UTAH

DAM SAFETY GUIDE

TO

EMERGENCY ACTION PLANS

DEVELOPMENT AND IMPLEMENTATION

2003

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A primary goal of the State of Utah's Dam Safety Program is to protect the public against the possibilities and consequences of dam failure. This goal is accomplished, in large measure, by establishing and enforcing adequate construction, operation, and maintenance standards for dams. Such methods do not provide absolute protection. Therefore, additional protection can be provided through a dam monitoring and emergency action plan.

This document is intended as an elaboration of the State of Utah, Dam Safety Administrative Rules and Regulations. This documentation should serve as a guide, and in no way is it to be considered absolute or comprehensive. Proper engineering judgement should be combined with sound risk and hazard management to produce an Emergency Action Plan that is complete, conclusive, and workable.

It should be recognized that monitoring and evacuation plans are not a substitute for necessary repairs. Monitoring and evacuation plans must be developed for all dams having a high or significant hazard potential as a means of protecting the public. The plan provides a low-cost way of recognizing dam safety problems as they develop and establishes non-structural means to prevent loss of life. The plan is essential for dams which have a high hazard potential or high risk of failure as an interim safety measure while the technical, legal, and financial aspects of remedial construction are resolved.

This manual is intended as a general guide for emergency action plan formulation, but allowances must be made for site-specific conditions of each dam and drainage. Every dam is unique with its own set of problems and solutions.

Additional guidance and site-specific detail is available from the Division of Water Rights, Dam Safety Section. Please do not hesitate to call if you need assistance in developing or implementing an Emergency Action Plan.

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## Table of Contents

### 1.0 Questions

1.1 What is an EAP?
1.2 Why is it important to have an EAP?

### 2.0 Introduction

2.1 Notification Flowchart
2.2 Responsibilities
2.3 Emergency Identification, Evaluation, Classification
2.4 Notification Procedures
2.5 Preventive Action
2.6 Inundation Map
2.7 Appendices

### 3.0 Overall Process for Developing an EAP

3.1 Development Steps 1-10
3.2 Coordinating the Development of the EAP with all Participants

### 4.0 Suggested Guidelines for EAP Format

4.1 Guidelines

### 5.0 Overview of Part I--Introductory Section

5.1 Title Page/Cover Sheet
5.2 Notification Flowchart
5.3 Statement of Purpose

### 6.0 Overview of Part II--Responsibilities

6.1 General Responsibility
   6.1.1 Owner Responsibility
   6.1.2 Responsibility for Notification
   6.1.3 Responsibility for Evacuation
   6.1.4 EAP Coordinator Responsibility
6.2 Approval of the Plan

### 7.0 Overview of Part III--Emergency Procedures

7.1 Emergency Identification, Evaluation and Classification
7.2 Notification Procedures
TABLE OF CONTENTS (CONTINUED)

8.0 OVERVIEW OF PART IV--PREVENTIVE ACTIONS PAGE

8.1 Surveillance
8.2 Access to the Site Transportation
8.3 Response during Periods of Darkness
8.4 Response during Periods of Adverse Weather and Flooding
8.5 Alternative Means of Communication
8.6 Emergency Supplies and Resources
  8.6.1 Stockpiling Materials and Equipment
  8.6.2 Coordinating Information or Flows
  8.6.3 Providing Alternative Sources of Power

9.0 OVERVIEW OF PART V--INUNDATION MAPS

9.1 Inundation Maps

10.0 OVERVIEW OF PART VI--APPENDICES

10.1 Description and Location of the Dam.
10.2 Investigation and Analysis of Dam Break Floods
10.3 Benchmarks and Flood Profiles
10.4 Training
10.5 Testing
10.6 Updating
10.7 Posting of the Notification Flowchart
10.8 Recording of Emergency Conditions
10.9 Glossary

11.0 SUMMARY

11.1 Steps 1-9
11.2 Parts I-VI

APPENDICES

I Potential Problems and Immediate Response Actions
II Glossary
III Sample Emergency Action Plan

REFERENCES - CREDITS
1.1 WHAT IS AN EAP?

An Emergency Action Plan, or EAP, is a formal plan that identifies potential emergency conditions at a dam and prescribes the procedures to be followed to minimize property damage and loss of life.

An emergency, in terms of dam operation, is defined as a condition which develops unexpectedly, endangers the structural integrity of the dam and/or downstream property and human life, and requires immediate action.

NOTE: Every EAP must be tailored to site-specific conditions and to the requirements of the agency/organization that owns the dam or the State Engineer who regulates the dam.

1.2 WHY IS IT IMPORTANT TO HAVE AN EAP?

An EAP is needed for the following reasons:

1.2.1 To preplan the coordination of necessary actions by the dam owner and the responsible local, State, and/or Federal officials to provide for timely notification, warning, and evacuation in the event of an emergency.

1.2.2 To reduce the risk of loss of life and property damage, particularly in downstream areas, resulting from an emergency situation.

1.2.3 The design, construction, operation and maintenance, and inspection of dams are all intended to minimize the risk of future dam failures. Despite the adequacy of these programs and their implementation, unique situations do sometimes develop that may result in dam failure. Therefore, it is prudent for dam owners to identify conditions which could lead to failure, in order to initiate emergency measures that could prevent or minimize the consequences to life and property.

1.2.4 It should be noted that monitoring and emergency action plans are not a substitute for necessary remedial construction and maintenance of the dam.
2.0 **INTRODUCTION**

This section will briefly examine the basic elements of an EAP.

2.1 **NOTIFICATION FLOWCHART**

A notification flowchart is a schematic representation of the hierarchy for notification in an emergency situation, including who is to be notified, by whom, and in what priority. The flowchart should be prominently displayed in the EAP document.

2.2 **RESPONSIBILITIES**

A determination of responsibility for EAP-related tasks must be made during the development of the plan. Generally speaking, owners are responsible for the development and maintenance of the EAP and for activating the notification procedures of the plan. Local, State and Federal officials having statutory obligation are responsible for warning and evacuation within affected areas. The EAP must specify the persons responsible for declaring an emergency under various circumstances and for initiating emergency actions. In doing so, the plan must be site-specific.

2.3 **EMERGENCY IDENTIFICATION, EVALUATION AND CLASSIFICATION**

Determination and identification of the situations or triggering events that initiate or require emergency action must be made. The establishment of procedures for reliable and timely recognition of emergency situations is imperative. If time permits, an emergency situation should be evaluated and confirmed by an experienced and qualified engineer. Finally, to determine the appropriate course of action, the emergency situation or triggering event should be classified according to its urgency.

2.4 **NOTIFICATION PROCEDURES**

Notification procedures should be developed to ensure the timely notification of persons responsible for taking emergency actions. The procedures should be brief, simple, and easy to implement.

2.5 **PREVENTIVE ACTION**

Preventive action is a general term used to refer to both preplanned and emergency actions that are aimed at preventing failure of a dam or minimizing loss of life and property damage in the event of a failure. A few of the preventive actions that a dam owner might take are to ensure access to the dam site under adverse conditions, provide emergency flood operating instructions, and arrange for expertise, equipment, labor, and materials for use in emergency situations.
2.6 INUNDATION MAP

An inundation map delineates the areas that would be flooded as a result of a dam failure or unusually large spillway releases. An inundation map is sometimes supplemented by a narrative description of the areas that would be flooded. The flow depth and timing of the potential flood should be related to known landmarks and historical flood heights.

2.7 APPENDICES

Appendices, containing supporting materials used in the development and maintenance of the plan, are usually included in the EAP document.

3.0 OVERALL PROCESS FOR DEVELOPING AN EAP

3.1 DEVELOPMENT STEPS

Careful research and coordinated planning with all involved parties will lay the foundation for a responsible and thorough emergency action program. The process of developing an EAP should generally follow the nine steps listed below.

3.1.1 Determine the potentially inundated area by defining dam break flood profiles downstream from the dam. Conditions to be considered may include:

3.1.1.1 Fair-weather dam failure at normal full-pool levels (seismic failure, piping failures, etc).

3.1.1.2 Design flood with and without failure.

3.1.1.3 As appropriate, other flood flow conditions, with and without failure, to determine the worst-case scenarios.

3.1.2 Prepare inundation maps which clearly depict the flooded areas. Secondary hazards, such as mud slides and hazardous wastes, should be identified as well as evacuation areas. Flood depth and timing should be related to landmarks and historical floods.

3.1.3 Determine and identify those situations or triggering events that would intimate an emergency action, and specify the corrective actions to be taken and by whom.

3.1.4 Identify all jurisdictions, agencies, and individuals who will be involved in the EAP. Coordinate the development of the EAP with these parties. Interactions should include discussion of emergency operations and reception centers,
evacuation (destinations, priorities, and procedures), post-flood actions (recovery and cleanup), and other measures in the event of an emergency. Civil Defense, police and medical support organizations should also be included.

3.1.5 Identify primary and auxiliary communications systems, both internal (between persons at the dam) and external (between dam personnel and outside entities). TV, radio and local media organizations should be included.

3.1.6 List and prioritize all persons and entities involved in the notification process, and draft the Notification Flowchart.

3.1.7 Develop a draft of the EAP. (Note: A suggested format for an EAP is described on the following pages, along with suggestions for what might be important to include in the EAP.)

3.1.8 Hold coordination meetings with all parties included on the notification list to receive comments on the draft EAP. The public may be invited.

3.1.9 Make any revisions, obtain the necessary signatures of plan approval, and disseminate the EAP to those who have responsibilities under the plan.

3.1.10 Implement the plan on a trial basis to see if it is workable.

3.2 COORDINATING THE DEVELOPMENT OF THE EAP WITH ALL PARTICIPANTS

Development of the EAP must be coordinated with all entities, jurisdictions, and agencies that would be affected by a dam failure, or that have statutory responsibilities for warning, evacuation, and post-flood actions. The finished product will therefore realistically take into account each organization’s capabilities, and each participant will be fully aware of individual responsibilities. Appropriate levels of management must be involved in developing the EAP to ensure that each entity will agree to execute its responsibilities under the plan.
4.0 SUGGESTED GUIDELINES FOR EAP FORMAT

4.1 GUIDELINES

These guidelines are provided to encourage thorough and consistent emergency action planning for levels of preparedness that may save lives and reduce property damage in areas affected by dam operation or failure. It is helpful to place the EAP in a loose-leaf binder, so that outdated pages (or the entire EAP) can be easily removed and replaced with updated information to ensure a complete, current, and workable plan. An EAP can be organized in whatever format seems most useful for those involved in the plan. One format will be described in this paper. While an EAP need not be organized in the described manner, it should include the contents described on the following pages. The contents and a suggested format for an EAP are listed briefly below, and described in detail on the subsequent pages:

4.1.1 Part I -- Introductory Section
4.1.2 Part II -- Responsibilities
4.1.3 Part III -- Emergency Procedures
4.1.4 Part IV -- Preventive Actions
4.1.5 Part V -- Inundation Maps
4.1.6 Part VI -- Appendices

5.0 OVERVIEW OF PART I--INTRODUCTORY SECTION

The introductory section of an EAP should include the following items:

5.1 TITLE PAGE/Cover SHEET

An EAP's cover identifies it as an Emergency Action Plan and specifies the dam for which it was developed. For some dams, different EAP's may be developed for different emergency situations or conditions, each with its own specific procedures to be followed. In such instances, title pages or cover sheets are essential, so personnel can be sure that they are using the right plan for the circumstances. A description of the dam and hazard area may be appropriate as well as the identification of the owner, responsible authority and approving agency.

5.2 NOTIFICATION FLOWCHART
5.2.1 The EAP should begin with a Notification Flowchart clearly summarizing the following information for each of the emergency conditions considered:

5.2.1.1 Person(s) responsible for notifying each owner representatives and/or public officials.

5.2.1.2 Person(s) to be notified.

5.2.1.3 Prioritized order in which individuals are to be notified.

5.2.1.4 Individual names and position titles, office and home telephone numbers, and alternative contacts and means of communication (e.g., radio call numbers).

5.2.2 Some of the emergency conditions to be considered are:

5.2.2.1 Failure is imminent or has occurred.

5.2.2.2 Potential emergency situation has developed or is developing.

5.2.2.3 Flooding is occurring or is expected.

The flowchart should be easy to follow under emergency conditions and should normally be limited to one page. Color coding (i.e., using different colored lines to trace the proper sequence of notification under various emergency conditions) will prove helpful. Narrative information supplementing the flowchart should be provided in the section discussing notification procedures. Additional copies of the flowchart should be readily available to each individual having responsibilities under the plan and should be kept up-to-date through tests and revisions.

5.3 STATEMENT OF PURPOSE

Following the Notification Flowchart, briefly state the purpose and scope of the EAP. Two examples of a statement of purpose are shown below.

5.3.1 Example 1: "This plan defines responsibilities and provides procedures designed to identify unusual and unlikely conditions, which may endanger Dam, in time to take remedial action and to notify the appropriate public officials of possible, impending, or actual failure of the dam. The plan also provides for notification when flood releases will create major flooding."

5.3.2 Example 2: "The purpose of this Emergency Action Plan (EAP) is to safeguard the lives and reduce damage to the property of the citizens of County, living along Creek, in the event of failure of Dam or flooding caused by excessive runoff."
6.0 OVERVIEW OF PART II--RESPONSIBILITIES

The responsibilities section of an EAP should include the following items, A discussion of each item follows.

6.1 GENERAL RESPONSIBILITIES UNDER THE PLAN

The plan should specify the person(s) or organization responsible for the maintenance and operation of the dam and the persons or groups responsible for implementing various phases of the EAP. Some specific responsibilities to be considered are discussed below.

6.1.1 Owner Responsibility

The duties of the owner or the owner's designated representatives in implementing the EAP should be clearly described. Some suggestions for information to include in this section are listed below.

6.1.1.1 Determine and identify the conditions or triggering events that initiate or require emergency actions, and specify the actions to be taken and by whom.

6.1.1.2 Provide guidance on how to clearly communicate the emergency situation to those who need to be contacted.

6.1.1.3 Include sample warning messages tailored to specific situations.

6.1.1.4 Describe who is responsible for taking specific actions at the dam after the notification procedures have been implemented. For example, spell out procedures for opening spillway gates, especially if a certain sequence is required, and opening/closing water intakes as appropriate. (This information should be available in the established procedures for reservoir operation.)

6.1.1.5 Provide instructions for the operation of the project during the anticipated emergency. Specific actions should be discussed under the section "Preventive Action." Sources of equipment, material and labor, and expertise should be identified.

6.1.1.6 Encourage local officials to develop a plan to safeguard life and property from flooding should the dam fail or pass unusually large flows through its spillway system. This plan should include, as a minimum, procedures for an emergency operations center, evacuation, and post-flood actions.

6.1.1.7 Responsibility for the identification, declaration and termination of the emergency should be determined.
6.1.2 Responsibility For Notification

The persons authorized to notify local officials should be determined and 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 National Weather Service (NWS) and/or other agencies have the general responsibility for issuing flood warnings. It will, therefore, be beneficial to notify the NWS or other appropriate agency of any pending or actual dam break flooding, so that its facilities can enhance warnings being issued.

The Utah State Division of Emergency Services and Homeland Security should also be notified for emergency management assistance. They will in turn contact all the appropriate governmental entities such as the Governor’s Office, FEMA, the State Geologist, Water Resources, the State Engineer.

6.1.3 Responsibility For Evacuation

Warning and evacuation planning are the responsibilities of the entities having statutory obligation. Under most plans, the dam owner is responsible for notifying the appropriate officials when flooding is anticipated or a failure is imminent or has occurred.

Dam owners should not normally assume the responsibility of governmental entities for evacuation of people. 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.

6.1.4 EAP Coordinator Responsibility

If appropriate, designate an EAP coordinator who will be responsible for EAP-related activities, including preparing revisions to the EAP, establishing training seminars, coordinating EAP drills, etc. This person should be the EAP contact should any involved parties have questions about the plan. Every EAP should be updated and exercised annually.

6.2 APPROVAL OF THE PLAN

The EAP should include a section that is signed by all parties involved in the plan where they indicate their approval of the plan and agree to their responsibilities in the execution. Including the approval signatures is essential, for they assure that all parties involved are
aware of and understand the EAP and agree to do their assigned roles should an emergency take place.

Procedures for updating the EAP should be included when conditions or personnel change.

7.0 OVERVIEW OF PART III--EMERGENCY PROCEDURES

The section of the EAP that covers emergency procedures should include the following:

7.1 EMERGENCY IDENTIFICATION, EVALUATION AND CLASSIFICATION

The EAP should include a discussion of procedures for timely and reliable identification, evaluation, and classification of existing or potential emergency conditions. Major elements of these procedures are:

7.1.1 A listing of the conditions or events which could lead to or indicate an existing or potential emergency. Situations involving flood emergencies due to a breach or other structural failure as well as a major flood without a breach should be included. Breach conditions could occur as a result of such occurrences as piping, landslide, floods, earthquake, or sabotage.

7.1.2 A brief description of the means by which potential emergencies will be identified, including the data and information collection system, monitoring arrangements, surveillance, inspection procedures, and other provisions for early detection of conditions indicating an existing or potential emergency. A more detailed discussion of instrumentation can be found in the section entitled "Part IV--Preventive Action" on Page 3.

7.1.3 Procedures, aids, instructions, and provisions for interpreting information and data to assess the severity and magnitude of any existing or potential emergency. An example that might be included in the EAP is an Emergency Action Table.

7.1.4 Designation of the person responsible for identifying and evaluating the emergency. This would normally be the owner or the owner's representative; however, if the owner does not have the proper technical expertise, responsibility may need to be assigned to another individual. Make sure that continuous coverage is provided by designating appropriate alternatives.

NOTE: At unattended dams (i.e., dams not continuously manned), special consideration should be given to the need for surveillance. Since any Emergency Action Plan has little value unless it can be implemented in a timely manner, surveillance at the dam should be evaluated to ensure that sufficient time will be available for notifying responsible officials and warning the public. Once an emergency condition has been identified and evaluated, it should be classified as to the urgency so that the appropriate action can be taken. Emergency conditions
can be classified as an alert, warning, continuing conditions, or imminent.

7.2 NOTIFICATION PROCEDURES

The notification portion of the EAP should contain a listing of all persons to be notified in the event that an emergency condition develops. This list should include individual names and position titles, locations, office and home telephone numbers, and radio communication frequencies and call signals (if available) for owner personnel, public officials, and other personnel, including alternates. For each type of emergency situation, the EAP should clearly indicate who is to make the call, to whom it is to be made, and in what priority.

The number of persons to be notified by each responsible individual in the notification plan should be kept to a minimum. The number of calls will in some cases be governed by what other responsibilities the caller has been assigned. For each emergency condition that is anticipated, the plan should describe actions to be taken and contacts to be made. Priority of notification will depend upon the actual emergency situation.

The following individuals or agencies, where applicable, should be considered for inclusion in the notification procedures:

7.2.1 Residents and property owners located immediately downstream of the dam with the area of potential inundation where available warning time is very limited.

7.2.2 Owner personnel.

7.2.3 Law enforcement officials.

7.2.4 Operators of upstream and downstream dams or water-retention facilities.

7.2.5 Appropriate Federal, State, and local agencies.

7.2.6 Managers and operators of recreation facilities.

7.2.7 Appropriate media organizations.

7.2.8 Others, as appropriate.

The plan should designate a spokesperson to disseminate information. The news media, including radio, television, and newspapers, should be utilized to the extent available and appropriate. Use of news media should be preplanned to the extent possible by the dam owner and/or public officials. Notification of the news media may be done by the dam owner or by public officials, depending on the type of emergency. News media should be given specific locations to congregate and film, away from decision discussion and
construction activities. A media spokesperson should be appointed to convey information from the emergency center to the press location. Notification plans should define emergency situations for which each media will be utilized and should include an example of a news release that would be the most effective for each possible emergency. (NOTE: News releases ordinarily should not be relied upon as the primary means of warning the public.)

To ensure that the contact that implements the plan is real and not a prank, a code or keyword might be arranged by the parties involved in the early stages of notification.

8.0 OVERVIEW OF PART IV--PREVENTIVE ACTIONS

The EAP should describe preventive actions taken both prior to and following the development of emergency conditions, to prepare for any emergency. Preventive actions involve the installation of equipment or the establishment of procedures for one or more of the following purposes:

8.0.1 Preventing emergency conditions from developing, if possible, or warning of the development of emergency situations.

8.0.2 Facilitating the operation of the dam in an emergency situation.

8.0.3 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 detection of an emergency situation and should clearly indicate that it 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.

In the EAP, discuss the time factor from the actual occurrence of an emergency to awareness of the emergency and its effect on the workability of the EAP. Timely implementation of the EAP is a crucial element in its effectiveness.

8.0.4 These are several types of preventive actions that should be considered when developing an EAP. This section will discuss each of these actions.

8.1 SURVEILLANCE

When a dam is not continuously manned (as is the case with most dams in Utah) and failure would endanger human life or cause significant property damage, it is imperative that procedures be developed to identify conditions requiring emergency actions, and to promptly alert public safety officials responsible for evacuating residents who would be affected in the event of an emergency at the dam. In order to be able to promptly notify
responsible officials of emergency conditions, a dam owner or owner’s representative must receive a timely warning that an emergency has developed or is developing.

The information received must be clear and concise, so that the responsible officials may react with confidence and activate the EAP, if necessary, without requiring personnel to visit the site to verify conditions.

At unattended dams, the dam owner should consider installing a remote surveillance system that includes instrumentation and telemetering facilities at the dam site, to provide a continuous reading of headwater and tailwater levels at an operations control center that is manned 24 hours a day. The system should include a computer at the operations center to monitor the data and to activate an audible alarm whenever the rate of change of the headwater or tailwater over a given period of time exceeds prescribed limits. The alarm also should be activated if the headwater or tailwater elevations exceed prescribed maximum or minimum levels. Design must be site-specific. The limits programmed in a system must account for change in headwater and tailwater levels that would occur during dam operation, floods, maintenance, etc. Alarm systems can be simple audible sounds or systems that automatically call owners and officials instead of alerting the general public directly.

Monitoring of the tailwater generally is more sensitive to changes resulting from a breach of the structures than monitoring of the headwater. Changes in tailwater will alert operators more quickly to site conditions and help determine whether public safety officials should be notified. If continuous readings of both the headwater and tailwater are available, the operator can obtain a current reading at any time and check conditions at the site after an alarm sounded.

Provisions should be made for the alarm to sound when there is an interruption of power to and loss of communication with the monitoring or telemetry instrumentation. (When a dam tender lives close to the project, consideration should also be given to having an alarm in the dam tender’s house.) When power to or communication with the site instrumentation is interrupted, the dam should be manned until conditions are returned to normal. Operation of the alarms should be checked periodically. Proper functioning of alarms should be confirmed by testing. For instance, annual testing of the plan might be initiated by causing one of the alarms to go off.

Reaction time must be minimized when inhabited structures are located immediately downstream of the dam. When these conditions exist, special procedures may need to be included in the EAP to notify the occupants. Local public safety officials should be fully involved in the development of these procedures.

The EAP should describe any instrumentation for monitoring the behavior of unattended dams and explain how warning systems would be implemented. Instrumentation responses should be instantaneous to facilitate immediate action by operators. Also, it should describe procedures for providing round-the-clock surveillance for periods of actual or forecasted high flows. It may be necessary to send an observer to the dam during these periods and not rely on the instrumentation alone. In addition, it is recommended that an observer be at the dam when flood conditions or signs of serious structural distress have been identified. If a discussion of remote surveillance at the dam is not applicable, that fact should be stated in the EAP.
8.2 ACCESS TO THE SITE--TRANSPORTATION

The description of access should focus on primary and secondary routes and means for reaching the site under various conditions (e.g., foot, boat, helicopter, snowmobile, etc.) and discuss in detail the expected response (travel) time.

8.3 RESPONSE DURING PERIODS OF DARKNESS

Discussion in the EAP of the response to potential or actual emergency conditions during periods of darkness should:

8.3.1 Describe actions to be taken to illuminate the spillway operating deck, and other actions that will facilitate the operation of gates or other emergency equipment. Light plants should be located on abutments rather than on the embankments or spillway, in case of failure.

8.3.2 Explain how the emergency operations center, spillway gates, etc. are to be operated during a power failure.

8.3.3 Describe any special procedures for contacting or notifying the proper personnel, local officials, or others during a power failure.

8.3.4 Discuss in detail the expected response time for verifying an emergency and implementing the EAP.

8.3.5 Include any other special instructions for the dam operators or local officials.

8.4 RESPONSE DURING PERIODS OF ADVERSE WEATHER AND FLOODING

Discussion of emergency response under adverse weather conditions should:

8.4.1 Describe in detail the actions to be taken. Action should be based on whether the dam is manned or unmanned.

8.4.2 Describe methods of access to the site (e.g., foot, boat, snowmobile).

8.4.3 Discuss in detail the expected response time.

8.4.4 Include any other special instructions for the dam operators or local officials.

8.5 ALTERNATIVE SYSTEMS OF COMMUNICATION

The description of the availability and use of alternative communications systems at the
site should:

8.5.1 List alternative channels of communication to be used in case of failure of the primary system or failure of other systems immediately available.

8.5.2 Explain proper procedures for activating the alternative channels of communication.

8.5.3 Include any other special instructions.

8.6 EMERGENCY SUPPLIES AND RESOURCES

There are certain planning and organizational measures that can help dam personnel and local officials manage emergency situations more safely and effectively. These measures include:

8.6.0.1 Stockpiling materials and equipment for emergency use.

8.6.0.2 Coordinating information on flows.

8.6.0.3 Providing alternative sources of power for gate operation and other emergency uses.

If any of these measures apply, they should be discussed in the EAP. Specific types of information to include when describing these emergency supplies and resources follow.

8.6.1 Stockpiling Materials And Equipment

Where applicable, document:

8.6.1.1 Materials needed for emergency repair, and their location, source, and intended use. Materials should be as close as possible to the dam site.

8.6.1.2 Equipment to be used, location, and who will operate it.

8.6.1.3 How the operator or contractor is to be contacted.

8.6.1.4 Any other people who may be needed (e.g., laborers, divers, geologists, engineers), and how they are to be contacted.

NOTE: For each applicable item, include specific contacts and their business and
nonbusiness means of communication. Also include any other special instructions. If stockpiling of materials and equipment is not applicable to your dam, that fact should be stated in your EAP.

8.6.2 Coordinating Information On Flows

Where applicable, describe:

8.6.2.1 The need for coordination of information on flows based on weather and runoff forecasts, failure and other emergency conditions. Describe how the coordination is achieved and the chain of communication, including names and day/night telephone numbers of responsible people. Coordination with the National Weather Service (NWS), State Dam Safety Office or other appropriate agency is recommended to monitor storms, river stages, and flood waves resulting from a dam break. The NWS or Dam Safety Office or other appropriate agency may also be able to supplement the warnings being issued by using its own communication system.

8.6.2.2 Additional actions contemplated to respond to an emergency situation or failure at an unattended dam. Include periods of darkness, inclement weather, and nonbusiness hours.

8.6.2.3 Actions to be taken to lower the reservoir water surface elevation, if applicable. Describe when and how this action should be taken. If not applicable, that fact should be stated in the EAP.

8.6.2.4 Actions to be taken to reduce inflow to the reservoir from upstream dams or control structures. The EAP should provide instructions for operators or other persons responsible for contact with other owners on when and how these actions should be taken. If such actions do not apply, that fact should be stated in the EAP.

8.6.2.5 Actions to be taken to reduce downstream flows, such as increasing or decreasing outflows from downstream dams or control structures on the waterway on which the dam is located or its tributaries. The EAP should provide instructions for operators or other responsible persons on when and how these actions should be taken. If such actions do not apply, that fact should be stated in the EAP.

Also describe any other appropriate actions to be taken. If coordination of information on flows is not applicable, that fact should be stated in the EAP.

8.6.3 Providing Alternative Sources Of Power
Where applicable, describe the alternative sources of power for gate operation and other emergency uses. The EAP should list the location of each power source, its mode of operation, and, if portable, the means of transportation and routes to be followed. The EAP should include the name and day/night telephone numbers of the operator or other responsible person. If this action is not applicable, that fact should be stated in the EAP.

Finally, describe any other site-specific actions devised to mitigate the extent of possible emergencies.

9.0 OVERVIEW OF PART V--INUNDATION MAPS

An EAP should include one or more inundation maps. An inundation map shows areas that would be subject to flooding due to storm conditions or failure of a dam. The flood routing shown on inundation maps should typically be carried to a point beyond which flooding would no longer constitute a hazard to downstream life and property. The following discussion describes how these maps are developed, and how they are used in evacuation planning.

9.1 INUNDATION MAPS

Whenever communities or dwellings are located in the floodplain downstream of a dam, inundation maps are usually needed to develop an adequate evacuation plan. These maps should show an outline of the area covered by the dam break flood in enough detail to identify dwellings and other significant features that are likely to be directly affected. Mapping is generally accomplished by superimposing the flood outline on an existing map. Estimated flood travel time, depth and velocity at selected locations should be included on the map. The maps should be of sufficient scale and detail to identify clearly the areas that would be flooded if large flows occurred from dam failure, misoperation, or extreme storms. Clarity and simplicity are important. Therefore, the map scale should be such that all important features can be identified.

Since local officials are likely to use the inundation maps for evacuation purposes, a note should be included on the maps to advise that, because of the method, procedures, and assumptions used to determine the flooded areas, the limits of flooding shown and flood wave travel times are worst-case approximations and should be used only as a guideline for establishing evacuation zones. Areas inundated in an actual event will depend on actual failure conditions and may differ from areas shown on the maps.

Generally, an inundation map depicting both breach and large flood conditions should be included in the plan. Although additional conditions could be covered, caution should be used to keep the plan simple enough to be clear and understandable. Generalized breach inundation maps may be used in the plan if sufficient for clearly depicting the inundated areas. Generalized maps may need to be supplemented with larger scale and more detailed maps in some areas. The mapping and the number of different flooded areas should be coordinated with local officials who are developing evacuation plans. It may be appropriate to supplement the inundation maps with water surface profiles in
9.1 INUNDATION MAPS (Continued)

For detailed maps, it is recommended that the best available maps for evacuation planning be used. Topographic or orthographic mapping or street maps may prove best. The lines delineating the inundated area should be drawn in such thickness or form (e.g., solid line, dashed line, dotted line) as to identify the inundation limits as the main features of the map, but not bold enough to obliterate features which would be inundated by the flood waters.

When plotting inundation limits between cross sections used for the analysis, the lines should reasonably reflect the change in water levels caused by topographic patterns and manmade features. Color-coded maps are recommended.

When inundation lines enter the area of an existing reservoir, they should represent an increase in the water level of the reservoir. If this increased water level would overtop or breach the dam impounding the reservoir, the appropriate inundation lines should extend downstream of the dam.

For dams not in series but which affect a common downstream area, it is usually adequate to consider the breach condition for each dam individually, unless special conditions warrant multiple failure considerations. Breach inundation lines of such dams should then consist of a line enveloping the lines for the individual breaches when common areas would be inundated.

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

NOTE: Development in the floodplain below some dams is sparse, and the expense of preparing inundation maps may not be warranted. Flooding information can be readily provided by detailed vicinity maps showing pertinent data at the key locations. Individuals living between key locations can estimate their vulnerability by interpolating data from locations upstream and downstream of their sites. Inundation maps should always be prepared by a qualified engineer or professional hydrologist.

10.0 OVERVIEW OF PART VI--APPENDICES

Following the main body of the plan, you should include an appendices that contain basic information about the dam, data used in the development of the EAP, and instructions for the maintenance of the plan.

Listed below are some of the topics to be covered in the appendices accompanying your EAP:

10.0.1 Description And Location Of The Dam
This section describes each of these possible appendices topics.

10.1 DESCRIPTION AND LOCATION OF THE DAM

The appendices would be an appropriate place to summarize the principal features of the dam and include plan and drawings. Such an appendices could also describe the upstream and downstream areas and topography and establish the location of the dam using maps and narrative description. Information concerning the dam owner, purpose, use schedule, date built, engineer, builder, height, capacity and other pertinent physical data should be included.

10.2 INVESTIGATION AND ANALYSIS OF DAM BREAK FLOODS

The EAP appendices can identify and briefly describe the method and assumptions selected to identify the inundated areas.

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 areas inundated by the flood as it travels downstream. To avoid unnecessary study and costs, the routing should cease at a point where real-time flood warning information can be provided on a pre-planned basis.

Many methods for developing the dam failure hydrograph and routing dam break flows downstream are available. Regardless of the method used, all EAP's for communities and other affected areas in a watershed should be developed using, to the extent practicable, the same computational procedures to insure coordination, compatibility, and acceptance. Many Federal and State agencies have developed procedures that are available upon
request. They may be obtained from the National Weather Service (NWS), Hydrological Engineering Center (HEC), Bureau of Reclamation, Soil Conservation Service, Corps of Engineers, Tennessee Valley Authority, U.S. Geological Survey, Federal Emergency Management Agency (FEMA), and the Utah Division of Water Rights-Dam Safety. Procedures developed by the NWS and HEC are the most widely used.

Sensitivity analyses are recommended in order to fully investigate the effects of a failure on downstream areas.

10.3 BENCHMARKS AND FLOOD PROFILES

This appendices would be an appropriate place to provide a listing of the benchmarks used in the preparation of inundation maps, to provide elevation data for reference and subsequent evaluations. The flood profiles used in the development of inundation maps should also be included.

10.4 TRAINING

Training of people involved in the EAP should be conducted to ensure that they are thoroughly familiar with all elements of the plan, the availability of equipment, 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 on onsite observations. A sufficient number of people should be trained to ensure adequate coverage at all times. A training plan could be included in the appendices to your EAP. Exercises simulating dam failures are excellent training mechanisms for ensuring readiness. 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.

10.5 TESTING

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 make sure that they know and understand the procedures to be followed and actions required. Any special procedures required for nighttime, weekends, and holidays should also be included. The tests should involve a drill simulating emergency conditions, preferably up to but not including actual evacuation. Testing of remote sensing equipment at unmanned dams should be included.

Coordination and consultation with local government, law enforcement officials, the State Engineer's office, and other organizations involved is desirable in order to enhance the realism of the drill. Their involvement will perfect the close coordination with agencies necessary for a successful execution of the plan in an actual emergency. The drills should be critiqued in writing, and the plan should be revised to correct any deficiencies noted.
10.6 **UPDATING**

The EAP should be updated promptly after each change in involved personnel or their telephone numbers. Together with local government officials, conduct a comprehensive review of the adequacy of the EAP at intervals not to exceed one year. During the review, an evaluation of any amendments to guidelines or changes in downstream human habitation or in the reservoir should be made, to determine whether any revisions to the current plan (including inundation maps) are necessary and would improve the workability of the plan. These revisions must be made in consultation with the appropriate public agencies. Reviews should be conducted on or about the same date each year. If no revision is necessary, a statement that the review was made and no revision to the plan was necessary should be provided to each recipient of the original plan. Copies of any revisions that do result from updating the plan or from periodic testing of the plan should be furnished to all individuals to whom the original plan was distributed. A procedure should be established to ensure that all copies of the plan are revised.

10.7 **POSTING OF THE NOTIFICATION FLOWCHART**

An up-to-date copy of the Notification Flowchart and/or list should be posted in prominent locations at the dam site or local emergency operations center (essential for unmanned dams). The flowchart should be posted at each phone and radio transmitter at the dam, powerhouse (if applicable), emergency operations center, and at all other desirable locations. The locations of the posted flowcharts should be indicated in the EAP. A copy of the complete, up-to-date EAP should also be available to the dam operators, emergency operations center personnel, state and local officials. The location of each copy should be stated in this section of the EAP.

10.8 **RECORDING OF EMERGENCY CONDITIONS**

A record of all telephone or radio reports of emergency conditions and facility failures, and actions initiated, should be kept at all steps of the communications network. Each call should be recorded in chronological order to maintain continuous records during an incident. A log should be developed and kept as an appendices to the EAP, for documenting emergency conditions, facility failures flow rates, and actions initiated and carried out.

10.9 **GLOSSARY**

The EAP may include a glossary that defines any technical terms used in the EAP.

11.0 **SUMMARY**

This paper outlined the general steps to follow when developing an EAP for a dam:
11.1 Steps 1-9

11.1.1 Step 1: Determine the areas that could be inundated.

11.1.2 Step 2: Prepare inundation maps.

11.1.3 Step 3: Identify the triggering events that initiate an emergency action, and specify the corrective actions to be taken and by whom.

11.1.4 Step 4: Coordinate the development of the EAP with all involved parties.

11.1.5 Step 5: Identify all communications systems.

11.1.6 Step 6: Draft the Notification Flowchart.

11.1.7 Step 7: Draft the EAP.

11.1.8 Step 8: Hold meetings for review and comment on the draft EAP.

11.1.9 Step 9: Revise the EAP as appropriate, obtain the necessary approvals, and disseminate the EAP.

11.2 Parts I-VI

11.2.1 Part I -- Introductory

11.2.2 Part II -- Responsibilities

11.2.3 Part III -- Emergency Procedures

11.2.4 Part IV -- Preventive Action

11.2.5 Part V -- Inundation Maps

11.2.6 Part VI -- Appendices
APPENDIX I POTENTIAL PROBLEMS AND IMMEDIATE RESPONSE ACTIONS

OVERTOPPING BY FLOOD WATERS

Open outlet to its maximum safe capacity.

Place sandbags along the crest to increase freeboard and force more water through the spillway and outlet.

Provide erosion-resistant protection to the downstream slope by placing plastic sheets or other materials over eroding areas.

Divert flood waters around the reservoir basin if possible. Restrict inflow if possible.

Create additional spillway capacity by making a controlled breach in a low embankment or dike section where the foundation materials are erosion resistant.

LOSS OF FREEBOARD OR DAM CROSS SECTION DUE TO STORM WAVE EROSION

Place additional rip rap or sandbags in damaged areas to prevent further embankment erosion.

Lower the water level to an elevation below the damaged area

Restore freeboard with sandbags or earth and rock fill.

Continue close inspection of the damaged area until the storm is over.

SLIDES ON THE UPSTREAM OR DOWNSTREAM SLOPE OF THE EMBANKMENT

Lower the water level at a rate and to an elevation considered safe given the slide condition. If the outlet is damaged or blocked, pumping, siphoning, or a controlled breach may be required.

Restore lost freeboard if required by placing sandbags or filling in the top of the slide.

Stabilize slides on the downstream slope by weighing the toe area with additional soil, rock, or gravel.

EROSIONAL FLOWS THROUGH THE EMBANKMENT, FOUNDATION, OR ABUTMENTS

Plug the reservoir side of the flow with whatever material is available (hay bales, bentonite, or plastic sheeting if the entrance to the leak is in the reservoir basin).

Lower the water level until the flow decreases to a non-erosive velocity or until it stops.
Place a protective sand and gravel filter over the exit area to hold materials in place.

Continue lowering the water level until a safe elevation is reached.

Continue operating at a reduced level until repairs can be made.

**FAILURE OF APPURTENANT STRUCTURES SUCH AS OUTLETS OR SPILLWAYS**

Implement temporary measures to protect the damaged structure, such as closing an outlet or providing temporary protection for a damaged spillway.

Employ experienced professional divers if necessary to assess the problem and possibly implement repair.

Lower the water level to a safe elevation. If the outlet is inoperable, pumping, siphoning, or controlled breach may be required.

**MASS MOVEMENT OF THE DAM ON ITS FOUNDATION (SPREADING OR MASS SLIDING FAILURE)**

Immediately lower the water level until excessive movement stops.

Continue lowering the water until a safe level is reached.

Continue operation at a reduced level until repairs can be made.

**EXCESSIVE SEEPAGE AND HIGH LEVEL SATURATION OF THE EMBANKMENT**

Lower the water to a safe level.

Continue frequent monitoring for signs of slides, cracking or concentrated seepage.

Continue operation at a reduced level until repairs can be made.

**SPILLWAY BACKCUTTING THREATENING RESERVOIR EVACUATION**

Reduce the flow over the spillway by fully opening the main outlet.

Provide temporary protection at the point of erosion by placing sandbags, riprap materials, or plastic sheets weighted with sandbags.

When inflow subsides, lower the water to safe level.

Continue operating at a low water level in order to minimize spillway flow.
EXCESSIVE SETTLEMENT OF THE EMBANKMENT

Lower the water level by releasing it through the outlet or by pumping, siphoning, or a controlled breach.

If necessary, restore freeboard, preferably by placing sandbags.

Lower water to a safe level.

Continue operating at a reduced level until repairs can be made.

LOSS OF ABUTMENT SUPPORT OR EXTENSIVE CRACKING IN CONCRETE DAMS

Lower the water level by releasing it through the outlet.

Attempt to block water movement through the dam by placing plastic sheets on the upstream face.

Lowering water to a safe level.
APPENDIX II

GLOSSARY

ABUTMENT - That part of a valley side against which a dam is constructed. Right and left abutments are those on the right and left sides respectively of an observer facing downstream.

AIRVENT PIPE - A pipe designed to provide air to the outlet conduit to reduce turbulence during release of water. Extra air is usually necessary downstream of constrictions.

BEACHING or BENCHING - The removal, by wave action, of a portion of the upstream (reservoir) side of the embankment and the resultant deposition of this material farther down the slope. Such deposition creates a relatively flat beach area.

BOIL - A disturbance in the surface layer of soil caused by water escaping under pressure. The boil may be accompanied by deposition of soil particles (usually sand) in a circle around the point at which the water exits.

BREACH - An opening or a breakthrough of a dam sometimes caused by rapid erosion of a section of earth embankment by water.

CAVITATION - Wear on hydraulic structures where a high hydraulic gradient is present. Cavitation is caused by the abrupt change in direction and velocity of the water so the pressure at some points is reduced to the vapor pressure and vapor pockets are created. These pockets collapse with great impact when they enter areas of higher pressure, producing very high impact pressures over small areas that eventually cause pits and holes in the surface. Noises and vibrations may be evident during high flows.

CONDUIT - A closed channel to convey the discharge through or under a dam.

CORE - A zone of material of low permeability, usually clayey soils, in an embankment dam.

CREST LENGTH - The length of the dam, from one abutment to the other, along the top of the dam. This includes the spillway width if it is adjacent to the embankment.

CUTOFF - An impervious construction or material which reduces seepage or prevents it from passing through foundation material.

CUTOFF TRENCH - An excavation into the foundation later to be filled with impervious material to form a cutoff below the dam.

CUTOFF WALL - A wall of impervious material (usually concrete) built into the foundation to reduce seepage under the dam.

DRAINS - Permeable vertical or horizontal sections in the dam which collect water to prevent saturation of the downstream portion of the embankment. This water is frequently piped from the drainage layer to daylight outside the embankment.

DRAINAGE AREA - Land above the damsite from which surface waters naturally drain to the dam.

FILTER - A band or zone of granular material that is incorporated into a dam and is graded so as to allow seepage to flow into the filter without allowing the migration of soils from zones adjacent to the filter.
FLASHBOARDS - A length of timber, concrete, or steel placed on the crest of a spillway to raise the water level, but that may be quickly removed in the event of a flood either by a tripping device or by deliberately designed failure of the flashboard or its supports.

FLOODPLAIN - An area adjoining a body of water or natural stream that has been or may be covered by flood water.

FLOWLINE - The path that a particle of water follows in its course of seepage under laminar flow conditions.

FLUME - A flow measuring device

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

FREEBOARD - The vertical distance between a stated water level and the top of a dam. Usually, this term is used to denote the difference in elevations between the flowline of the spillway, which is considered to be the maximum normal water surface, and the top of the dam.

GATE or VALVE - In general, a device in which a member is moved across the waterway to control or stop the flow.

HEIGHT OF DAM - Hydraulic height refers to the height that water can rise to behind a dam. It is the difference between the elevations of the lowest point in the original streambed at the downstream toe of the dam and the maximum controllable water surface. Structural Height is the same as hydraulic height except that it is measured to the top of the dam.

INSTRUMENTATION - Permanent devices which are installed in/near a dam to allow monitoring of the dam and impoundment. These devices may include a staff gage for measuring the reservoir level, piezometers and/or observation wells to determine the phreatic surface through the dam, weirs or flumes, and survey monuments. Each of these terms is defined in this glossary.

INTAKE - A structure which is designed to guide water into another, such as the intake structure for the outlet conduit.

LIQUEFACTION - The sudden large decrease of the shearing resistance of a cohesion less soil. It is caused by a collapse of the structure by shock or other type of strain and is associated with a sudden but temporary increase of the pore-filled pressure. It involves a temporary transformation of the soil into a fluid mass.

LOG BOOM - A device intended to prevent large floating debris from being carried into the spillway and possibly clogging it. Typically, it is constructed out of logs which are hinged together and anchored on either side of the spillway so that the floating debris catches on the log boom and is kept in the reservoir basin.

OUTLET - A conduit through which controlled releases can be made from the reservoir.

PHREATIC SURFACE - The upper surface of saturation within an embankment.

PIEZOMETER - A device for measuring internal water pressures or levels in the dam, its foundation, or the abutments. Most piezometers are wells with small diameter pipes installed through which the water level is measured. Observation wells are similar to piezometers but are often larger in diameter than piezometers.
PIPING - The progressive development of internal erosion by seepage, appearing downstream as a hole or seam discharging water that contains soil particles.

PLUNGE POOL - A natural or sometimes artificially created pool that dissipates the energy of free-falling water. The pool is located at a safe distance downstream of the structure from which water is being released. Also called STILLING BASIN.

RIP RAP - A layer of non-erodable large stones, broken rock or precast blocks placed in a random fashion on the upstream slope of an embankment dam, on a reservoir shore, or on the sides of a channel as a protection against wave and ice action.

SLUMP AREA - A portion of earth embankment which moves downslope, sometimes suddenly, often with cracks and bulges developing.

SPALLING - The separation and deterioration of a thin surface layer of concrete or rock.

SPILLWAY SYSTEM - A structure over or through which excess reservoir water is discharged. If the flow is controlled by gates, it is considered a controlled spillway; if the elevation of the spillway crest cannot be adjusted and is the only control, it is considered an uncontrolled spillway.

EMERGENCY SPILLWAY - A secondary spillway designed to operate only during extreme floods.

PRINCIPAL SPILLWAY - The main spillway for normal operations and flows.

STILLING BASIN - A basin constructed to dissipate the energy of fast-flowing water from a spillway or outlet to protect the river bed from erosion.

STOPLOGS - Removable logs or timbers, steel or concrete beams placed on top of each other with their ends held in guides on each side of a channel to raise the reservoir level.

SURVEY MONUMENTS - Surveyed monuments are sometimes installed on dams to allow monitoring of movement of the dam.

TOE OF EMBANKMENT - The intersection of the face of a dam with the ground surface.

TRASH RACK - A structure of metal or concrete bars located in the waterway at an intake to prevent the entry of floating or submerged debris.

WATERSTOP - A strip of metal, rubber, or other material used to prevent leakage through joints between adjacent sections of concrete.

WEEPHOLES - Holes in concrete walls or slabs intended to drain water from the soil behind the wall.

WEIR - A low dam or wall built across a stream to raise the upstream water level or a structure built across a stream or channel for the purpose of measuring flow. Sometimes described as measuring weir or gauging weir. Types of weirs include broad crested weir, sharp-crested weir, ogee weir, and V-notched weir.
APPENDIX III

SAMPLE EMERGENCY ACTION PLAN

***dam name***

***water user name***

***your county*** County, Utah

OPERATED BY

***water user name***

***your town***, Utah

APPROVED FOR USE BY:

______________________________

***title***

***water user name***

______________________________

Date

Copy No. ______
EMERGENCY ACTION PLAN

Participant Concurrence

We, the undersigned, representing our respective organizations, have read the Emergency Action Plan for ***dam name*** Dam, and understand our responsibilities in the execution of this plan should an emergency occur:

***your county*** County Sheriff

***your county*** County Emergency Management Director

***title***, ***water user name***, ***title***

Dam Tender, ***dam name*** Dam

***dam name*** Dam Engineer

Division of Emergency Services and Homeland Security

Colorado Basin River Forecast Center,
National Weather Service

***dam name*** Dam

EMERGENCY ACTION PLAN

This copy includes the following revisions:
This Emergency Action Plan defines responsibilities and provides procedures designed to identify unusual and unlikely conditions, which may endanger ***dam name*** Dam, in time to take remedial actions and to notify appropriate public officials of possible, impending, or actual failure of the dam. The plan also provides for notification when flood releases may create major flooding.

The term "dam tender" referenced in this document is the individual having onsite supervisory control of the dam and reservoir. In the absence of the dam tender, the next highest ranking official associated with the entity owning the dam is designated as the dam tender.

The term "engineer" referenced in this document an individual or corporation, generally having a continuing relationship with the dam owner, who provides technical advice and assistance pertaining to the dam. The engineer may be an employee of the owner, an officer in the organization, or may be a consultant retained to provide advice and support. The engineer should possess qualifications, training, and experience with the specific type of facility involved and be a licensed professional engineer in the state of Utah.

The dam tender and staff must be knowledgeable in recognizing an emergency situation or unusual condition and must act immediately to minimize danger to the structure and to all persons within the immediate area - especially those in the downstream channel.

As a minimum procedure the ***dam name*** dam tender shall immediately:

- Identify the emergency situation
- Contact ***your county*** County Sheriff
- With assistance from the State Office of Emergency Services and Homeland Security, as needed, determine necessary actions
- Carry out the above actions
- Maintain contact with State Office of Emergency Services and Homeland Security (if necessary, enlist help to remain at communications source or to relay information)
PART II. RESPONSIBILITIES

A. GENERAL RESPONSIBILITIES UNDER THE PLAN

1. Owner Responsibility

***dam name*** Dam is owned by ***water user name***. The owner has the responsibility to operate, maintain, and repair ***dam name*** Dam. The responsible official of ***water user name*** is ***. Daily operations of the dam are delegated to ***, who also serves as the dam tender.

The owner

- insures safe operation of the dam
- maintains and repairs the dam as needed to insure safe operation
- directs the dam tender in operating the dam
- insures the dam complies with applicable local, state and federal law
- secures and appoints a dam tender
- provides or arranges training for the dam tender
- prepares and distributes the Emergency Action Plan and Standard Operating Procedures for ***dam name*** Dam.
- Communicates with local public safety officials, Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section, and State Division of Emergency Services and Homeland Security, as needed

The dam tender

- operates and maintains the dam according to approved Standard Operating Procedures
- Determines and identifies conditions or triggering events that initiate or require emergency actions
- Initiates actions to be taken
- Clearly communicates the emergency situation to those who need to be contacted
- Issues warning messages if dam failure is impending or has occurred
- Maintains records as required by law and by the owner
- Cooperates with local public safety officials in exercising the Emergency Action Plan
2. Sample Warning Messages

**DAM HAS FAILED**

"This is ***, ***title*** of ***dam name*** Dam, located *** miles upstream from ***. ***dam name*** Dam has failed. Flooding can be expected. The floodplain below must be evacuated immediately."

**DAM FAILURE IS POSSIBLE**

"This is ***, ***title*** of ***dam name*** Dam, located *** miles upstream from ***. Failure of ***dam name*** Dam is possible. Flooding in the floodplain may be expected at any time. The floodplain below may require evacuation."

**A POTENTIAL EMERGENCY SITUATION AT THE DAM HAS DEVELOPED OR IS DEVELOPING**

"This is ***, ***title*** of ***dam name*** Dam, located *** miles upstream from ***. A potential emergency situation at the dam has developed, which, if it continues may result in failure or uncontrolled releases from ***dam name*** Dam. Flooding in the floodplain may be expected. Further information will be provided as it develops."

3. Emergency Declaration

***, ***title***, ***water user name***, is responsible for declaring the existence of an emergency at ***dam name*** Dam.

***, ***title***, ***water user name***, is responsible for declaring the termination of an emergency at ***dam name*** Dam, after consultation the Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section.

The State Engineer, State Dam Safety Officer, county sheriff, or other responsible public safety official, may also, upon cause, declare an emergency condition at ***dam name*** Dam.

Consultation among the parties concerned with the dam should take place prior to declaring an emergency, if time permits.

4. Responsibility For Notification
The ***title***, ***water user name*** is responsible to notify local officials. If time allows in an emergency situation, onsite personnel should seek advice and assistance. However, if failure is impending or has occurred, the responsibility and authority for notification is delegated to the dam tender if the owner cannot be quickly contacted.

The ***title***, ***water user name*** is responsible to notify the National Weather Service (NWS) Colorado Basin River Forecast Center, which has general responsibility for issuing flood warnings. The National Weather Service, Colorado Basin River Forecast Center must be notified of any impending or actual dam break flooding, so that flood warnings can be issued via the Emergency Broadcast System.

The ***title***, ***water user name*** is responsible to notify the Utah State Office of Emergency Services and Homeland Security for emergency management assistance. Emergency Services and Homeland Security will in turn contact all the appropriate governmental entities such as the Governor's Office, FEMA, the State Geologist, Water Resources, the State Engineer, Area Office, and Dam Safety Section personnel.

5. Responsibility For Evacuation

The ***your county*** County Sheriff is responsible for warning and evacuation planning. The ***water user name*** is responsible for notifying the ***your county*** County Sheriff when flooding is anticipated or a failure is impending or has occurred.

The ***water user name*** cannot assume the responsibility of governmental entities for evacuation of people.

6. EAP Coordinator Responsibility

The ***title***, ***water user group***, is designated as Emergency Action Plan coordinator. The EAP Coordinator is responsible for EAP-related activities, including (but not limited to) preparing revisions to the EAP, establishing training seminars, coordinating EAP exercises with ***your county*** County Sheriff and ***your county*** County Emergency Preparedness Director., etc. Persons having questions or concerns should address their interest to ***title***, ***water user group***.

7. EAP Revisions

This EAP should be reviewed every three years for applicability and accuracy. Phone numbers listed in the Communications should be verified annually by the EAP Coordinator and revised communications directory pages should be prepared. The EAP Coordinator should issue
revisions to all copy holders. When conditions or personnel change revisions should be made prior to the review cycles listed above.

PART III. EMERGENCY PROCEDURES

A. EMERGENCY SITUATIONS

1. Failure or Impending Failure of the Dam

DOWNSTREAM HAZARD POTENTIAL: ***dam name*** Dam could present a high hazard potential to the downstream area as a result of failure or unsound operation. Should it fail, loss of life and potential economic loss may occur.

The dam's location in the watershed above *** and recreational use downstream should alert the reader of an urgency in event of a failure.

WARNING MESSAGES: The initial warning message to the 24-hour warning point would be one of three possible emergency conditions.

1. Advice that a POTENTIAL emergency situation exists or is developing and expressing concern for the safety of the dam.

2. A WATCH of the strong possibility of failure and calling for the evacuation of the flood plain.

3. A WARNING of failure and calling for immediate evacuation of the flood plain.

Notification Flowcharts A, B, and C, located in the front of this EAP graphically define the notification and warning process.

a. Failure

If the dam is failing, the dam tender (or other operating personnel at the dam) must immediately initiate downstream evacuation using the following procedures:

(1) Inform the following by phone, radio, or by driving to the nearest phone (refer to the Communications Directory for phone numbers, radio, or backup systems):

***your county*** County Sheriff, ***your town***, UT

(2) Contact Utah Division of Emergency Services and Homeland Security; they will inform other appropriate federal, state and county government offices.
(3) Coordinate efforts with ***your county*** County Sheriff's Office and ***your county*** County Emergency Preparedness Director in alerting all downstream areas.

(4) Contact downstream dam operators and major water users if possible.

(5) Maintain contact with Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section.

b. Impending failure

If the dam tender suspects **impending failure**, the following procedures should begin immediately:

(1) Contact the Utah Division of Emergency Services and Homeland Security and ***your engineer***:

   a) determine if and what downstream entities should be notified

(2) Initiate corrective measures and other actions as recommended by ***your engineer***.

(3) Maintain contact with Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section.

NOTE: Notify both ***your county*** County Sheriff's Office of possible flooding downstream as early as possible; make certain all officials understand the situation.

2. Flooding

a. **With normal communications** - If a the reservoir water surface is projected to rise above *** feet, immediately contact the Utah State Division of Emergency Services and Homeland Security. Information reported should include:

   (1) Current reservoir water surface elevation

   (2) Observed water surface rise rate

   (3) Weather conditions in the vicinity--past, present, and predicted

   (4) The discharge condition of the stream above and below the reservoir
(5) Known conditions at locations upstream or downstream from ***dam name*** Dam.

b. The Utah Division of Emergency Services and Homeland Security will contact the Utah State Department of Natural Resources, State Engineer's Office, Dam Safety Section.

3. Earthquake

LATITUDE: ***° ***' North LONGITUDE: ***° ***' West

ZONE: ***dam name*** Dam is located in an area subject to earthquakes of major damaging intensity. The dam lies in seismic risk zone **.

SAMPLE POST EARTHQUAKE POST - INSPECTION RANGE

<table>
<thead>
<tr>
<th>Richter Magnitude</th>
<th>Search Radius (MI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.0 to 4.5</td>
<td>10</td>
</tr>
<tr>
<td>4.6 to 5.0</td>
<td>12</td>
</tr>
<tr>
<td>5.1 to 5.5</td>
<td>18</td>
</tr>
<tr>
<td>5.6 to 6.0</td>
<td>25</td>
</tr>
<tr>
<td>6.1 to 6.5</td>
<td>38</td>
</tr>
<tr>
<td>6.6 to 7.0</td>
<td>55</td>
</tr>
<tr>
<td>7.1 and greater</td>
<td>75</td>
</tr>
</tbody>
</table>

Seismic Evaluation: Enter a summary of seismic evaluation, if such a study has been done.

a. Normal communications - If an earthquake is felt or one is reported to have occurred in the area, use the following procedures:

(1) Immediately conduct an overall visual dam inspection.

(2) IF THE DAM IS DAMAGED TO THE EXTENT THERE IS INCREASED FLOW PASSING DOWNSTREAM, IMMEDIATELY IMPLEMENT FAILURE OR IMPENDING FAILURE PROCEDURES.
(3) If visible damage occurred but is not serious enough to cause dam failure, immediately:

(a) Observe nature, location, and extent of damage. The description of slides, sloughs, and sudden subsidence should include:

Location
Extent (severity)
Rate of subsidence
Effects on adjoining structures
Springs or seeps
Reservoir and tailwater elevations
Prevailing weather conditions
Other facts believed pertinent

Evaluate impending failure hazard.

(b) Report all information to the Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section; if key personnel are unavailable, report directly to the ***your county*** County Sheriff.

It is extremely important that the person receiving your report understands your evaluation and description of the potential hazard at the dam. A decision on further actions required should be made promptly.

©) Reinspect the damage site and maintain communications with key personnel previously receiving the report.

(d) If dam failure is not impending, continue to the following step (4).

(4) Thoroughly inspect for damage

(a) Both dam faces for cracks, settlement, or seepage

(b) Abutments for possible displacement

©) Drains and seeps

(d) Spillway structure

(e) Outlet works control house, shaft, and gate chamber
(f) Power supply and standby power unit

(g) Visible reservoir and downstream areas for landslides

(h) Other appurtenant structures

(i) Read critical instruments and note any abnormal or changed readings.

(5) Report inspection findings to the Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section during the earthquake incident.

(6) If apparent damage has not occurred to the dam, embankments, or appurtenant structures, a "No Damage" report should be made to the Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section.

(7) Continue to inspect and monitor the facilities for at least 48 hours or as instructed by ***your engineer*** and the Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section - in the event unobservable or delayed damage should occur.

(8) Some damage to structures may not be apparent during the inspection immediately following an earthquake. It is possible that the settlement of structures, the reactivation of old slides, or the development of new slides may not occur with ground shaking and would manifest itself after the initial inspection. A secondary inspection 2 weeks to a month after the initial inspection should be made.

(9) Survey settlement and alignment measurement points if requested ***your engineer*** and the Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section.

b. Communication outage - IF ALL COMMUNICATIONS FROM THE DAM ARE LOST and there is potential for impending failure of the dam, use the following checklist as a guide during an earthquake event:

(1) Quickly inspect the dam and evaluate potential failure hazard.

(2) Check for sloughs, slides, slumps, and other signs of distress near dam abutments.

46
(3) If failure is impending, use all measures that can reduce reservoir storage. Warning downstream residents is imperative. If possible, enlist aid of ***your county*** County Emergency Preparedness Director and the ***your county*** County Sheriff's Office. Personally warning downstream residents will be performed by the ***your county*** County Sheriff.

NOTE: Caution should be used when increasing discharge through the outlet works because the conduit may be sheared and increased flow may cause piping in the dam. It may be necessary to shut off the outlet works flow (if possible) to avoid piping.

(4) Continue trying to contact or send word to the ***your county*** County Sheriff, ***your engineer***, and the Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section.

B. UNUSUAL OCCURRENCES

1. Slumping or Cracking of the Dam or Abutments
   a. Determine -
      (1) Location
      (2) Size of affected area(s) in height, width, and depth
      (3) Extent (severity)
      (4) Estimated discharge (whether clear or cloudy water)
      (5) Reservoir and tailwater elevations
   b. Contact ***your engineer*** and the Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section.

2. Failure of Appurtenances or Operating Equipment
   a. Determine -
      (1) Probable cause of failure, duration, and effects on reservoir operation
      (2) Immediate assistance required from ***your engineer*** and contact the Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section to remedy the problem, including:
(a) Replacement parts
(b) Type of labor available
(c) Repair equipment

(3) Available temporary replacements or temporary alternatives

(4) Any other facts believed pertinent

b. Contact ***your engineer*** and the Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section.

3. **New Springs, Seeps, or Boggy Areas**

If new springs, seeps, and boggy areas develop, use the following procedures:

a. **Determine** -

(1) Location

(2) Size of affected area(s)

(3) Estimated discharge

(4) Nature of the discharge (whether clear or cloudy water)

(5) Reservoir and tailwater elevation

b. Read data from all pertinent instrumentation

c. **Map data** - If necessary to further analyze conditions, a map should be prepared showing the extent of all seep areas, springs, and any other pertinent data, including the dates of recording reservoir levels.

d. Contact ***your engineer***.

e. contact the Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section and continue to monitor situation.

f. Initiate corrective measures as directed by ***your engineer***.

4. **Rapid Increase or Cloudy Appearance in Seepage**
If existing or new springs, seeps, and boggy areas develop rapid increases in cloudy water, use the following procedures:

a. **Determinations** -  
   
   (1) Location 
   
   (2) Size of affected area(s) 
   
   (3) Estimated discharge 
   
   (4) Nature of the discharge (whether clear or cloudy water) 
   
   (5) Reservoir and tailwater elevation 

b. Contact ***your engineer*** or the Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section for assistance.  
   
   (1) Read and report other instrumentation readings 
   
   (2) Monitor continuously until instructed otherwise 

c. **Map data** - If necessary to further analyze conditions, a map should be prepared showing the extent of all seep areas, springs, and any other pertinent data, including the dates of recording reservoir levels. 

d. **Settlement points** - If surface measurement (reading for settlement points) readings will help clarify abnormal conditions, such observations should be made, reported, and recorded. 

5. **Abnormal Instrumentation Readings** 

During instrument recording, the ***dam name*** Dam tender will compare the current readings with the previous readings and, if necessary, with readings at the same reservoir elevation. If the reading appears to be abnormal, the ***dam name*** Dam tender shall: 

a. **Determine** -  
   
   (1) Possible reading or computation error or instrument failure 
   
   (2) Calculate change in reading from normal 
   
   (3) Reservoir elevation 
   
   (4) Weather conditions
Any other facts believed pertinent

b. Contact ***your engineer*** and the Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section for assistance.

6. Landslide

Any landslide that could move into the outlet works, spillway area, or into the reservoir - rapidly displacing large volumes of water - would be dangerous to the dam. Landslides or potential landslides into the downstream channel which may impound water should be reported.

Any landslide which may affect either abutment should be reported to the Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section immediately.

All landslides or potential landslides which may affect the dam, abutments, outlet works, or reservoir basin should be reported to the Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section. Identify landslide areas by name and location.

a. Determine -

(1) Size

(2) Possible cause

(3) Degree of effect on operation

(4) Probability of additional movement of disturbed area or of other slide areas

(5) Development of new slides

(6) Any other facts believed pertinent

b. Contact ***your engineer*** and the Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section for assistance.

For a landslide that occurs in the downstream channel:

a. Determine

(1) Size (including depth and percent across river channel)

(2) Capability of immediately closing outlet works
(3) Other inflows

(4) Location in relation to the toe of the dam and other appurtenant structures

(5) Availability or need for heavy equipment

b. Contact ***your engineer*** and the Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section for assistance.

7. Severe Storms

Contact the Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section and report local news reports and personal observations of severe storms, including heavy rainstorms, unusual snowfall, high winds, tornadoes, etc. Data should include pertinent information to aid in evaluating the impact of the event upon the ***dam name*** Dam.

8. Fires

a. For forest or range fires -

   (1) Determine

       (a) Location and extent

       (b) Possibility of fire spreading to or damaging dam facilities

       (c) Prevailing weather conditions

       (d) Communications outage

       (e) Any other facts believed pertinent

   (2) Contact the Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section.

b. For fire within or about the structure -

   (1) Determine location and severity

   (2) Contact ***your county*** County fire department.

   (3) Initiate use of available fire equipment
(4) Contact Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section and report

(a) Extent (severity)
(b) Possibility of additional damage
(c) Damage to operating equipment
(d) Loss of records or communications equipment
(e) Any other pertinent facts

9. Demonstrations, Sabotage, or Nuclear Attack

For a demonstration at the dam use this checklist as a minimum procedure:

a. Show restraint.
b. Lock all gates and doors.
c. Notify ***your county*** County Sheriff's Office.
d. Notify the Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section.

If a bomb threat call is received, use the following checklist during and after the incident:

a. Keep the caller on the line as long as possible. Ask the caller to repeat the message. Record every word spoken by the caller.
b. If the caller does not indicate the location of the bomb nor the time of detonation, the person receiving the call should ask the caller to provide this information.
c. It may be advisable to inform the caller that detonation of a bomb would result in death or serious injury to many innocent people.
d. Pay particular attention for any strange or peculiar background noises such as: motors running, background music (type), and any other noises that might give a remote clue as to the caller's location.
e. Listen closely to the voice (male or female), voice quality, accent, or speech impediment.
f. Immediately after the caller hangs up, the person receiving the call should report to –
   
   (1) ***your county*** County Sheriff's Office

g. Evacuate all unnecessary personnel and visitors from the facility.

h. Immediately suspend **ALL** radio transmissions in the vicinity until directed to resume radio use by the public safety official directing the bomb search. **CAUTION:** The use of radios during a bomb search could be dangerous. The radio transmissions could cause premature detonation of an electric initiator (blasting cap).

I. If a suspicious package or object is found, **DO NOT TOUCH.** It should be left for trained personnel to remove or disarm.

j. The dam tender, after consultation with on-site public safety or fire authorities, shall be responsible for giving the "all clear" for normal duty to be resumed.

In the event of a **nuclear attack** or **an act of war**, and assuming communications are lost, the following procedures will be used as a checklist:

a. Evacuate dam area and downstream vicinity if failure is impending.

b. As soon as possible, check for any damage to the dam.

C. If there are any injuries, assist with first aid treatment.

d. Protect essential records.

e. Maintain a complete blackout.

f. Maintain 24-hour watch over all facilities to prevent sabotage

g. Notify Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section as soon as communications are restored.

**IF ALL COMMUNICATIONS FROM THE DAM ARE LOST** and **impending failure** is possible due to an **act of sabotage**, use the following checklist as a guide:

a. Immediately perform an overall visual dam inspection to determine location and extent of damage.
b. IF THE DAM IS FAILING, use procedures outlined above.

c. If damage to the embankment is substantial, reservoir evacuation should be initiated.

d. Check to see whether the saboteur has left the area.

e. When it is determined that the saboteur has left, check area for further sabotage potential and any evidence that might aid in apprehending the saboteur.

f. As soon as possible, notify the ***your county*** County Sheriff.

g. Continue trying to contact the Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section.

10. Oil and Hazardous Substance Spills

For an oil spill (Environmental Protection Agency defines as "* * * a visible sheen or film on the water* * *") from any source, perform these procedures:

a. Contact the ***your county*** County Sheriff for onsite coordinator and instruction.

b. Pinpoint source of spill, if possible.

c. Contact responsible party(ies) to ensure that they are aware of spill and to determine what remedial measures they are taking.

d. Determine nature (including but not limited to petroleum, fuel oil, sludge, oil refuse, or oil mixed with wastes; industrial chemicals, herbicides, or pesticides) and quantity

   minor spill: less than 1,000 gallons
   medium spill: 1,000 to 10,000 gallons
   major spill: more than 10,000 gallons

   CAUTION: IF IDENTITY AND POTENTIAL HAZARD IN HANDLING THE SUBSTANCE IS UNKNOWN, immediately notify ***your county*** County Sheriff for surveillance and DO NOT ATTEMPT TO HANDLE.

e. Determine if and to what extent resources in the area may be affected by the discharge. Ascertain whether discharge will affect adjacent lands or facilities.
f. Make initial determination regarding the extent of effort and equipment required to contain the spill.

g. Notify the ***your county*** County Sheriff and the Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section and report above information.

h. Assess threat posed to public health and make appropriate warnings –
   (1) Municipal water system
   (2) Law enforcement
   (3) Fire protection

I. Initiate cleanup, disposal, and documentation as directed by ***your county*** County Sheriff.

11. Large or Sudden Releases into the Downstream Channel
   a. Notify ***your county*** County Sheriff
   b. ***your county*** County Emergency Preparedness Director
   c. Contact the Utah Division of Wildlife Resources
   d. Notify Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section.

12. Fish and Wildlife Losses
   a. Describe loss, species, numbers, location, possible further losses, probable cause, and other pertinent information.
   b. Contact Utah State Division of Wildlife Resources Area Office.

13. Drowning

14. Major Accident
    
15. Criminal Action
    a. ***your county*** County Sheriff

D. ATTENDANCE AND COMMUNICATIONS PROCEDURES
***dam name*** Dam will be attended continuously during initial filling. The dam tender may be contacted at the ***dam name*** Field Office telephone number listed in the *Communications Directory*. After initial filling criteria have been met, the dam will be monitored by a supervisory control and data acquisition system.

The dam is attended continuously when threatened by physical harm such as bomb threat or extreme runoff condition.

Refer to the *Communications Directory* for normal and emergency phone numbers and methods of communications.

**PART IV. PREVENTATIVE ACTIONS**

**A. SURVEILLANCE**

**THIS SECTION MUST BE WRITTEN SPECIFICALLY FOR EACH DAM**

When a dam is not continuously manned (as is the case with most dams in Utah) and failure would endanger human life or cause significant property damage, it is imperative that procedures be developed to identify conditions requiring emergency actions, and to promptly alert public safety officials responsible for evacuating residents who would be affected in the event of an emergency at the dam. In order to be able to promptly notify responsible officials of emergency conditions, a dam owner or owner’s representative must receive a timely warning that an emergency has developed or is developing.

The information received must be clear and concise, so that the responsible officials may react with confidence and activate the EAP, if necessary, without requiring personnel to visit the site to verify conditions.

At unattended dams, the dam owner should consider installing a remote surveillance system that includes instrumentation and telemetering facilities at the dam site, to provide a continuous reading of headwater and tailwater levels at an operations control center that is manned 24 hours a day. The system should include a computer at the operations center to monitor the data and to activate an audible alarm whenever the rate of change of the headwater or tailwater over a given period of time exceeds prescribed limits. The alarm also should be activated if the headwater or tailwater elevations exceed prescribed maximum or minimum levels. Design must be site-specific. The limits programmed in a system must account for change in headwater and tailwater levels that would occur during dam operation, floods, maintenance, etc. Alarm systems can be simple audible sounds or systems that automatically call owners and officials instead of alerting the general public directly.

Monitoring of the tailwater generally is more sensitive to changes resulting from a breach of the structures than monitoring of the
headwater. Changes in tailwater will alert operators more quickly to site conditions and help determine whether public safety officials should be notified. If continuous readings of both the headwater and tailwater are available, the operator can obtain a current reading at any time and check conditions at the site after an alarm sounded.

Provisions should be made for the alarm to sound when there is an interruption of power to and loss of communication with the monitoring or telemetry instrumentation. (When a dam tender lives close to the project, consideration should also be given to having an alarm in the dam tender's house.) When power to or communication with the site instrumentation is interrupted, the dam should be manned until conditions are returned to normal. Operation of the alarms should be checked periodically. Proper functioning of alarms should be confirmed by testing. For instance, annual testing of the plan might be initiated by causing one of the alarms to go off.

Reaction time must be minimized when inhabited structures are located immediately downstream of the dam. When these conditions exist, special procedures may need to be included in the EAP to notify the occupants. Local public safety officials should be fully involved in the development of these procedures.

The EAP should describe any instrumentation for monitoring the behavior of unattended dams and explain how warning systems would be implemented. Instrumentation responses should be instantaneous to facilitate immediate action by operators.

Also, it should describe procedures for providing round-the-clock surveillance for periods of actual or forecasted high flows. It may be necessary to send an observer to the dam during these periods and not rely on the instrumentation alone. In addition, it is recommended that an observer be at the dam when flood conditions or signs of serious structural distress have been identified.

If a discussion of remote surveillance at the dam is not applicable, that fact should be stated in the EAP.

B. ACCESS TO THE SITE--TRANSPORTATION

***dam name*** Dam is located approximately *** miles *** of ***your town***, Utah.

1. From ***your town***, Utah - Access to the dam is via a ***-mile *** road which intersects with *** approximately ** miles *** of the junction of State Route *** and ***. The access road is locally called "***". There is no road access to the dam crest from either abutment. The dam could be reached cross country on foot or horseback from ***. Vehicle access to the dam crest is ***.

*** are paved all-weather roads. "***" may not be passable during the winter or during periods of heavy rainfall or snowmelt runoff.
2. **From Salt Lake City, Utah** - Follow *** to ***, thence *** on *** *** miles to the junction with ***. Then follow the directions from ***your town***, Utah, listed above.

During severe storms four-wheel drive vehicles may be required to travel the route. Operation of the ***dam name*** Dam spillway will flood the access road from to the dam. During the winter access to the dam is by snowmobile, cross-county skis, or snowshoes.

The nearest airport is the *** located *** *** of ***, approximately *** *** miles *** of the dam. Helicopters may land at ***.

**C. RESPONSE DURING PERIODS OF DARKNESS**

Response to potential or actual emergency conditions during periods of darkness is complicated by poor visibility. If 24-hour surveillance is required at the dam, portable light plants, located on the abutments, will be used to illuminate the operating deck, crest, groins and toe.

**D. POWER FAILURE**

During power failure, releases may be made from the spillway or outlet works by ***.

**E. RESPONSE TIME**

Since ***dam name*** Dam is located in a remote area, response time to verify emergency depends on in large part on weather conditions. Anticipated response times for various weather scenarios are listed below:

<table>
<thead>
<tr>
<th>Weather Conditions</th>
<th>Estimated Time to Access Dam from <em><strong>your town</strong></em></th>
<th>Estimated Time to Assess Emergency</th>
<th>Estimated Time to Notify Sheriff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunny Day</td>
<td>*** hours</td>
<td>*** hours</td>
<td>*** hours</td>
</tr>
<tr>
<td>Rainy Day</td>
<td>*** hours</td>
<td>*** hours</td>
<td>*** hours</td>
</tr>
<tr>
<td>Winter</td>
<td>*** hours</td>
<td>*** hours</td>
<td>*** hours</td>
</tr>
<tr>
<td>Power Failure</td>
<td>*** hours</td>
<td>*** hours</td>
<td>*** hours</td>
</tr>
<tr>
<td>Night</td>
<td>*** hours</td>
<td>*** hours</td>
<td>*** hours</td>
</tr>
</tbody>
</table>
F. RESPONSE DURING PERIODS OF ADVERSE WEATHER AND FLOODING

ALTERNATIVE SYSTEMS OF COMMUNICATION

In the event of power or communications failure, the ***your county*** County Sheriff would be contacted by dispatching a courier with a written message to the nearest public safety official's office and having them contact the sheriff via their radio system. If time permits, the ***your county*** County Sheriff may dispatch emergency radio communications technicians to the dam to establish direct communications with the sheriff's office. The sheriff is responsible for recruiting, training, and supervising volunteer communications staff as appropriate.

G. COORDINATING INFORMATION ON FLOWS

Information on flows based on weather and runoff forecasts, failure and other emergency conditions will be coordinated with downstream water users and the National Weather Service, when possible. Coordination with the National Weather Service and state Dam Safety Section is recommended to monitor storms, river stages, and flood waves resulting from a dam break. The NWS or Dam Safety Section may also supplement warnings being issued by using its own communication system.

H. EMERGENCY RESERVOIR EVACUATION

Emergency evacuation of the reservoir should only be undertaken under extreme emergencies. The dam owner, in consultation with ***your engineer*** and the Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section, decides if emergency evacuation is appropriate. Notification should be given to the ***your county*** County Sheriff and National Weather Service in advance. Releases should be ramped so that downstream users receive visual confirmation of increased stream flows in addition to public warnings.

I. EMERGENCY INFLOW REDUCTION

If time permits, actions should be taken to reduce inflow to the reservoir from upstream dams or control structures. Coordination with upstream water users, the river commissioner, ***your engineer***, and the Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section is required prior to modifying any streamflow. Actions should be taken to reduce downstream flows, such as increasing or decreasing outflows from downstream dams or control structures on the waterway on which the dam is located or its tributaries. Coordination with upstream water users, the river commissioner, ***your engineer***, and the Utah State Department of
Natural Resources, State Engineers Office, Dam Safety Section, is required prior to modifying stream flows.

PART V. INUNDATION MAPS

Inundation maps for ***dam name*** are located on the following pages.

Below is a summary list of major structures and populated areas downstream from the dam which may be affected. This list serves only as a guide for evacuation purposes (List towns and populated areas downstream from the dam)

Structures and features downstream from dam include: (List roads, major bridges, railroads, major industries, housing areas,

WARNING SYSTEM

There is no warning system at the dam. The nearest telephone is located ***. Warning of failure or notification of impending failure would be telephoned to the ***your county*** County Sheriff's office. That office will implement appropriate procedures to warn or evacuate the downstream population.

COMMUNICATIONS DIRECTORY

***dam name*** Dam ................. COMM-1
Supporting Agencies and Organizations ................. COMM-2

COMMUNICATIONS DIRECTORY

***dam name*** DAM
***your county***, Utah

A. DAM OWNER
***water user name***
***Address***
***your town*** UT 84***
Phone: (801) ***-****

B. OPERATING AGENCY
***water user name***
***Address***
***your town*** UT 84***
Phone: (801) ***-****

C. FACILITIES OPERATOR AND DAM TENDER
All maintenance and local operations during construction are performed by ***, the dam tender. *** lives at ******, about *** miles from the dam.

Normal Communications

Phone: (801) ***-****, ***your town***, UT

Radio: ***

Emergency Communications:

<table>
<thead>
<tr>
<th>NAME</th>
<th>POSITION</th>
<th>ADDRESS</th>
<th>HOME PHONE</th>
</tr>
</thead>
<tbody>
<tr>
<td>***Dam Owners</td>
<td>Name***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>***Dam tender</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

D. NOTES
***dam name*** Dam is located on *** approximately *** miles *** of ***your town***, Utah. Access is via *** from ***. The road is *** up to up to the dam. Access to the dam crest is ***; access to the outlet works is via ***.

LOCAL LAW ENFORCEMENT

***your county*** County Sheriff ......................... ***
Business calls .................................................. (801) ***-****

SUPPORTING AGENCIES AND ORGANIZATIONS

Ambulance ........................................................ ***-****
Colorado Basin River Forecast Center ...................... 801-524-5130
Emergency Action Plan Coordinator (***name***) ........... ***-****

***Water User Name*** Public Information Officer (***name***) ....... ***-****

*****your engineer****** ................................. 801-***-****

Fire ***your county*** ........................................ ***-****

Hazardous Material Spill

***your county*** County ..................................... ***-****
National Response Center ................................. 1-800-424-8802
Environmental Protection Agency 24-Hour Spill Reporting . . .

Utah State Division of Emergency Services and Homeland Security ........................................... 1-801-538-3400

Hospital
  *** Hospital, ***your town*** .................. ***-****

Oil Spill ............................ see Hazardous Material Spill

*** River Commissioner .......................... ***-****

Sheriff  ***your county*** County Sheriff
  (Emergency) .......................... ***-****
  (Business) .............................. ***-****

Utah Highway Patrol .......................... 1-800-243-0456

Radio Station KSL, Salt Lake City .......................... 575-7600

Utah Division of Wildlife Resources .......................... ***-****

Water Districts

Downstream Dam Owners

Downstream Powerplant owners

Upstream Dam Owners and water users

APPENDIX 2

A. DESCRIPTION OF THE DAM

***dam name*** Dam is a *** dam, constructed by *** during ***. The reservoir impounded by ***dam name*** Dam is known as ***dam name*** Reservoir. It's primary purpose is to store flows of *** for *** use in *** and ***your county*** County, Utah. Additional reservoir uses include recreation, irrigation storage, and ***. The dam is located on *** in Section ***, T***, R***, Salt Lake Base and Meridian.

Construction of ***dam name*** Dam began on ***. The embankment was completed ***. Initial filling began ***.

B. DIRECTIONS AND ACCESS TO DAM

***dam name*** Dam is located approximately *** miles *** of ***your town***, Utah.

1. From ***your town***, Utah - Access to the dam is via a ***-mile *** road which intersects with *** approximately *** miles *** of the junction of State Route *** and ***. The access road is locally called "***". There is no road access to the dam crest from either
abutment. The dam could be reached cross country on foot or horseback from ***. Vehicle access to the dam crest is ***.

*** are paved all-weather roads. "***" may not be passable during the winter or during periods of heavy rainfall or snowmelt runoff.

2. **From Salt Lake City, Utah** - Follow *** to ***, thence *** on *** *** miles to the junction with ***. Then follow the directions from ***your town***, Utah, listed above.

During severe storms four-wheel drive vehicles may be required to travel the route. Operation of the ***dam name*** Dam spillway will flood the access road from to the dam.

The nearest airport is the *** located *** *** of ***, approximately *** *** miles *** of the dam.

**APPENDIX ***

**POTENTIAL PROBLEMS AND IMMEDIATE RESPONSE ACTIONS**

The information listed below is provided for general information. In the event one or more of these conditions exist at ***dam name*** Dam, the ***water user name*** should contact ***your engineer*** immediately for specific advice based on field observation.

The Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section should be contacted as soon as possible and details of the problem and emergency action taken.

**OVERTOPPING BY FLOOD WATERS**

Open outlet to maximum safe capacity

Place sandbags along the crest to increase freeboard and force more water through the spillway.

Provide erosion-resistant protection to the downstream slope by placing plastic sheets or other material over eroding areas.

Divert flood water around the reservoir basin if possible. Restrict reservoir inflow if possible.

Create additional spillway capacity by making a controlled breach in a low embankment section or dike section where the foundation materials are erosion resistant.

**LOSS OF FREEBOARD OR DAM CROSS SECTION DUE TO STORM WAVE EROSION**

Place additional rip rap or sandbags in damaged areas to prevent further embankment erosion.
Lower the water level to an elevation below the damaged area.
Restore freeboard with sandbags or earth and rock fill.
Continue close inspection of the damaged area until the storm is over.

**SLIDES ON THE UPSTREAM OR DOWNSTREAM SLOPE OF THE EMBANKMENT**

Lower the water level at a rate and to an elevation considered safe given the slide condition. If the outlet is damaged or blocked, pumping, siphoning, or a controlled breach may be required. Restore lost freeboard if required by placing sandbags or filling in the top of the slide. Stabilize slides on the downstream slope by weighing the toe area with additional oil, rock, or gravel.

**EROSIONAL FLOWS THROUGH THE EMBANKMENT, FOUNDATION, OR ABUTMENTS**

Plug the reservoir side of the flow with whatever material is available (hay bales, bentonite, or plastic sheeting if the entrance to the leak is in the reservoir basin).

Lower the water level until the flow decreases to a non-erosive velocity or until it stops.

Place a protective sand and gravel filter over the exit area to hold materials in place.

Continue lowering the water level until a safe elevation is reached.

Continue operating at a reduced level until repairs can be made.

**FAILURE OF APPURTEMENT STRUCTURES SUCH AS OUTLETS OR SPILLWAYS**

Implement temporary measures to protect the damaged structure, such as closing an outlet or providing temporary protection for a damaged spillway.

Employ experienced professional divers if necessary to assess the problem and possibly implement repair.

Lower the water level to a safe elevation. If the outlet is inoperable, pumping, siphoning, or controlled breach may be required.

**MASS MOVEMENT OF THE DAM ON ITS FOUNDATION (SPREADING OR MASS SLIDING FAILURE)**

Immediately lower the water level until excessive movement stops.
Continue lowering the water until a safe level is reached.
Continue operation at a reduced level until repairs can be made.

**EXCESSIVE SEEPAGE AND HIGH LEVEL SATURATION OF THE EMBANKMENT**

Lower the water to a safe level.
Continue frequent monitoring for signs of slides, cracking or concentrated seepage.
Continue operation at a reduced level until repairs can be made.

**SPILLWAY BACK CUTTING THREATENING RESERVOIR EVACUATION**

Reduce the flow over the spillway by fully opening the main outlet.
Provide temporary protection at the point of erosion by placing sandbags, rip rap materials, or plastic sheets weighted with sandbags.
When inflow subsides, lower the water to safe level.
Continue operating at a low water level in order to minimize spillway flow.

**EXCESSIVE SETTLEMENT OF THE EMBANKMENT**

Lower the water level by releasing it through the outlet or by pumping, siphoning, or a controlled breach.
If necessary, restore freeboard, preferably by placing sandbags.
Lower water to a safe level.
Continue operating at a reduced level until repairs can be made.

**LOSS OF ABUTMENT SUPPORT OR EXTENSIVE CRACKING IN CONCRETE DAMS**

Lower the water level by releasing it through the outlet.
Attempt to block water movement through the dam by placing plastic sheets on the upstream face.
Lowering water to a safe level.

***water user name***

***dam name*** Dam
EMERGENCY ACTION PLAN
DISTRIBUTION LIST

Organization

***dam tender***

***your county*** County Sheriff

***your county*** County Emergency Preparedness Director

***water user name*** Office

Utah State Department of Natural Resources, State Engineers Office, Dam Safety Section

National Weather Service, Colorado Basin River Forecast Center

Utah State Division of Comprehensive Emergency Management

***downstream dam owner***

***downstream power plant operator***

**ranger district**, ***national forest***

***District office***, Bureau of Land Management

***Provo Projects Office, U.S. Bureau of Reclamation***
REFERENCES

