of a dam site. In effect, this rule requires you to anticipate what parts of the facility would be particularly attractive to children. Since signs may not adequately warn children, security fencing may be necessary. Dam sites located near state or county roads, campgrounds, picnic areas, or near populated areas will attract many more people. These popular dam sites require frequent inspections by the dam owner to inspect and assure safety.

POTENTIAL LIABILITY DUE TO OPERATION OF A DAM

In addition to liability problems arising out of dam ownership, operation of the dam is also a significant legal issue. First and foremost is the simple right to operate a dam and impound water. State law requires a permit to construct, operate, and/or maintain a dam. DEP's Division of Dam Safety should be consulted for particular matters regarding this issue. In addition, a dam on a navigable stream may involve federal government regulations which may govern operation.

Beyond the basic permitting question, all dam owners must also consider the effect of dam operation on the rights of other water users, whether they are upstream or downstream of the facility. For both upstream and downstream users, this responsibility includes a duty to avoid negligent flooding of their property.

In times of high runoff, the dam owner must assess the effects of operation which alter prevailing conditions. Increasing discharge may create flooding downstream while decreasing discharge may protect downstream property but cause flooding or other damage upstream. The dam owner must always consider the maximum discharge capacity of the structure relative to prevailing hydrologic conditions and weather forecasts. Overtopping of a dam due to insufficient or untimely operations must be avoided.

In situations where there is no specific duty to protect downstream land owners from flooding, the dam owner must still operate the dam conscientiously. As the dam owner, you must be in a position to clearly show that your dam did not increase flooding.

Upstream users may also have the right to be protected from damage caused by operation of the dam. Therefore, the dam owner is advised to assess the legal as well as physical impact of any change in the level of impoundment, including dam removal.

A FINAL WORD ABOUT LIABILITY

This fact sheet is only a general introduction to the many issues regarding dam owner liability. The discussion is intended only to provide a basis for you to consider liability potentials and to encourage you, the dam owner, to seek competent legal counsel and/or technical experts

to help resolve your problems. Where the ownership and operation of dams and impoundments are concerned, the old saying, "an ounce of prevention..." is appropriate. Following it will truly save you the "pound of cure."

For more information contact:

Department of Environmental Protection
Bureau of Dams, Waterways, and Wetlands
Division of Dam Safety
P.O. Box 8554
Harrisburg, PA 17105-8554
(717)787-8568

This fact sheet and related environmental information are available electronically via Internet. Access the DEP-DCNR Web Site at <http://www.dep.state.pa.us> (choose Information by Environmental Subject/choose Water Management).

Commonwealth of Pennsylvania
Tom Ridge, Governor
Department of Environmental Protection
James M. Seif, Secretary
3200-FS-DEP-1954 11/95

An Equal Opportunity/Affirmative Action Employer

APPENDIX K - SAMPLE FEE STRUCTURES

I. APPLICATION FILING FEE

CASE 1: California

- (a) For the first three hundred thousand dollars (\$300,000), a fee of 3 percent of the estimated cost.
- (b) For the next seven hundred thousand dollars (\$700,000), a fee of 2 percent.
- (c) For the next one million dollars (\$1,000,000), a fee of 1½ percent.
- (d) For the next one million dollars (\$1,000,000), a fee of 1¼ percent.
- (e) For the next two million dollars (\$2,000,000), a fee of 1 percent.
- (f) For the next two million dollars (\$2,000,000), a fee of three-fourths of 1 percent.
- (g) For all costs in excess of seven million dollars (\$7,000,000), a fee of one-half of 1 percent.

In no case, however, shall the fee be less than three hundred dollars (\$300).

In the event the actual cost exceeds the estimated cost by more than 15 percent, a further fee shall be required by the agency computed under the schedule set forth in Section 1125 upon the additional cost, plus a penalty of 15 percent of the additional cost. No further fee shall be required, however, if such fee is to be computed at less than \$100. Upon making a determination that a further fee is required, the agency shall notify the owner that he may appear within 30 days thereafter before an authorized representative of the agency to protest the amount of the fee, in whole or in part.

II. ANNUAL REGISTRATION FEES

CASE 1: California Example:

An annual registration fee shall be paid on or before December 31, of each year, and on or before December 31 of each succeeding year, based upon the height of the dam, including all enlargements. The annual fee shall be one hundred fifty (\$150) plus sixteen dollars (\$16) per foot of height of the dam.

For the purposes of this section, "height of dam" means the vertical distance, to the nearest foot, from the natural bed of the stream or watercourse at the downstream toe of the barrier, as determined by the agency, or from the lowest elevation of the outside limit of the barrier, as determined by the agency, if it is not across a stream channel or watercourse, to the maximum possible water storage elevation.

CASE 2: West Virginia Example:

Annual Registration Fees - Owners of existing dams holding certificates of approval shall be assessed an annual registration fee. In accordance with provisions of the Dam Control and Safety Act, West Virginia Code § 22-14-7, existing certificates of approval will be extended for one year upon receipt of the annual registration fee, an inspection report, a monitoring and emergency action plan, and a maintenance plan; Provided that where an approved, up-to-date: inspection report; monitoring and emergency action plan; and maintenance plan are on file in the Dam Safety Section, and where no outstanding violation(s) exist, then the certificate of approval will be extended without resubmission of the foregoing documents upon receipt of the annual registration fee. The following annual registration fees apply:

Low hazard potential dams shall be assessed fifty dollars.

Significant hazard potential dams shall be assessed seventy-five dollars.

High hazard potential dams shall be assessed one hundred dollars.

Any certificate of approval issued pursuant to W. Va. Code § 22-14-17 and this rule is void without notification to the person holding the certificate of approval when the annual registration fee is more than one hundred eighty (180) days past due. Resubmission of an application in accordance with section 5 of this rule is required where a certificate has become void due to failure to pay the appropriate annual registration fee within 180 days of the date due.

APPENDIX L

NATIONAL PERFORMANCE OF DAMS PROGRAM

APPENDIX L - NATIONAL PERFORMANCE OF DAMS PROGRAM

I. Background

The National Performance of Dams Program (NPDP), established in 1994, is a cooperative effort of dam safety professionals in the U.S. and Canada that operates an information network to retrieve, archive and disseminate information on the performance of dams. The NPDP manages and maintains a special library and utilizes the Internet as a means to disseminate information. The NPDP resources are a means to facilitate the ongoing process of learning from the in-service performance of dams.

II. Dam Types

Dam incidents (as defined in the *Guidelines for Reporting the Performance of Dams*) should be reported for dams/reservoirs that satisfy the size criteria used in the National Dam Inventory or that fall within the state's jurisdiction. Conversely, states may not have jurisdiction over dams that fall within the NATDAM criteria. When the engineer becomes aware of an incident at a dam that falls in this category, the event should be reported based on available information.

III. Dam Incidents

Dam incidents are defined as events (e.g., load/response scenarios, dam operations during extreme or emergency conditions) which are of engineering interest due to the insights they provide on the performance of dams. While this definition includes cases involving failure (i.e., breach and uncontrolled release of the reservoir) or near failure of a dam, it also accommodates a broader scope of events. It includes events involving:

- the performance of a dam (satisfactory or unsatisfactory, anticipated or unanticipated) during periods of extreme loading such as that produced by a nearby seismic event or a large inflow flood;
- misoperation of a dam resulting in an uncontrolled release from the reservoir;
- implementation of an emergency action plan;
- signs of distress that are indicative of a potential loss of structural/operational integrity of a dam or its appurtenant structures;
- extreme deterioration of concrete, steel or timber structures that jeopardizes their structural integrity and safety; and
- dam-safety modifications to satisfy regulatory requirements and repairs to remedy damage caused by a dam incident.

Systematic documentation of events of this type, as well as those that involve failures or other levels of unsatisfactory performance, provides an experience database with which quantitative assessments can be performed and valuable insights derived.

In most cases it is easy to determine if a dam incident has occurred. Table 1 can be consulted to determine if events are considered dam incidents. The key words in the first column are used to enter the table. The second column describes the events that are considered dam incidents. The Guidelines can be consulted for further guidance.

IV. Steps to Report Dam Incidents

The process of reporting dam incidents consists of a series of steps that can be followed when reporting all incidents. The steps to report a dam incident are:

1. Determine if a dam incident has occurred (see Table 1);
2. Notify the Center of the dam incident by submitting a Dam Incident Notification (DIN) form, which is available in the Guidelines;
3. Prepare and transmit a Dam Incident Documentation Report; and
4. Prepare Dam Incident Follow-up reports.

Figure 1 illustrates the steps involved in reporting a dam incident.

Dam Incident Notification (DIN) - The DIN is a brief one-page form that is forwarded to the Center shortly after the incident. It provides the Center with early notification that an incident has occurred.

Dam Incident Documentation Report (DIDR) - The DIDR is used to document what happened during an incident and to provide information on the characteristics of the dam. The DIDR consists of:

- the incident chronology and, as applicable, the breach and downstream and/or upstream flooding;
- documentation of the damage to the dam and appurtenant structures;
- design criteria and as-built design and construction characteristics of the dam;
- documentation of post-incident actions; and
- costs of the dam incident.

Dam Incident Follow-up Report (DIFR) - Following an incident, a number of activities may take place and may include:

APPENDIX L - NATIONAL PERFORMANCE OF DAMS PROGRAM

- modifications or repairs to the dam;
- breaching of a dam;
- changes to operating procedures; and
- investigative studies to determine the cause of the incident, and
- legal proceedings.

As information on these activities becomes available, copies of applicable documents are submitted as part of the incident documentation.

V. Where to Report Dam Incidents

Dam incident reports are sent to the Center on the Performance of Dams at Stanford University. The Center's address is provided below.

VI. For More Information:

Further information about reporting dam incidents is provided in the Guidelines for Reporting the Performance of Dams. For further information about the NPDP, how to access NPDP resources, or to order the Guidelines you can contact:

Center on the Performance of Dams
Department of Civil Engineering
Stanford University
Stanford, California 94305

Telephone: (415) 723-9323
Fax: (415) 723-8398
e-mail: npdp@ce.stanford.edu

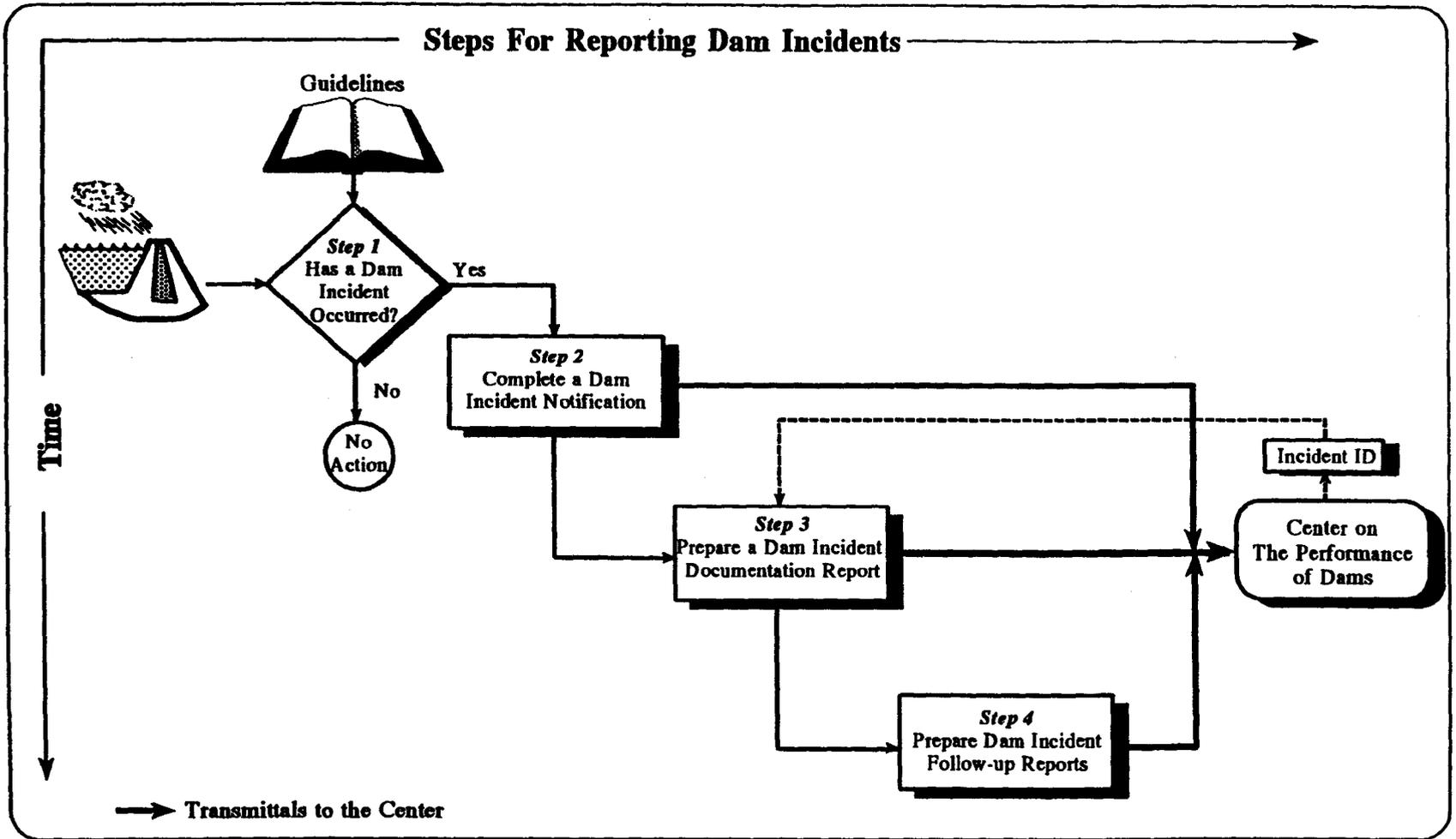


Figure 1. Diagram illustrating the steps for reporting dam incidents.

APPENDIX L - NATIONAL PERFORMANCE OF DAMS PROGRAM

Table 1
 Guidance For Determining if a Dam Incident Has Occurred
 List of Dam Incident Categories

Key Words	Incident Category
Inspection Findings	The findings of a dam-safety inspection that identifies previously unreported (to the Center) incidents of unsatisfactory or unsafe conditions at a dam (exclusive of ordinary maintenance and repair and findings of inadequacies relative to current design criteria).
Damage, Signs of Distress, Instability	Observations of damage, signs of distress or instability of the dam or appurtenant structures ¹ .
Dam Breach, Dam Failure	Dam breach (partial or complete).
Controlled Breach	Planned (non-emergency, non-incident initiated) breach of a dam. Possibly carried out to remove the dam from service or to make major repairs.
Downstream Release - Controlled or Uncontrolled	Uncontrolled release of the reservoir (e.g., appurtenant structure misoperation), or controlled release with damage.
Inflow Floods, Earthquakes	The performance of a dam (satisfactory or unsatisfactory, anticipated or unanticipated) during periods of extreme loading such as generated by a nearby seismic event or inflow flood.
Misoperation, Operator Error	Misoperation of appurtenant structures such as during a hydrologic event.
Equipment Failure	Failure of mechanical or electrical equipment to perform the dam-safety functions for which they were intended.
Deterioration	Deterioration of concrete, steel or timber structures that jeopardizes the structural/functional integrity of the dam or appurtenant structures.
Dam Safety Modifications, Repairs	Modifications to improve the safety of the dam or appurtenant structures such as might be required due to changes in the design basis.
Reservoir Incidents	Events that occur in the reservoir (e.g., landslides, waves) that may impact the safety of a dam.
Emergency Action Plans	Implementation of Emergency Action Plans (or emergency actions) in part or whole.
Regulatory Action	The regulator has determined an unsafe condition exists, or the dam does not meet applicable design criteria (e.g., inadequate spillway capacity), and requires action to be taken by the owner (e.g., reservoir restriction, safety modification).

¹Consult the Guidelines for specific reporting criteria.

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