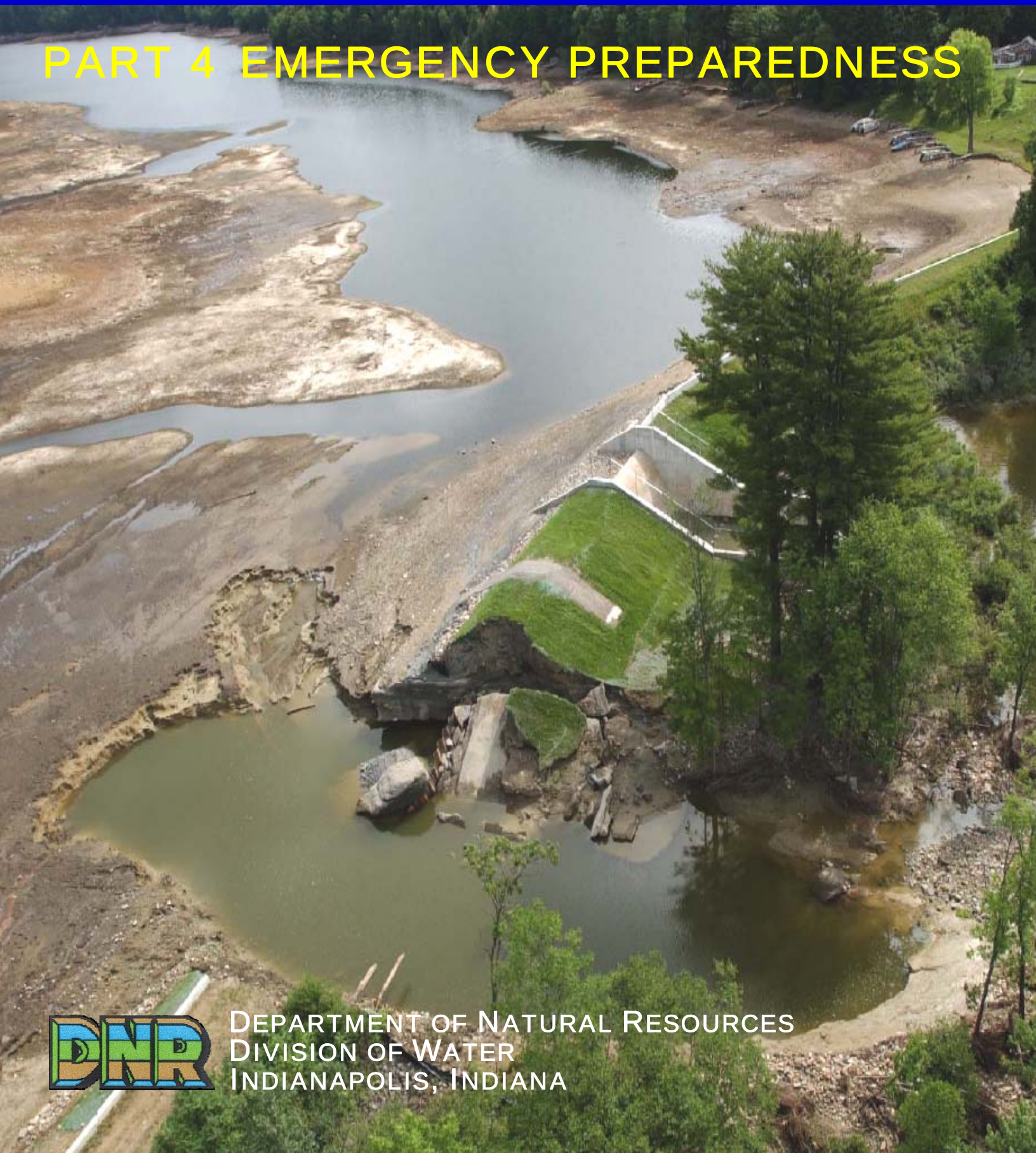
INDIANA DAM SAFETY INSPECTION MANUAL

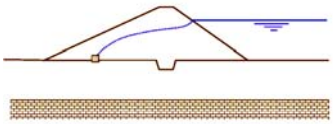
UPDATED 2007

PART 4 EMERGENCY PREPAREDNESS



DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATER
INDIANAPOLIS, INDIANA

INDIANA DAM SAFETY INSPECTION MANUAL



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Preface

The Indiana Dam Safety Inspection Manual is based on accepted practice and consists of information developed from existing documentation on dam safety inspections obtained from state and federal agencies. Dam safety is a complex and multi-disciplinary practice that continues to evolve as professionals gain a better understanding of how the various dam components behave under different loading conditions and how society's level of risk tolerance changes with time. This manual is a "living document" that will change to reflect evolving national practice. As this manual improves with time, it will provide a stable reference for good dam safety inspection practice as administrators, program priorities, and statutes change. The manual consists of five separate parts:

Part 1 describes ownership responsibilities and roles, risks and hazards of dam failure, and provides a detailed overview of dams in Indiana.

Part 2 presents guidelines for operating and maintaining a dam, including specific instructions on how to prepare a management and maintenance plan and how to respond to emergencies.

Part 3 provides guidance on evaluating dam safety and performing dam inspections. It covers who should perform the inspections and how, and provides guidance on identifying and reporting dam deficiencies and problems.

Part 4, this part, describes guidelines for preparing Emergency Action Plans (EAP) to guide the dam owner during emergency situations. It also covers Emergency Response planning.

Part 5 is a compilation of Dam Safety Fact Sheets that present information on a variety of dam operational issues, such as seepage, slope protection, embankment stability, and spillway design, to name a few.

This manual should not be used in lieu of appropriate dam safety technical courses or training by a dam safety professional in the area of dam inspection. However, it should be used by experienced dam safety professionals as a reference and reminder of the aspects required to make a thorough dam safety inspection and evaluation. It should be stressed, however, that inspections alone do not make a dam safe; timely repairs and maintenance are essential to the safe management and operation of every dam.

The dam owner is responsible for maintaining the dam in a safe condition, and should do whatever is necessary to avoid injuring persons or property. As once stated by a highly respected legal scholar, "It is clear that compliance with a generally accepted industry or professional standard of care, or with government regulations, establishes only the minimal standard of care. Courts may assess a higher standard of care, utilizing the "reasonable person" standard and foreseeability of risk as the criteria. It is fair to say that persons who rely blindly upon a governmental or professional standard of care, pose great danger to others, and present a legal risk to themselves, when they know or reasonably should know that reasonable prudence requires higher care."

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Acknowledgements and Disclaimer

This Manual was developed by Christopher B. Burke Engineering, Ltd. (CBBEL) for the Indiana Department of Natural Resources (IDNR), Division of Water. Principal editors, authors, and support staff within CBBEL included: Siavash E. Beik, P.E. (Project Manager & Technical Editor), Ken Bosar, P.E. (Principal Author), and Jon Stolz, P.E. (Technical Consultant). Principal reviewers and project coordinators at the Division of Water included Kenneth E. Smith, P.E. (Assistant Director) and George Crosby, P.G. (Manager, Dam and Levee Safety Section).

A four-member peer review team provided technical review and advice during the preparation of the manual. The team members included Charles Rucker P.G., Robert Biel, P.E., Thomas Hugenberg, P.E., and John Pfeifer, P.E., all former Army Corps of Engineers dam safety professionals.

Much of the material presented in the manual was adapted from various publications developed by Federal and State agencies for dam inspection, operation, and maintenance. In many cases, pertinent text and illustrations were directly utilized within the manual with permission. A complete list of these publications is provided in the Appendices under References. The photographs were primarily obtained from IDNR and CBBEL files for Indiana dams; some photographs were obtained from public sources. The following is a list of agencies whose publications were extensively used in the preparation of this handbook:

Indiana Department of Natural Resources
Association of State Dam Safety Officials
U.S. Army Corps of Engineers
U.S. Department of Agriculture Natural Resources Conservation Service
U.S. Department of the Interior, Bureau of Reclamation
Wisconsin Department of Natural Resources
Ohio Department of Natural Resources
Colorado Division of Water Resources
Pennsylvania Department of Environmental Protection

Special recognition is given to the Federal Emergency Management Agency (FEMA) who provided funding to the IDNR for the development of this manual. Special recognition is also given to the Association of State Dam Safety Officials (ASDSO) for their leadership in developing effective dam safety programs and policies for the furtherance of dam safety. Their diligence in assisting the U.S. dam safety community was an important factor in the issuance of the FEMA grant.

Indiana Dam Safety Inspection Manual Revisions		
Revision No.	**Date**	**Revisions Made**
0	Aug 28, 2003	First Edition published and placed on IDNR web site.
1	Aug 28, 2007	General grammatical revisions throughout; updated for new dam regulations and policy; added new Part 4, Emergency Preparedness; the original Part 4, Dam Safety Fact Sheets, has been renumbered as Part 5; revised Fact Sheets 1, 9, 11, 14, 17; revised front covers and prefaces; revised Table of Contents.

PART 4 EMERGENCY PREPAREDNESS

TABLE OF CONTENTS

CHAPTER 1.0

INTRODUCTION

1.0 INTRODUCTION

Dams should be designed, monitored, and maintained so that they do not fail. However, conditions beyond the control of the dam owner and engineer can occur due to unforeseen structural problems, natural forces, mistakes in operation, negligence, or vandalism. Therefore, all dam owners should be prepared to react to emergencies that could occur. The extent to which the dam owner is prepared for emergencies is referred to as the degree of "emergency preparedness."

The downstream effect of a dam failure can be devastating. When a break in a dam (breach) develops, water discharge increases due to the uncontrolled release of water stored by the dam. Destruction of homes and property has been well publicized. The force of water through existing bridges and culverts and over roads can cause their collapse. It has been documented that the flood wave from a small dam can overtop roads and wash cars from the roadway. Overtopping of the roads also makes them impassable for emergency vehicles. Dam failures can kill people. Numerous dam failures throughout the world have resulted in the extensive loss of life and property.

The people standing on the rooftops in this striking image are likely sightseers who have come to see the flood destruction.

Figure 1-1 Old photo from Johnstown Pennsylvania following the failure of the Southfork Dam on May 31, 1889. Over 2,200 people were killed and the City of Johnstown was almost completely destroyed as a result of this preventable dam failure.

Figure 1-2 Photo in Rexburg, Idaho after the Teton Dam failure on June 5, 1979. Eleven to 14 people were killed and $400 million in property damage occurred as a result of this dam failure. The dam failed during initial filling when the reservoir was near its normal pool level.

Damage to the environment and to upstream users from a dam failure can also be catastrophic. A breach in the dam and rapid loss of the impounded water can cause heavy silt loads to be passed downstream. These sediments, after a period of time, will settle out, clogging and covering the flooded land and streambed. Fish and wildlife habitat can also be damaged. Upstream slopes can fail and boaters could be washed downstream.

The degree of preparedness and the extent of the action taken during emergencies depend, in large part, on the potential threat or hazard that may be imposed on the downstream areas. The greatest threat generally occurs where residences are located immediately downstream from a dam

that has safety deficiencies. In this case, the dam owner should develop and maintain a high degree of emergency preparedness. The least threat occurs where the downstream areas contain undeveloped property with no cultural features and the dam has no safety deficiencies. In this case, dam owners generally maintain a lower degree of emergency preparedness. Regardless of the threat imposed on downstream areas, all dam owners should be aware of what would happen and how they would respond to a failure or large discharge from their dam. All dam owners should assess and regularly review their emergency preparedness in order to define the hazards that a dam represents and to reduce potential loss of life and property.

Figure 1-3 Photo showing downstream environmental damage after the Taum Sauk Dam failure in December, 2005, near Lesterville, Missouri. No people were injured. The dam failed when pump/reservoir level control equipment failed to shut of the reservoir filling pumps.

The dam hazard classification (described in Part 1) can help a dam owner prepare for emergencies by providing an indication of the potential for downstream losses and damage. It is also very important for the dam owner to monitor the hazard classification on a regular basis to determine if new downstream development affects the safety hazards of the dam.

The components of a facility's emergency preparedness may be grouped into three categories for ease of discussion: 1) site conditions, 2), emergency preparedness equipment, and 3) emergency procedures.

Site conditions:

- downstream hazard classification
- physical condition of dam and appurtenant equipment
- access to the dam and equipment
- security measures

Emergency preparedness equipment:

- communications systems
- warning systems
- auxiliary power systems
- remote operation capability
- reservoir drawdown capability
- emergency response equipment, such as earth moving equipment, pumps, sand bags, soil stockpiles, etc. that can be used to prevent or delay dam failures

Emergency procedures:

- Emergency Action Plan
- Emergency Response Plan (for downstream areas)
- Management and Maintenance Plan
- Operating Logbook
- operator training

Site Conditions

A downstream hazard classification is a rating (e.g. low, significant, or high hazard) that indicates the probable loss of life and property damage downstream from a dam, based on the results of breaching studies of the dam and/or an identification of the area downstream that would be inundated. The dam's condition or potential for failure has no bearing on hazard classification. Greater emergency preparedness measures should be performed for dams with higher hazard classifications. Compared to dams with low hazard classifications, high hazard dams should be inspected more frequently and be given a higher priority for any necessary corrective actions. The dam owner should monitor downstream development for potential changes in the dam's hazard classification.

The dam and its appurtenant equipment should be regularly inspected and maintained to keep everything in good condition. This includes having properly designed embankments, spillways, and other equipment necessary to safely handle extreme natural events that could pose a threat to the dam's safety, such as severe rain storms or earthquakes. These procedures will help prevent the dam from experiencing failure.

Access to the dam includes the capability of dam personnel to reach the site under adverse conditions and the transportation of construction equipment and materials to the site in the event of an emergency, if the nature of the emergency makes averting or alleviating dam failure possible. In an emergency, successful execution of an Emergency Action Plan (EAP) will depend upon emergency personnel and equipment being able to freely access all areas of the site. Access is also important for the normal duties of site operations, maintenance, and inspection personnel. Seasonal access should be available during winter months and periods of heavy or prolonged precipitation. Alternative access routes may be required in the event that the normal access route may be affected by the emergency.

At a minimum, a dam's security system should effectively prevent vandals or saboteurs from gaining access to and operating or damaging dam electrical and mechanical operating equipment. This is particularly important at critical facilities, such as water supply reservoirs and power generation facilities. In the past, protection from vandalism had been the primary reason for site security. However, recent events have clearly shown that sabotage and terrorism is a distinct possibility. Vandals or saboteurs may damage or operate equipment at a project, or even threaten the safety of the dam directly, and thus jeopardize downstream residents and property. The security of a

project against such potential acts must be assessed and appropriately addressed before such incidents occur. A security assessment evaluates the potential threats to the dam, identifies the potential consequences of a successful attack, and looks at the vulnerabilities of the dam to attack. It is in the best interests of security that a dam has a security plan that identifies the features of the dam that are critical to its purpose and the countermeasures that have been implemented to eliminate, reduce, or mitigate the security risk to the dam.

Emergency Preparedness Equipment

The adequacy of emergency preparedness equipment is fundamental to the successful execution of an EAP. The EAP should contain a list of available equipment, or potential contractors that would be utilized during an emergency. The EAP prepared by the dam owner/operator must contain descriptions of the following equipment as applicable:

Communications Systems: The available communications systems must be adequate during adverse situations to serve the needs of persons or organizations responsible for emergency operations. Communications systems form the link between a dam, the project or owner's office, and the authorities responsible for the safety of the affected population downstream of the dam. If a threatening situation develops, immediate communication from the site may allow time for flood preparation or evacuation. Failure of communications equipment could have disastrous consequences. Consequently, backup communications should be provided for high hazard dams.

Warning Systems: Dams may have electrical/mechanical devices to alert onsite or remote personnel of adverse conditions. However, dam attendance is the major means of warning for most sites. Some means must exist to detect a developing emergency and convey a warning to persons responsible for taking emergency actions. Electrical/mechanical warning systems may be included in project instrumentation, but most sites rely upon warnings transmitted by site personnel. Without warnings, evacuation or preventative actions may be delayed or made impossible. Relatively few dams have electrical/mechanical devices to warn of potential adverse conditions at a site.

Auxiliary Power Systems: In the event of failure of the primary power system, auxiliary power, which could be manual operation, must be available to operate mechanical equipment and lighting and communications equipment, if necessary. If normal power is disabled during an emergency, auxiliary power may be needed to operate equipment such as gates and communications facilities. Ability to carry out the EAP could be severely hindered without auxiliary power. An auxiliary power system usually consists of an engine-generator set that is operated on liquid fuel and has adequate electrical distribution cables.

Remote Operation: Remote operation is the ability to operate equipment, such as spillway gates, from a location other than the dam site. The ability to control equipment such as spillway gates or outlet works gates from a location away from the dam permits

timely response to emergencies requiring the operation of this equipment, particularly if someone is not at the dam all the time, and access to the site is relatively difficult. If remote operation is a part of the EAP, the system must operate reliably when needed. Remote operating facilities are not common. Remote operation may also involve visual monitoring using stationary cameras with remote television display.

Reservoir Drawdown Capability: The ability to lower the reservoir rapidly during an emergency is vital to emergency preparedness. If design or equipment problems make reservoir drawdown unacceptably slow, the dam could fail and release a full or nearly-full reservoir. For some dam-threatening conditions, such as piping, lowering the reservoir quickly could prevent failure or reduce the effects of failure.

Emergency Response Equipment: The dam owner should maintain or have access to equipment and supplies that can be quickly mobilized during an emergency to avert or delay dam failures. This equipment could include dozers, front-end loaders, backhoes, trucks, pumps, and cranes. Supplies that should be considered include sand bags, hand digging equipment, soil stockpiles, siphon piping, and lumber. If contractors will be relied on, contracts should be obtained in advance with agreements for rapid response any time of the day and year.

Emergency Procedures

Emergency procedures generally include planning, training, and implementation of emergency plans. Good plans and the identification of resources necessary to implement the plans are essential to saving lives and minimizing damage during an emergency. The two (2) principal plans that should be ready for implementation during a dam emergency are the Emergency Action Plan and the Emergency Response Plan.

An **Emergency Action Plan** (EAP) is a formal plan that identifies potential emergency conditions at a dam and outlines the procedures to follow to minimize property damage and loss of life. An EAP is needed to preplan the actions taken by the dam owner, Indiana Department of Homeland Security (IDHS) personnel, and local emergency officials during an emergency. The plan will help provide for timely notification, warning, and evacuation in the event of an emergency; however, it must be updated and practiced as conditions dictate. It is up to the dam owner to prepare and implement the EAP during an emergency. Appendix A contains a Template Emergency Action Plan that the dam owner or representative can use to prepare their own plan. This template is available in Microsoft Word format so that it can be used as the basis for the EAP preparation.

An **Emergency Response Plan** (ERP) is a formal document intended to improve mitigation, warning, evacuation, and search and rescue activities during a dam safety emergency. A sheriff, firefighter, or an official with IDHS, among others, generally prepares and implements the ERP. These individuals are broadly referred to as emergency responders in this manual. The ERP is generally prepared for areas downstream of a dam, but may include areas around the reservoir or upstream if flood

water levels impact residents in these areas.

It is the responsibility of the dam owner to develop an EAP for a high hazard dam and to implement it during emergencies. In turn, it is the responsibility of the emergency responders to take the EAP and apply it during their emergency response plan implementation. Dam awareness and operation must be a priority for all emergency management personnel.

In addition to an EAP and an ERP, every dam should have a Management and Maintenance (M&M) Plan (see Part 2). The M&M is a document containing instructions for normal management and maintenance of the dam and its appurtenant works. A dam and its components should be operated and maintained according to the design intent. Faulty operation or lack of maintenance could create an emergency or dam safety problem. The M&M Plan should contain all necessary plans, instructions, and guidelines for operating all components of the dam, as well as security provisions. The Plan should also provide details and schedules for maintenance, repairs, and inspections of all the dam components. Regardless of how simple a piece of equipment may be to operate, instructions should be prepared and included as part of the M&M Plan. The adequacy of operating instructions, including those for operation with auxiliary power, should be evaluated for both normal and emergency conditions. The operating instructions should be clear and readily accessible to the site and emergency personnel. If at all possible, the M&M Plan should be kept at the site where it is readily accessible. The operating equipment at some dams is of such a basic nature that no posted operating instructions are required. At other facilities, posted operating instructions are deliberately avoided in case unauthorized persons were to gain access to the equipment. In those cases, considerable downstream damage might result from such unauthorized operation. However, trespassers still might operate equipment even without posted instructions, so the proper approach in those circumstances would be to improve security at the site. The dam owner or operator is responsible for preparing and maintaining the M&M Plan. An M&M Plan should be prepared for all dams in Indiana, no matter how simple the dam construction and operating procedures are.

An Operating Logbook should be kept at all dams to document maintenance, storm events, maximum water levels related to specific storm events, general observations, and problems that may develop. Generally, a specific individual should be assigned the responsibility for maintaining the Logbook.

Training should be provided to all personnel involved with the maintenance and operation of a dam. The training should include the design details of the structures, information concerning potential water levels and spillway capacity, emergency preparedness procedures, and EAP training if one is available for the facility.

CHAPTER 2.0

EMERGENCY ACTION PLANNING

2.0 EMERGENCY ACTION PLANNING

2.1 OVERVIEW

This chapter is intended to assist the dam owner with the preparation of an **Emergency Action Plan** (EAP). The Template EAP contained in Appendix A of this Part 4 is a complete document with all the necessary components. Highlighted (in yellow) sections indicate information that must be supplied by the dam owner or his/her representative. The highlighted text provides specific guidance on what information should be included.

2.2 EAP DEFINITION

An EAP is a formal plan that identifies potential emergency conditions at a dam and outlines the procedures to follow to minimize property damage and loss of life. The dam owner is responsible for preparing, updating, and implementing the EAP during an emergency. The owner, his/her representative, and all parties included in the EAP must be made aware of its existence and of their involvement. Training and planning sessions involving all potential participants are essential for the successful implementation of an EAP during emergencies.

The Emergency Action Plan contains procedures to be followed during an emergency, such as structural problems, equipment malfunctions, or natural events such as floods or earthquakes that cause the design limits of a dam to be approached or exceeded. Generally, the EAP defines emergency detection, warning, and notification procedures to provide a clear set of instructions for the dam owner or his representative to: 1) take action at the dam site in response to emergencies such as floods, earthquakes, or equipment or structural failures such as piping; and, 2) notify designated emergency response and agency personnel of the emergency so they can issue warnings to the public for evacuation. Other components of the EAP provide information on the dam, water levels, emergency event levels, etc. as discussed below.

An EAP should be prepared whenever there is a risk to downstream life and/or property, especially if the dam has a high hazard classification. Outdated, confusing, or incomplete procedures and instructions could result in an ineffective response to an emergency; therefore the EAP should be reviewed and updated on a regular basis. A Template EAP is included in Appendix A of Part 4 (this Part) of the Indiana Dam Safety Inspection Manual; this template is intended for use by dam owners to help them prepare their own EAP.

2.3 EAP COMPONENTS

Emergency Action Plans for dam emergencies should be clear, concise, and easy to use during emergencies. Every EAP should provide details on 4 steps, which must be followed anytime an unusual or emergency event is detected at a dam. The steps are:

Step 1: Event Detection (unusual) and Level Determination
Step 2: Notification and Communication
Step 3: Expected Actions
Step 4: Termination and Follow-up

Specific actions required for each step will depend on the severity of the emergency situation as defined during Step 1. The actions required for each step of the EAP are summarized graphically on the EAP Flow Chart for ease of implementation (see Figure i of Appendix A, duplicated below in Figure 2.1). A summary of each of the four steps is provided below.

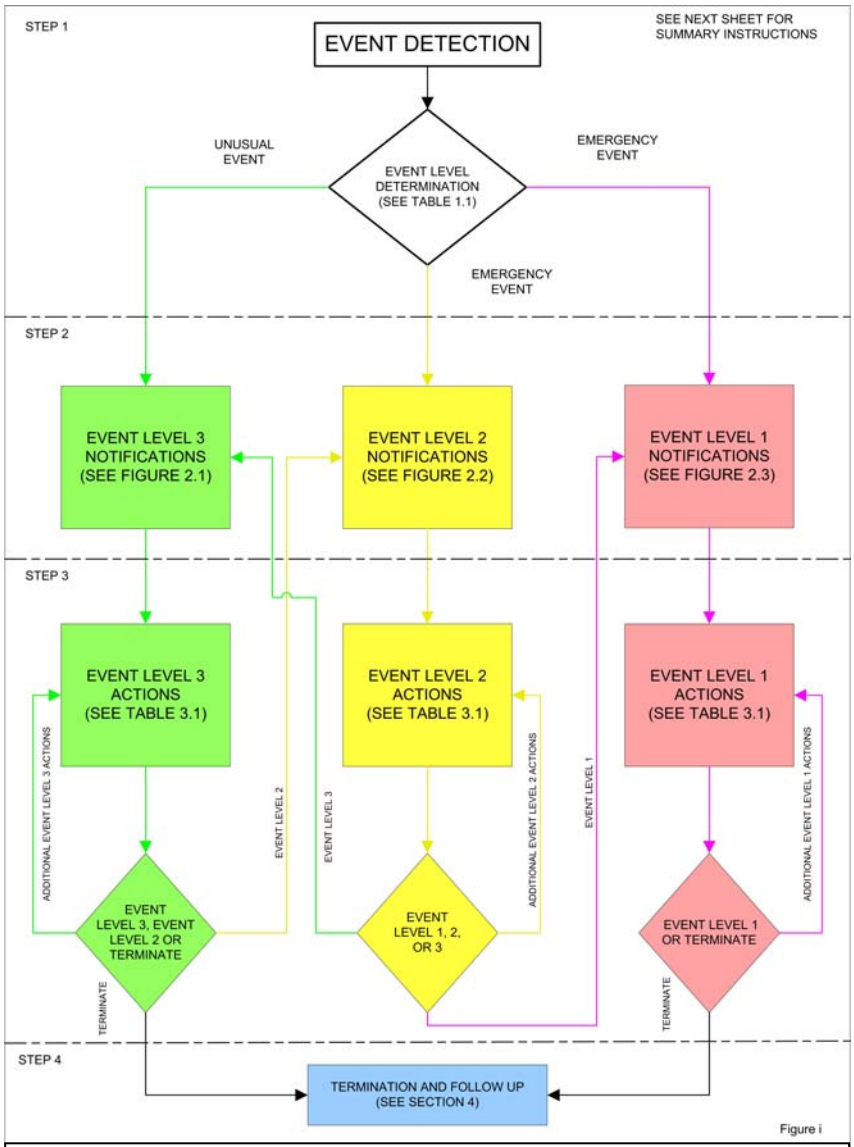

Figure 2-1 Recommended EAP Flowchart

Step 1 - Event Detection and Level Determination

An unusual event is defined as an event which takes place, or a condition which develops, that is not normally encountered in the routine operation of the dam and reservoir, or one that necessitates a variation from Standard Operating Procedures. An unusual event usually requires implementation of the EAP. An Event Level generally defines the seriousness of the unusual event, with Level 3 being the least serious, and Level 1 being the most serious. Level 1 events require immediate action due to imminent dam failure or flash flooding.

During the initial step, an unusual event or emergency event is detected at the dam and classified by the EAP Coordinator or designee into one of the following event levels:

Event Level 3: Unusual Event, slowly developing

Event Level 2: Emergency Event, rapidly developing
Event Level 1: Emergency Event, imminent dam failure or flash flooding

Information to help the EAP Coordinator or designee determine which of the above event levels is applicable is provided in Section 1 of the EAP. The Template EAP in Appendix A contains a Event Level Determination Guidance table that should be populated and customized for each dam by a qualified dam safety professional for use by the EAP Coordinator or designee to quickly determine the Event Level during an emergency.

Dam incidents should be reported immediately by the person discovering the dangerous condition to the person responsible for executing the emergency plan (listed in the EAP, and referred to as the EAP Coordinator or designee). The person who first discovers what appears to be a potentially hazardous condition at a dam site may have little or no background in dam design, construction, or safety, or may not be associated with the dam at all. In order to be able to properly identify a potentially dangerous condition, it is necessary that dam tenders and others who visit the site regularly are familiar with all features of the dam and dam site. This is especially true for dams with a history of leakage, cracking, settlement, misalignment, and erosion from wave action. Also, it is necessary to have knowledge of measurements of significant drain and seepage outflows to act as a basis for meaningful comparisons. The person that reports a dam incident should provide clear and concise information concerning the incident, including:

1. Name of dam, lake, or reservoir, and river, stream, or tributary the dam is located on.
2. Location from highway or nearest town (U.S., State, or county road numbers); also section, township and range, if known.
3. Nature of the problem (e.g., excessive leakage, cracks, sand boils, slides, wet spots, etc.).
4. Location of problem area in terms of embankment height, (e.g., about 1/3 up from the toe) and location along the dam's crest (e.g., 100 feet to the right of the outlet or abutment) and whether on the upstream slope, crest, or downstream slope.
5. Extent of the problem area. This can be satisfactorily established by pacing.
6. Estimated quantity of unusual flows as well as whether the water is clear, cloudy, or muddy.
7. Water level in the reservoir below the dam's crest or below the spillway, or the gauge rod reading.
8. Whether or not the water level in reservoir is rising or falling.
9. Name and how to contact the person making report.
10. Whether or not the situation appears to be worsening while being observed.
11. Whether or not the problem appears to be a containable problem at the time, or whether it is an emergency situation.
12. Current weather conditions at the site.
13. Anything else that seems important.

Step 2 - Notification and Communication

After the event level has been determined, notifications are made in accordance with the appropriate notification flow chart provided in Section 2 of the Template EAP.

This step of the EAP involves making the appropriate notifications after the EAP Coordinator or designee has determined the event level as an Event Level 3, 2, or 1. This section of the EAP should outline the communication systems that are available for making notifications as well as a Public Affairs Plan with sample media release and a list of media contacts. Notifications should be made in accordance with the appropriate Notification Flow Chart provided in Section 2 of the Template EAP (see Figures 2.1, 2.2, and 2.3 in the Template EAP).

The notification chart varies depending on the Event Level, or severity of the emergency situation, but in general it contains three (3) separate "branches" of notification for the more serious emergencies. The EAP Coordinator of designee is responsible for making the first level of notifications to the three branches. The branches are labeled 1 through 3 indicating the order in which the notifications are made.

Branch 1 is comprised of organizations that are responsible for the notification of potential evacuees and for the preparation of evacuation plans downstream of the dam. Individuals listed on this branch should include local law enforcement and emergency response units, as well as the Indiana Department of Homeland Security and the local Emergency Management Agency. List a primary and alternate contact for each element of the branch. Include work, home, cell phone, and/or pager numbers to ensure that the individual or organization can be reached at any time. Note that neither the dam owner, the EAP coordinator, nor the designee contacts the downstream residents directly, nor do they participate in the evacuation procedures. This process is implemented by the emergency responders contacted on Branch 1. However, for small dams or dams with very limited number of residents living downstream (say, less than 3), it may practical for the dam personnel to make direct calls to the residents in addition to the emergency responders.

Branch 2 is the engineering branch and should include individuals that are responsible for assisting in event determination and evaluation, that are knowledgeable with technical aspects of the dam, and that are responsible for other tasks concerning the condition of the dam. Individual(s) of this branch are also responsible for coordinating emergency efforts at the dam site to limit downstream damage and for maintaining contact with various groups until the event is terminated. Potential members of this branch include an on-call engineer, the Indiana Department of Natural Resources—Dam and Levee Safety Section Head (IDNR—DLSSH), an emergency contractor, and other technical resources. List a primary and alternate contact for each element of the branch. Include work, home, cell phone, and/or pager numbers to ensure that the individual or organization can be reached at any time.

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Branch 3 is the public relations notifications to inform the media of the emergency event through official press releases. Potential members of this branch include the dam owner, town leaders and those organizations in charge of community relations. List a primary and alternate contact for each element of the branch. Include work, home, cell phone, and/or pager numbers to ensure that the individual or organization can be reached at any time.

Notifications and communications should be clear, concise, and informative. The individuals on each notification branch should be kept abreast of developing conditions.

Step 3 - Expected Actions

After the initial notifications are made, the EAP Coordinator or designee should refer to Table 3.1 in the Template EAP (Figure 2.1 at the right) and confer with the Engineering Director or designee to develop and execute appropriate preventative actions. During this step of the EAP, there is a continuous process of taking actions, assessing the status of the situations, and keeping others informed through communication channels established during the initial notifications. The EAP may go through multiple event levels during Steps 2 and 3 as the situation either improves or worsens. Based on the type of event (i.e. flooding, seepage, etc) and the event level (1, 2, or 3), various Action Data Sheets (A1 through J3) should be prepared and used to direct actions during the emergency situation. Section 3 of the Template EAP contains samples of the Action Data Sheets that are needed.

Figure 2-1 Action Data Sheet Index

Event	Event Level	Action Data Sheet
Flooding	3	A3
	2	A2
	1	A1
Earthquake	3	B3
	2	B2
	1	B1
Seepage	3	C3
	2	C2
	1	C1
Cracking	3	D3
	2	D2
Movement	3	E3
	2	E2
Overtopping	1	F1
Gate Failure	3	G3
	2	G2
	1	G1
Blocked Gates	3	H3
Instruments	3	I3
Sabotage	3	J3
	2	J2
	1	J1

A directory of contractors or others that can help during the emergency at the dam should be established which lists the home phone, address, and office phone of the primary and secondary contacts for each, as well as a listing of the equipment and/or service they can provide and stating an estimate of their response time. This directory should be updated as needed.

Step 4 - Termination and Follow-up

Once the event has ended or been resolved, termination and follow-up procedures should be followed as outlined in Section 4 of the Template EAP. EAP operations can only be terminated after completing operations under Event Level 3 or 1. If Event Level

2 is declared, the operations must be designated Event Level 3 or 1 before terminating the EAP operations.

Other Information in the EAP

The last section in the EAP (Section 5 of the Template EAP) should contain the following supporting information and documents:

- Location and Vicinity Map
- Emergency Site Access Route Map
- Estimated Dam Failure Flood Inundation Map
- Reservoir Area and Capacity Curve
- Spillway Rating Curve
- Annotated Site Pictures
- Schematic Plan of the Dam

This information provides supporting data for emergency responders and is used when communicating emergencies to others. The Location Maps and Access Route Maps are critical to defining the exact site location and means of gaining access to the dam. Photographs and Schematic Plan(s) are helpful for the responders to better understand the conditions at the site.

Preparation of an estimated dam failure flood inundation map requires a detailed analysis by a qualified dam safety professional. The analysis should also predict and map flood wave height and speed. All affected downstream landowners and buildings should be identified so that the emergency responders can develop a list of who to contact with flood warnings and evacuation notices.

When preparing inundation maps for EAP's, two types of failures are usually considered: rainy day and sunny day failures.

A rainy day failure could occur when heavy precipitation, in excess of that normally observed in the watershed above the dam, leads to a high runoff period. If the high water overtops the dam or adds too much pressure, a rapid breach failure could result. The dam owner should be alert to severe weather warnings and inspect the dam before, during, and after such events. A rainy day failure is typically evaluated using the design flood event appropriate for the hazard classification of the subject dam (100% Probable Maximum Flood for High Hazard dams and 50% Probable Maximum Flood for Significant and Low Hazard dams).

A normal storm event could lead to overtopping the dam if the outlet works are plugged with debris, if the gates jammed or were broken, or if a power failure prevented operation of key mechanisms. All the items can be controlled by proper management and maintenance of the dam.

Dams have also failed without any heavy precipitation. These failures are called sunny day failures. They are usually the result of neglected inspection programs and poor

maintenance and operation of the dam. As an example, failure to consider embankment seepage could lead to piping (internal erosion). A sunny day failure could be caused by vandalism of the outlet works, such as damage to gate mechanisms, or if the outlet works are inoperable or are plugged with debris. Sunny day failures are more likely at unattended dams than frequently visited dams.

Appendices

The EAP appendices contain other useful data and forms. Past EAP activity, EAP reviews and revisions, and EAP distribution are documented here; these are critical items and must be carefully documented. The number of EAP copies issued should be limited to those individuals that will participate in the emergency event. The Appendices included in the Template EAP are as follows:

Appendix A Warning and Evacuation
Appendix B Inundation Map Documentation
Appendix C Past EAP Activity
Appendix D EAP Review and Revision
Appendix E EAP Distribution
Appendix F Supplementary Information
Appendix G Glossary

2.4 GENERAL TRAINING AND UPDATING THE EAP

Recurring training for the dam operator and backup(s) is important to ensure that they understand their responsibilities with regard to operating and maintaining the dam and responding to emergencies. The training should provide sufficient information for the dam operators to make knowledgeable, correct, and prompt decisions concerning protection to the downstream residents and property. Both the principal operator(s) and designated backups should receive operator training in accordance with organizational policy. New operators should be trained before assuming duties at a dam. The training should include the following as may be applicable:

- general dam safety overview, and site specific potential failure modes and their precursors
- inspection responsibilities, including any specific concerns
- operations and reservoir regulation
- maintenance requirements and practices
- operating logbook
- safety
- site security
- Emergency Action Plan and responsibilities
- reading instrumentation, if required
- public relations and recreation management, if required
- familiarization with the project and equipment

- review of the facility operating procedures
- operation of all equipment

The EAP must be a "living document" in order to be effective when it needs to be activated. Therefore, periodic reviews, updating, training, and exercising are necessary. The dam owner/operator is responsible for conducting a review and updating of the EAP at least annually. The annual review should consist of the following:

- Calling all of the contacts on the EAP notification charts to verify that the phone numbers and persons in the specified positions are current. Update the information if any of the contacts have changed.
- Contacting the local law enforcement agency to verify the phone numbers and persons in the specified positions.
- Asking the appropriate contact persons if they know where the EAP is kept and if he or she understands his or her responsibilities as described in the EAP.
- Calling the locally available resources to verify that the phone numbers, addresses, and services are current.

The dam owner/operator is responsible for updating the EAP document and providing updated sections of the EAP to all the EAP document holders. Outdated pages should be immediately discarded to avoid any confusion with the revisions.

2.5 EXERCISING THE EAP

After the EAP is developed, initial EAP training should be performed. The training should include representatives of all organizations with key responsibilities identified in the EAP. The training may take the better part of a full day and can be divided into four segments to facilitate the process: Motivation Exercise, EAP Content and Format, Site Visit, and EAP Exercise.

The Motivation Exercise should be a video or photographic presentation of an actual dam failure that has caused loss of life and/or serious property damage. The purpose of this part of the training is to provide incentive for the participants to remain involved.

The next part of the training is to review the content and format of the EAP so that the participants are familiar with the document. It may help considerably if the participants review the EAP before the training session. A visit to the dam site should then be made to give everyone the opportunity to view the dam in person so that they know and understand the complexity of the structure, the size of the water body, potential access routes, etc. An onsite presentation or overview of the dam and its design should be made. Downstream areas should be discussed and shown either in person or on a map. Key features of the dam should be pointed out and described in some detail because many of the participants may have no knowledge of the dam or of the features involved.

The final, and possibly most important, part of the training is the EAP Exercise. The exercise most often used is called a functional exercise, and consists of going through the motions of finding, evaluating, and resolving a fictional emergency scenario at the dam. This exercise is conducted in a room, usually at the site. The purpose of the functional exercise is to familiarize participants with roles, procedures, responsibilities, and personalities of the other participants. An emergency situation specific to the dam at hand is developed (in writing) and presented to all of the participants. The participants then perform all of the EAP steps as though the emergency were real, including making an event level determination, performing notifications to appropriate individuals, implementing emergency actions and responses, and terminating the emergency with appropriate follow-up actions. Mock phone calls should be made to participants with realistic conversations being held discussing actions and events. An Event Log should be completed as during an actual event. After the EAP exercise is completed, a detailed discussion should be held to evaluate the process that occurred. During the exercise, an observer should monitor and document the exercise to provide feedback to the participants on ways to improve their performance and procedures. The functional exercise should be used to identify needed improvements in the EAP and in the notification procedures. This is an excellent time to also discuss mutual aid agreements and other emergency procedures as well as update and revise the EAP as determined necessary.

The owner/operator should host and facilitate a periodic test of the EAP at least once every five years. The periodic test should consist of a functional exercise, including representatives of all organizations with key responsibilities identified in the EAP. Participants should visit the dam during the periodic test to familiarize themselves with the dam site before the functional exercise begins. The same procedures used during the initial training should be employed.

Two other types of EAP exercises include the tabletop exercise and the full-scale exercise. The tabletop exercise is conducted in a room and consists of an open-ended discussion in a meeting format with a facilitator. The tabletop exercise should begin with the facilitator presenting a scenario of an unusual or emergency event at the dam that has been developed prior to the exercise. Once the scenario has been presented, the participants should discuss the responses and actions that they would take to address and resolve the scenario. The facilitator should lead the discussion, ensuring realistic responses and developing the scenario throughout the exercise. The participants may ask questions and provide comments. Typically, the facilitator reads a narrative description of what has occurred and then poses problem statements and asks participants to explain how they would react. The problem statements cover various issues expected to be encountered during the emergency incident. The full-scale exercise is a comprehensive exercise that tests, among other things, the actual warning and notification procedures and equipment, the emergency response agencies' response to the notification and their knowledge of the EAP, and the cooperative spirit of all participants in a stress-induces environment. The full-scale exercise requires the mobilization of personnel and resources and simulates a real emergency.

CHAPTER 3.0

EMERGENCY RESPONSE PLANNING

3.0 EMERGENCY RESPONSE PLANNING

3.1 EMERGENCY RESPONSE PLAN

An **Emergency Response Plan** (ERP) is a formal document intended to improve mitigation, warning, evacuation, and search and rescue activities during a dam safety emergency. A sheriff, firefighter, or official with IDHS, among others, generally prepares, maintains, and implements the ERP. These individuals are broadly referred to as emergency responders in this manual. The ERP is generally prepared for areas downstream of a dam, but may include areas around the reservoir or upstream if flood water levels impact residents in these areas.

The two primary components of any ERP are warning procedures and evacuation procedures. The ERP typically contains evacuation area definition (hazard area maps), warning and notification procedures, evacuation route maps and information, detour planning, community shelter information, emergency responder staffing requirements, equipment and supply requirements, termination procedures, and re-entry procedures, at a minimum.

The typical duties of emergency responders include:

- support local efforts to attain and maintain the capability to warn and evacuate people in the hazard area
- ensure that the ERP response procedures are properly linked to the notification procedures in the EAP
- encourage and participate in dam EAP exercises
- document all coordination efforts with other emergency management official for future reference
- ensure that responsible entities carry out the assigned responsibilities
- provide public warnings and notification during an emergency
- notify National Weather Service and other applicable agencies
- perform evacuations as necessary
- implement shelter plan
- provide rescue and recovery operations
- make state of emergency declarations
- setup and maintain detours and evacuation routes
- provide security and law enforcement

The ERP is not part of the EAP, but the two (2) plans are inextricably linked during an emergency. The EAP governs the first critical moments of an emergency and defines the time remaining for ERP implementation. The EAP provides the blueprint for notifying responsible downstream emergency management authorities and provides direction for determination of the urgency and clarity of warning messages issued to the emergency responders. EAPs help pinpoint the appropriate time to initiate or withhold warnings and evacuations, reducing false alarms and reducing response times when evacuations are appropriate. The EAP helps define authorities and responsibilities of

the emergency responders and identifies pre-failure warnings, evacuations, optimized notification sequences, and early warning systems. The most important link between the EAP and the ERP is the flood or inundation maps. These maps define the region, or hazard area, within which the emergency responders implement the ERP. New life-loss risk evaluation techniques now include information such as excess evacuation time (time available to evacuate minus time needed to evacuate) and flood zones (dynamic interaction between available shelter and escape routes, flood depths, and flood velocities), and are much more useful for prioritizing ERP activities than the traditional inundation parameters of depth and flood wave travel time. An important benefit of the new risk evaluation methodology is that it can be used to identify locations where significant risk reduction can only be achieved by early warning devices or techniques. Finally, ERP responders should be involved in EAP exercises.

The dam owner should also prepare emergency response procedures that he or she would follow to resolve issues at the dam, including taking steps to eliminate the danger, delay dam failure, or correct nuisance problems. These procedures are not part of the ERP. The dam owner typically is not directly involved with the ERP and is not involved with its implementation other than to provide the notification and supporting information to the emergency responders that are responsible for the ERP. Suggested dam owner's emergency response procedures are described in Setion 3.2.

The hazard area is the area(s) that will be affected by a dam emergency. Typically, it is the downstream area that would be affected in the event of a dam failure. However, the hazard area may also include upstream areas that may be flooded as a result of rising reservoir levels.

Figure 3-1 A large storm event can provide insight to areas of inundation in the event of a uncontrolled dam breach failure.

The dam owner and the emergency responders should be aware of the properties and structures that could be affected if a dam failure occurs. The dam owner may be legally and financially liable for all damage that is incurred. Hazard areas may be identified using USGS Quadrangle maps, FEMA Flood Insurance Rate Maps, aerial photography and mapping, or by visual inspection of the areas adjacent the dam and reservoir. Detailed engineering studies involving dam breach analyses may also be performed to determine the hazard areas. Maps showing potential areas of flooding as a result of a dam failure are especially useful; these maps are referred to as flood maps or inundation maps. More detailed information concerning the identification of inundation areas and the development of mapping of potential flood areas is available from the IDNR. It should be noted that the hazard area may extend beyond the inundation zone in areas where residents may become trapped due to flooded access routes, or in areas upstream of dams affected

by backwater from the dam.

The estimated hazard area should be shown on a map, such as a current USGS quadrangle map. The map should be made part of the EAP and kept on site in the owner's project files. Roads, buildings, dwellings, and other dams that could be affected by a dam failure should be identified on the map. This map becomes an integral part of the ERP to help the emergency responders define the evacuation zone.

Typically, very few inundation maps are available for local officials to use in their emergency warning and evacuation plans for dam emergencies. Consequently, local officials and dam owners may have to use available mapping and common sense in determining the potential hazard areas.

If the dam is a high hazard dam and has a large reservoir pool, evacuation of the downstream hazard area may be required if emergency repair measures are unsuccessful and dam failure is imminent. Areas nearest to the dam should be evacuated first. Federal Emergency Management Agency (FEMA) Flood Hazard Boundary maps and/or FEMA Flood Insurance Rate Maps (FIRMs) can provide rough approximations of necessary evacuation areas. However, the evacuation area should be extended beyond the limits of the maximum flood area shown on these maps as floods resulting from dam failures are usually more widespread and destructive. When making these determinations, it is always better to err on the conservative side.

Whenever possible, warning of a dam failure or an impending dam failure should follow procedures already established for other emergencies in the area where the dam is located, such as flooding from streams, tornados, and other disasters. However, it must be stressed that warning and evacuation times will be limited and that immediate evacuation must follow warnings of imminent dam failure. Warnings delivered through personal modes such as telephones, loudspeakers, and face-to-face communications are more effective than warnings delivered impersonally, by sirens for example. Persons delivering the warnings should always say "the dam is failing," and not "flooding is expected." Warnings should be clear and concise. Residents should be advised to move to safety immediately. Police, radio and television news media should be used to the extent available and appropriate. Residents are more likely to respond if they receive warnings from several sources.

Typical warning methods include direct dial, reverse 911, National Weather Service announcements, television and radio emergency alert messages, door-to-door verbal notification, State police Information Networks, and sirens.

Evacuation routes and roadways should be identified. Roadblocks along potentially flooded routes may be required, and should also be identified ahead of time. Agencies and/or persons that will be required to perform emergency tasks should be identified.

The farther downstream a damage center is located, the more chance there is for a long flood warning and more time to carry out an organized evacuation. Protection of life

should also be considered before anything else in an evacuation effort.

3.2 DAM EMERGENCY RESPONSE PROCEDURES

3.2.1 Introduction

Every dam owner should develop emergency response procedures as part of the dam's Management and Maintenance (M&M) Plan. Emergency response procedures should consist of a clear, concise set of instructions for dealing with emergencies or potential failures at the dam.

Emergencies that threaten the safety and integrity of a dam could arise at any dam. Emergencies usually develop as a result of severe weather conditions, storms, or seismic events. However, poor dam design, construction, or maintenance may contribute to or result in an emergency. For example, a riser spillway could become clogged as a result of an improper or no trash rack, causing the reservoir level to rise and threaten the embankment stability. Or, unnoticed or uncorrected seepage problems could progress and create a potential slope stability or seepage emergency.

The amount of time that a dam owner has to react depends on the cause and severity of the emergency. If a large rainstorm is occurring and the reservoir level is rapidly rising, there may be little time to respond to the situation, and immediate action may be required. However, if a problem is relatively minor and does not pose an immediate risk to the dam stability or safety, there may be time to plan and schedule the necessary repairs (these problems are not actually emergencies, but do require attention).

In general, responses to dam problems and emergencies can be divided into three categories:

(1) **Low priority response**; implement a low priority response procedure, and schedule and perform maintenance repairs in the near future. "Near future" depends on available resources, and the severity of the deficiency.
(2) **Medium priority response**; implement a medium priority response procedure, and perform repairs as soon as possible. "As soon as possible" is subjective, and the timing depends on the urgency of the situation.
(3) **High priority response**; implement a high priority response procedure, and perform emergency repairs immediately. "Immediately" means now. The EAP is usually activated during a high priority response.

Dam owners, operating personnel, and/or their engineers must be prepared to act promptly and effectively when a dam begins to show signs of uncontrolled breach failure. Early identification of a potential breach situation may provide additional time to warn and evacuate downstream residents and to implement measures to prevent or delay dam failure.

Because failure of a dam may take only minutes or hours to occur, it is imperative to have a detailed plan of action ready for use. However, the dam owner should use caution and must be able to make sound decisions regarding the severity of the emergency. The dam owner must assess whether the emergency condition will result in a dam component failure (Type 1) or an uncontrolled breach failure (Type 2), or whether no failure will result at all. Unnecessary evacuation of the downstream areas can be costly and detrimental to the dam owner's public image, especially if the hazard area is large and involves a large number of people and properties.

A detailed Emergency Action Plan should be prepared for high hazard dams and should be implemented if the dam emergency warrants.

3.2.2 Identification of Emergencies and Potential Risks

Early identification of emergencies and unsafe conditions at a dam will allow prompt implementation of the EAP and emergency response procedures at the dam. Dam owners and operators should be familiar with the principal types of failure and their telltale signs, especially if they may result in an uncontrolled breach failure. If any of the following conditions are noted, the high level emergency procedures should be implemented immediately, including activation of the EAP.

1. The dam is overtopping or nearly overtopping. The dam owner or operator should closely monitor the level of the reservoir during periods of heavy rainfall and runoff. If the spillway and reservoir storage capacities are exceeded during a storm, overtopping may occur. Overtopping could result if a large slide on the upstream or downstream slopes of the embankment has significantly lowered the dam crest. Blockage of pipe spillways and risers may also cause overtopping of a dam. Other conditions which could cause overtopping include significant settlement on the dam crest, sinkholes, excessive embankment soil erosion, spillway and embankment cracks, and wind-blown trees.

Figure 3-2 Water is starting to overtop this embankment.

2. Piping (internal erosion of soil from the dam or its foundation) has developed. Piping is usually indicated by a rapid increase in seepage rate, a muddy discharge at or near the downstream toe, sinkholes on or near the embankment, and/or a whirlpool (eddy) in the reservoir. Boils at or near the downstream toe may be indications that piping is beginning. Piping may also develop along spillway and outlet conduits.

3. A large slide develops on either the upstream or downstream slope of the embankment and threatens to release the impounded water by lowering the dam crest.

4. Sudden and rapid failure of an appurtenant structure threatens complete failure of the dam and release of its impoundment.

Identification of any of these conditions at a dam should be cause for alarm and the emergency procedures should be implemented promptly. If there is any question as to the severity or urgency of the suspected problem, a qualified dam safety professional should be contacted. IDNR may also be contacted for additional advice.

The dam owner should prepare a list of critical dam features and conditions that would be checked during any emergency. For periods of unusual activity (heavy rains, earthquakes, embankment instability, etc.), the owner should record reservoir levels to determine the rate of pool rise or fall. Inspection of the embankment, downstream toe and abutments for wet areas or seepage for indications of piping through the structure or foundation is important during these events. The owner should check for abnormal sloughing of earth, depressions, and horizontal and vertical displacement of the embankment and concrete structures. If the dam is instrumented, monitoring should be performed to detect changes from normal readings that would indicate distress in the embankment. If overtopping occurs, the embankment should be closely monitored for signs of deterioration.

After the emergency condition is identified, the potential risks associated with the condition should be evaluated. The severity of the risks will be dependent on the type of condition, reservoir level, size of reservoir, proximity of downstream property and structures, potential success of emergency repairs, etc. The risks may include release of small quantities of water from the reservoir, release of larger quantities of water, or complete dam breaching and failure. Depending on the severity of the risk to the dam, associated risks to the hazard area(s) should also be assessed. These risks may include shallow flooding of properties, extensive flooding of properties, total destruction of dwellings and other buildings, flooding of public roads, breaching of downstream dams, severe erosion, etc.

Figure 3-3 Backhoe being used to place an emergency pump in the reservoir.

3.2.3 Available Resources

The emergency response procedures should include a list of available resources that may be needed during a dam emergency condition. The dam owner should immediately initiate efforts to prevent or delay failure of the dam. Because of the likely limitation on time, it is important to identify in the emergency response procedures the location of available resources which may be

used to attempt to avoid (delay or prevent) the failure. Any emergency repairs will require equipment, materials, labor, and expertise. For large reservoirs where failure could result in loss of life or severe damage to high value property, materials (clay, sand, gravel, stone, riprap, sandbags, cement, plastic sheeting, etc.) and equipment for handling these materials should be kept at or near the site. If this provision is not possible, then prior arrangements for use of locally available, off-site materials and equipment should be made in case of an emergency. Equipment that may be needed includes pumps, dozers, backhoes, front-end loaders, trucks, and boats. A list of local contractors and other labor sources should be prepared and kept up-to-date. Telephone numbers where these people can be contacted 24 hours per day should be included. The dam owner should contact the potential contractors ahead of time and obtain their cooperation in advance.

3.2.4 Emergency Repair Procedures

The emergency response procedures should include potential repair procedures that may be implemented for the different types of emergencies that could threaten the dam. The most likely modes of failure were described earlier. It is important to know what types of emergency repairs should be attempted for the different modes of failure.

Figure 3-4a Riser without a trash rack was clogged with the wood pallet in foreground.

Owners should not allow temporary actions to become permanent repairs. This practice is dangerous because the chance of a rapid and catastrophic failure may increase if the repairs are not adequate. A qualified dam safety professional should be contacted to recommend appropriate permanent remedial measures.

Repair procedures will be dependent on the type of safety concern or emergency condition that is encountered. Emergency repairs should be performed when the dam's safety appears to be threatened. Maintenance repairs should be performed when dam deficiencies are minor and have not progressed to an emergency status.

Figure 3-4b The riser in figure 2-6a is visible after pallet is removed and water is drawn down.

The remainder of this chapter presents guidelines for performing emergency repairs for dams. The EAP should also be implemented as part of the process.

High priority emergency repairs

These emergencies usually require immediate action to prevent the release of the reservoir. Therefore, it is very important that the dam owner or operator be prepared ahead of time so that a rapid response is possible. The following descriptions of possible actions to take during emergencies that could result in an uncontrolled breach are offered as guidance. These measures are preliminary and may need further development in the site specific emergency response procedures. Extreme caution should be exercised by those working around the dam during emergency conditions when there is uncontrolled flow of water.

To facilitate the procedures, repairs of impending uncontrolled breach failures are categorized by the three most common conditions a dam owner is likely to encounter: (1) embankment overtopping, (2) embankment or foundation piping, and (3) structural failure.

Embankment Overtopping

If overtopping has begun or appears imminent, the following actions may be taken:

1. Implement the EAP.
2. Contact a qualified dam safety professional for assistance.
3. Contact a contractor or other parties that can perform the repairs, and secure necessary repair materials.
4. Be sure that the spillway(s) is not plugged with debris and is functioning as efficiently as possible. Debris removal may be difficult due to pressure from the high velocity flow and should be accomplished by using long poles or hooks. Personnel should not be allowed close to spillway inlets.
5. Open all lake drains or other gates to lower the pool level. Pumps and/or siphons may also be helpful on small reservoirs.
6. Dig a by-pass channel around the dam through an abutment if possible and necessary. The location for this channel should be chosen with extreme caution so that the embankment will not be affected by rapid erosion of the channel. This action should not be undertaken without the supervision of a qualified dam safety professional.
7. If a bypass channel is not feasible (or in addition to a bypass channel), provide erosion resistant protection on the downstream slope where overtopping is or will occur (e.g., riprap, concrete lining, plastic sheets).
8. Create additional spillway capacity by making a controlled breach in the lowest portion of the embankment, or along the abutment. Erosion resistant materials may need to be installed on the floor and walls of the controlled breach area.

Generally, it is not recommended to temporarily raise the top of embankments with sandbags or by other means to try to prevent overtopping during a severe storm. This action is dangerous because the flood inflow may still Increase and result in the overtopping of the raised dam. If the temporarily raised dam fails, the release of an

even greater volume and depth of water would result.

Obstructions in spillways are a common cause of dam overtopping.

Embankment or Foundation Piping

If piping has developed or is imminent, the following actions may be taken:

1. Implement the EAP.
2. Determine whether the piping can lead to an uncontrolled breach failure.
3. Contact a qualified dam safety professional for assistance.
4. Contact a contractor or other parties that can perform the repairs, and secure necessary repair materials.
5. Open all lake drains and other gates to lower the pool level. Pumps and/or siphons may also be helpful on small reservoirs.
6. Attempt to plug the "pipe" at the upstream end by dumping material into the whirlpool or sinkhole. Straw has been used effectively for this purpose. If straw is not readily available, other materials (e.g., earth, rock, Bentonite, plastic, etc.) should be tried. If the "pipe" is plugged, the owner should be aware that this is only a temporary repair. The reservoir should be fully drained or drawn down below the “pipe” inlet, and a professional engineer should be contacted to recommend permanent remedial measures.
7. Place a protective sand and gravel filter over the exit area to hold the soil material in place and ring the filter with sandbags.

Figure 3-5 Uncontrolled breach of a dam caused by component failure (piping).

Structural Failure of Embankment or Appurtenances

If a sudden and rapid failure of an appurtenance or a large slide in the embankment has occurred or is imminent, the following actions may be taken:

1. Implement the EAP
2. Determine whether the slide can lead to an uncontrolled breach failure.
3. Contact a qualified dam safety professional for assistance.
4. Contact a contractor or other parties that can perform the repairs, and secure necessary repair materials.
5. Open all lake drains and other gates to lower the pool level. Pumps and/or siphons may be helpful on small reservoirs.

6. Attempt emergency repairs to prevent or delay failure.
7. Attempt to block water movement through the dam (if occurring) by placing plastic sheets, soil, etc. on the upstream face.

Slides may be caused by seepage pressures, a saturated slope, a slope which is too steep, or possibly an earthquake. Earthquakes, although not common in Indiana, can cause structural damage to the embankment or appurtenances which might lead to complete failure of the dam. If a large slide in the upstream or downstream slope has occurred which significantly lowers the dam crest and threatens to release impounded water, sandbags can be used to temporarily raise the crest to prevent overtopping. (Temporarily raising the embankment during a severe storm is not recommended.) On large reservoirs, beaching and rapid erosion of the upstream slope by wave action could occur due to high winds. A complete breach of the dam crest may result if the slope protection fails and bare soil is exposed to wave action. A supply of large rock should be available for use during this type of emergency. Severe foundation erosion and subsequent collapse of a concrete spillway may also lower the dam crest, resulting in a potential breaching condition.

Medium priority emergency repairs

Component failure, by definition, does not result in a significant release of water. Therefore, there is usually enough time to repair the damaged components, and in some cases, temporary repairs may be made until permanent repairs can be implemented. If the component failure is rapidly progressing, it could lead to an uncontrolled breach, and immediate repairs may be required. Temporary repair of appurtenant structures will depend on the nature of the problem. The following descriptions of possible actions to take during emergencies that have or could result in component failure are offered as guidance. These measures are preliminary and may need further development in the site specific emergency response procedures. The EAP should be implemented if the situation threatens the safety of the dam.

Loss of Freeboard or Dam Cross Section due to Wave Erosion

1. Lower water level to an elevation below the damaged area.
2. Immediately place additional riprap or sandbags in damaged areas to prevent further embankment erosion.
3. Restore freeboard with sandbags or earth fill. Place suitable-sized riprap on the damaged area to stop erosion.
4. Continue close inspection of the damaged area. Mark the damage areas with stakes and monitor on a regular, frequent basis.
5. Perform permanent structural repairs of the dam embankment.

Slides in the Upstream or Downstream Slope of the Embankment

1. Lower water level at a rate and to an elevation which are judged to be safe under the slide condition. If the outlet is damaged or blocked then pumping, siphoning,

or a controlled breach may be required.
2. Restore lost freeboard if required. This may include placing sandbags or fill on top of the slide.
3. Stabilize slides on the downstream slope by weighting the toe area with additional soil material, rock, or gravel. If there is significant leakage, construct a sand and gravel filter over the leakage exit.
4. Monitor for additional settlement, sliding, movement, and seepage.
5. Perform permanent structural repairs of the slide area.

Flows through the Embankment, Foundation, or Abutments which Erode the Materials

1. If the entrance area of the leak in the reservoir can be found, try to plug it off with whatever materials are available such as hay bales, soil, bentonite, plastic, etc.
2. Lower the water level until the flows decrease to a non-erosive velocity or until the flow stops.
3. Place a protective sand and gravel filter over the exit area to hold the soil materials in place.
4. Continue lowering the water level until an elevation judged to be safe is reached.
5. Continue operating at a reduced level until permanent repairs can be made.
6. Monitor and document the leakage, including leakage rate and turbidity.
7. Perform permanent structural repairs.

Embankment Cracking

1. Lower the water level by opening the outlet (and/or pumping). Continue until the water is below the cracking.
2. Attempt to block water movement into cracks by placing plastic sheeting or soil over them.
3. Mark the extent of cracking with adequate stakes in order to monitor any increase or change in pattern. Document the observations.
4. Continue operation at a reduced level until permanent repairs can be made.
5. Perform permanent structural repairs.

Saturation of the Embankment/Abutments

1. Lower the reservoir with the outlet works to a level determined by a qualified dam safety professional or judged to be safe.
2. Monitor the conditions frequently for leakage, piping, cracking, and slides. Document the observations.
3. Continue operation at a reduced level until permanent repairs can be made.
4. Perform permanent structural repairs.

Settlement of Embankment

1. Determine whether the settlement is related to piping. If it is, see Embankment Piping discussed earlier.

2. Survey the existing monuments to determine the amount and rate of settlement. Install measurement points if necessary. Document the observations.
3. If the settlement is greater than one-foot, lower the reservoir with the outlet works to a level determined by a qualified dam safety professional.
4. If the settlement is not related to piping, place additional fill to restore the lost freeboard.
5. Continue operating at a reduced level until repairs can be made.
6. Perform permanent structural repairs.

Failure of Appurtenant Structures such as the Outlet or Spillway

1. Implement temporary measures to protect the damaged structure, such as closing the outlet and providing temporary protection for the damaged spillway area. Provide temporary protection at the eroding surface by placing sandbags or riprap material.
2. Experienced professional divers may be able to quickly assess the problem and possibly implement repair.
3. Lower the water level to an elevation judged to be safe. If the outlet is inoperable, then pumping, siphoning, or a controlled breach may be required.
4. Monitor the outlet and embankment for settlement, sinkholes, and muddy leakage. Monitor leakage rate.
5. Continue operating at a low water level to prevent spillway flows.
6. Perform permanent structural repairs or replace components.

Figure 3-6 Spillway component failure that could lead to uncontrolled breach failure. Note that water is flowing from under spillway.

Mass Movement of the Dam on its Foundation

1. Immediately lower water level until excessive movement stops.
2. Prepare to implement the EAP.
3. Continue lowering water until a level judged to be safe is reached.
4. Continue operating at a reduced level until repairs can be made.
5. Perform permanent structural repairs or remove the dam.

Loss of Abutment Support or Extensive Cracking in Concrete Dams

1. Lower the water level by releases through the outlet.
2. Attempt to block water movement through the dam by placing plastic sheets etc., on the upstream face.
3. Prepare to implement the EAP.
4. Continue lowering water to a level judged to be safe.

The following suggestions may be helpful when making a controlled breach, placing sandbags, and placing plastic sheet to control leakage.

Controlled Breach

One method of making a controlled breach is to construct a small coffer dam upstream from the breach area. Then excavate the breach through the embankment and place an appropriately sized pipe through the embankment and backfill around the pipe and re-establish the dam to embankment freeboard. The coffer dam can then be removed and water released through the newly installed pipe.

A second method also starts with the construction of a small coffer dam upstream from the breach area. The breach is then excavated one to four feet below the water level. The excavation area and outfall area should be lined with erosion resistant material, and the coffer dam slowly removed. The excavated breach may be made shallower and relatively wide to help minimize exit velocities.

A third method is to line the area downstream where the breach will be made, then excavate a shallow (one foot maximum) and relatively wide breach. After the water level is lowered to the invert of the breach excavation, an additional one foot of soil is excavated. This process is repeated until the reservoir level is reduced to a safe level.

Placing Sandbags

When placing sandbags in high velocity flow water, it is difficult to keep the bags in place. In order to control water in this situation it is advisable to:

1. Make sure the bags are securely tied so the material does not wash out of them.
2. Begin placement near the shore or in a quiet area and work toward the higher velocity flow areas.

Placing Plastic Sheets

Plastic sheets normally used in construction have been employed successfully to resist erosion of a dam's downstream slope or spillway channel during storm flows. The top end of the sheet must be securely anchored in a nearly horizontal area such as the crest area, where velocities are low. Closely spaced sandbags or rocks can be used to anchor the sheet and minimize flow under the sheet. This protection should be extended beyond the dam's toe or the eroding area in the spillway by overlapping with the upper sheet over the lower one and anchoring successive sheets.

APPENDIX A

TEMPLATE EMERGENCY ACTION PLAN

Open Emergency Action Plan Template
in Microsoft Word Format

(TEMPLATE LAKE DAM)

EAP

EMERGENCY ACTION PLAN

NATIONAL INVENTORY OF DAMS NO. IN(*XXXXX*)
IDNR DAM NO. (*X-XX*)
(DAM LOCATION)

(*OWNER OF DAM*)

Copy No. _____
Revision No. 0
(Month&Year)

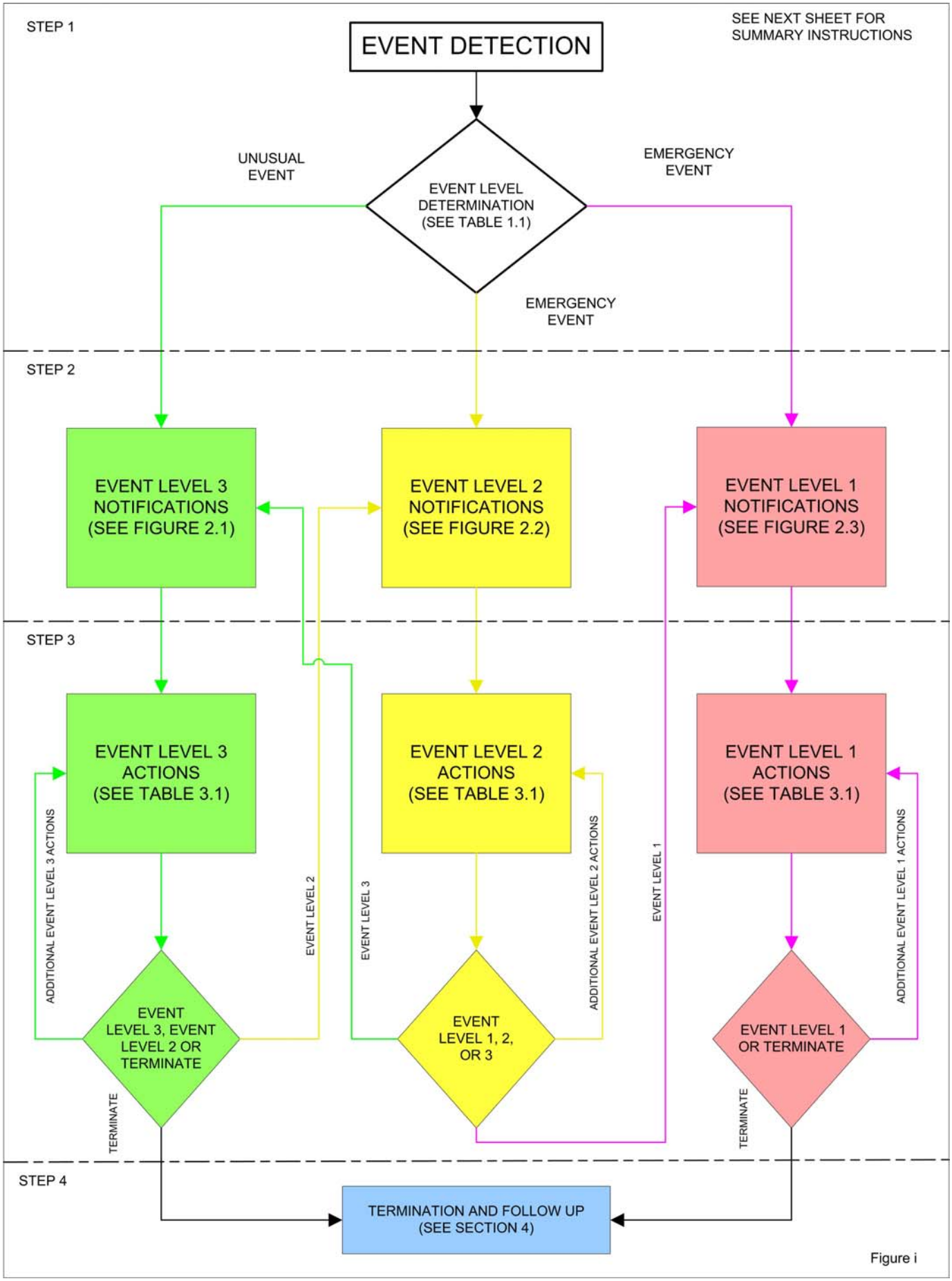
STEP 1
EVENT DETECTION
SEE NEXT SHEET FOR SUMMARY INSTRUCTIONS
UNUSUAL EVENT
EVENT LEVEL DETERMINATION (SEE TABLE 1.1)
EMERGENCY EVENT
EMERGENCY EVENT
STEP 2
EVENT LEVEL 3 NOTIFICATIONS (SEE FIGURE 2.1)
EVENT LEVEL 2 NOTIFICATIONS (SEE FIGURE 2.2)
EVENT LEVEL 1 NOTIFICATIONS (SEE FIGURE 2.3)
STEP 3
EVENT LEVEL 3 ACTIONS (SEE TABLE 3.1)
EVENT LEVEL 2 ACTIONS (SEE TABLE 3.1)
EVENT LEVEL 1 ACTIONS (SEE TABLE 3.1)
ADDITIONAL EVENT LEVEL 3 ACTIONS
EVENT LEVEL 2
EVENT LEVEL 3
ADDITIONAL EVENT LEVEL 2 ACTIONS
EVENT LEVEL 1
ADDITIONAL EVENT LEVEL 1 ACTIONS
EVENT LEVEL 3, EVENT LEVEL 2 OR TERMINATE
EVENT LEVEL 1, 2, OR 3
EVENT LEVEL 1 OR TERMINATE
TERMINATE
TERMINATE
STEP 4
TERMINATION AND FOLLOW UP (SEE SECTION 4)

Figure i

SUMMARY OF EAP PROCESS

There are four steps that must be followed anytime an unusual or emergency event is detected at *(Template Lake Dam)*. The steps are:

Step 1: Event Detection and Level Determination
Step 2: Notification and Communication
Step 3: Expected Actions
Step 4: Termination and Follow-up

Unusual and emergency events are defined in Section 1.2.1 of this Emergency Action Plan (EAP). Specific actions required for each step will depend on the severity of the situation as defined during Step 1. The actions required for each step of the EAP are summarized graphically on the EAP Flow Chart (Figure i) and are described in the corresponding EAP Section. A summary of each step is provided below.

Step 1 - Event Detection and Level Determination

During the initial step, an unusual event or emergency event is detected at the dam and classified by the *(EAP Coordinator or designee)* into one of the following event levels:

Event Level 3: Unusual Event, slowly developing
Event Level 2: Emergency Event, rapidly developing
Event Level 1: Emergency Event, imminent dam failure or flash flooding

Information to help the *(EAP Coordinator or designee)* determine which of the above event levels is applicable is provided in Section 1 of this EAP.

Step 2 - Notification and Communication

After the event level has been determined, notifications are made in accordance with the appropriate notification flow chart provided in Section 2 of this EAP.

Step 3 - Expected Actions

After the initial notifications are made, the *(EAP Coordinator or designee)* should refer to Table 3.1 and confer with the *(Engineering Director or designee)* to develop and execute appropriate preventative actions. During this step of the EAP, there is a continuous process of taking actions, assessing the status of the situations, and keeping others informed through communication channels established during the initial notifications. The EAP may go through multiple event levels during Steps 2 and 3 as the situation either improves or worsens.

Step 4 - Termination and Follow-up

Once the event has ended or been resolved, termination and follow-up procedures should be followed as outlined in Section 4 of this EAP. EAP operations can only be terminated after completing operations under Event Level 3 or 1. If Event Level 2 is declared, the operations must be designated Event Level 3 or 1 before terminating the EAP operations.

APPROVAL AND ACCEPTANCE

The undersigned states that he/she has read the following document and understands the contents of it, and that all the statements contained in the document are true and correct, to the best of his/her knowledge and belief.

EAP Coordinator's Approval and Acceptance:

_____
(Signature)

_____
(Printed Name)

_____
(Title)

_____
(Date)

Owner/Engineering Department Director's Approval and Acceptance:

_____
(Signature)

_____
(Printed Name)

_____
(Title)

_____
(Date)

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PRIVACY STATEMENT

(*Insert statement regarding the collection, distribution and use of the pertinent information included in this report. Describe the need for an emergency roster, who has collected it, and that it is subject to the provision of the applicable Federal and State privacy acts and regulations.*)

ACKNOWLEDGEMENTS

This document was prepared by (*preparer of document*) for (*dam owner*). (*Recognize any pertinent assistance or input received in the development of this document.*)

PURPOSE

The purpose of this EAP is to reduce the risk of human life loss and injury during an unusual or emergency event at *(Template Lake Dam)*. (*Identify the locations downstream of the dam that can potentially present risk to human lives in the case of an emergency event.*)

A secondary purpose of the EAP is to minimize the potential for property damage during an unusual or emergency event at *(Template Lake Dam).* (*Identify any notable infrastructure (e.g. neighborhoods, bridges, shopping centers etc.) that may be damaged by an unusual or emergency event.*)

EAP ANNUAL REVIEW AND PERIODIC TEST

This EAP document will require an annual review and update to stay current. A periodic test of the EAP procedures is also required every (*test interval, typically 5 years*) to ensure continued effectiveness. For annual review and periodic test procedures, reference Appendix D.

REVISIONS

For revision procedures, reference Appendix D.

Revision No.	Date	Revisions Made
0	*(Month&Year)*	EAP published in IDNR 2006 format.

Revised pages inserted in this EAP by

_____
(Signature)

_____
(Printed Name)

_____
(Date)

SECTION 1.
EVENT DETECTION AND LEVEL DETERMINATION

This section of the Emergency Action Plan (EAP) describes the first step that must be followed whenever an unusual or emergency event is detected at *(Template Lake Dam)*. This section also describes event detection and information to assist the *(EAP Coordinator or designee)* in determining the appropriate level for the event.

1.1 Event Detection

Unusual or emergency events may be detected by:

- *(List the various means by which an unusual or emergency event may be detected. Include likely point of notification and, if applicable, specifics regarding instrumentation, earthquakes and/or severe weather alerts from USGS, etc..)*

After any unusual or emergency event is detected and reported to the *(EAP Coordinator)*, the *(EAP Coordinator)* (or Acting *(EAP Coordinator)*) is responsible for determining the level of the event. If the *(Local Emergency Services Agency)* receives a 911 call regarding observations of an unusual or emergency event at the dam, the dispatcher shall first contact the *(EAP Coordinator)*. The *(EAP Coordinator or designee)* shall determine the appropriate event level (as defined in Section 1.2.2) and advise the dispatcher of the event level.

1.2 Event Level Determination

1.2.1 Unusual Events and Emergency Events

An unusual event is defined as an event, which takes place, or a condition, which develops, that is not normally encountered in the routine operation of the dam and reservoir, or necessitates a variation from Standard Operating Procedures. An unusual event requires operations in accordance with Event Level 3 of this EAP.

An emergency event is defined as an event, which takes place, or a condition, which develops, that is of a serious nature that may endanger the dam, or endanger persons or property, and demands immediate attention. An emergency event requires immediate operations in accordance with Event Level 2 or 1 of this EAP.

1.2.2 Level Determination

The *(EAP Coordinator)* shall be responsible for defining unusual or emergency events as one of the three following event levels:

Event Level 3 - This is an unusual event that is defined as a slowly developing situation that may endanger the structural integrity of the dam. (*Identify the position responsible for monitoring the progression of the event. Typically, this is the EAP Coordinator. Note any special cases that would cause or require deviation from the standard notification protocol.*)

Event Level 2 - This is an emergency event that is defined as rapidly developing and could quickly lead to dam failure and flash flooding downstream of the dam. (*Identify the organization(s) that will prepare the area downstream of Template Lake Dam for evacuation. Typically, this is the local emergency management agency or fire department. Establish a contingency plan should the EAP Coordinator be unable to determine event level.*)

Event Level 1 - This is an emergency event that is defined as imminent dam failure or flash flooding downstream of the dam. (*Identify the organization(s) responsible for the immediate evacuation of potentially inundated areas downstream of Template Lake Dam. Typically, this is the local emergency management agency or fire department.*)

1.2.3 Level Determination Guidance

Table 1.1 shall be used as a guide for determining the appropriate event level. This table attempts to be all inclusive; however, an event or condition may arise that is not covered in this table. In the circumstance of multiple events occurring at the dam with conflicting event levels, always designate the higher event level as the governing event level.

1.2.4 Roles, Responsibilities, and Authority

EAP Coordinator – The (*EAP Coordinator*) shall function as the EAP operations coordinator and/or Incident Manager during any of the three event levels of operation described in this EAP. The (*EAP Coordinator*) has the authority to take the necessary actions described in this EAP. If time permits, the (*EAP Coordinator*) should consult with the (*Engineering Director*) before initiating notifications described in this EAP.

The (*EAP Coordinator*) is responsible for providing initial, timely, and accurate notifications to the (*Warning/Evacuation Director*) and the (*Public Relations Director*) after an Event Level 2 or 1 has been determined. The (*EAP Coordinator*) is also responsible for providing subsequent updates of the situation to the (*Warning/Evacuation Director*) to assist in making timely and accurate decisions regarding warning and evacuation responsibilities.

Once an Event Level 2 or 1 is terminated, the (*EAP Coordinator*) is responsible to submit to the (*Engineering Director*), as soon as possible, an accurate summary document of the field observation and activities of the event.

(*Warning/Evacuation Director – Describe the role of the Warning/Evacuation Director; typically, this is the local emergency management agency or fire department. In general, this will involve coordinating the preparation to evacuate downstream of the dam, as well as the implementation of the evacuation itself. Clarify notification procedures, and establish a redundancy protocol in the case that event detection notification is not through the EAP Coordinator.*

Engineering Director – Describe the role of the Engineering Director. Typically, this is the engineering department of the owner or an on-call engineer who is familiar with the dam and with whom the owner has established a contractual on-call agreement. In general, the responsibilities of this position will involve assistance in technical aspects of the dam, event level determination and evaluation, and anything that pertains to the condition of the dam, including any necessary follow-up activities, including issuing updates to the EAP.

Public Relations Director – Describe the role of the Public Relations Director; typically, this is the owner or his/her public relations department. In general, this will involve preparing a public statement and notifying the media about the event.)

[*Note to preparer: Add a tab sheet before this page, with the tab label indicating "Table 1.1."*]

TABLE 1.1
EVENT LEVEL DETERMINATION GUIDANCE

Event	Observation	Event Level
Flooding	(*Clearly describe the condition(s) necessary to classify an unusual event as Event Level 3 in accordance with its definition in Section 1.2. Include a specific description of the requirements, as well as one that may be determined visually, without assistance from instrumentation. This description should be easily understood by someone unfamiliar with the concepts of dam engineering. For example, in the event of flooding, an exact reservoir water surface elevation threshold would be given, as well as visual cues that allow for quick detection of this water level.*)	3
	(*Clearly describe the condition(s) necessary to classify a rapidly developing emergency event as Event Level 2 in accordance with its definition in Section 1.2. Include a specific, measurable standard in addition to easily observable visual cues. Note that these conditions should be more severe than those that reflect a classification of Event Level 3, but should still be conservative enough to allow adequate time for warning/evacuation prior to dam failure*)	2
	(*Clearly describe the condition(s) necessary to classify an emergency event that may result in imminent dam failure or flash flooding as Event Level 1. Note that these conditions should be more severe than those that reflect a classification of Event Level 2, but should still be conservative enough to allow adequate time for warning/evacuation prior to potential dam failure*)	1
Earthquake	(*See Level 3 description above. Ex: magnitude of earthquake within a specified distance*)	3
	(*See level 2 description above. Ex.: earthquake that causes visible damage*)	2
	(*See Level 1 description above. Ex.: visible damage, water released*)	1
Seepage	(*See Level 3 description above Ex.: discovery of new seepage areas*)	3
	(*See level 2 description above. Ex.: threshold of seepage flow rate, color of discharge*)	2
	(*See Level 1 description above. Ex.: threshold of seepage flow rate.*)	1
Cracking	(*See Level 3 description above. Ex.: new cracks of a specified width*)	3
	(*See level 2 description above. Ex.: new cracks of specified width, seepage*)	2
Movement	(*See Level 3 description above. Ex.: movement of structures by a specified distance*)	3
	(*See level 2 description above. Ex.: significant movement*)	2
Overtopping	(*See Level 1 description above. Ex.: reservoir water surface elevation level above dam crest*)	1
Gate Failure	(*See Level 3 description above. Ex.: inability to open/close gates*)	3
	(*See level 2 description above. Ex.: inability to open/close gates, rising water*)	2
	(*See Level 1 description above. Ex.: inability to open/close gates, overtopping*)	1
Blocked Gates	(*See Level 3 description above. Ex.: gates blocked by debris*)	3
Instruments	(*See Level 3 description above. Ex.: abnormal instrumentation reading*)	3
Sabotage	(*See Level 3 description above. Ex.: sabotage unlikely to cause dam failure*)	3
	(*See level 2 description above. Ex.: sabotage that may cause dam failure*)	2
	(*See Level 1 description above. Ex.: sabotage resulting in imminent dam failure*)	1

[*While a separate description is necessary for each event level assigned to an event, note that not all three event levels will apply to each type of event. For example, a blocked outlet culvert may*

warrant an Event Level 3 determination, but it would not have an entry for Event Level 1 since it is unlikely to cause failure of the dam unless other emergency events are present. Also, not all event types may be applicable to every dam. For example, if the dam does not have instrumentation or gates, those rows should be deleted.]

SECTION 2.
NOTIFICATION AND COMMUNICATION

This section of the EAP describes the appropriate notifications that should be made after the *(EAP Coordinator)* has determined the event level as an Event Level 3, 2, or 1. This section also outlines the communication systems that are available for making notifications as well as a Public Affairs Plan with sample media release and a list of media contacts. Notifications should be made in accordance with the appropriate Notification Flow Chart provided in this Section (Figures 2.1, 2.2, and 2.3).

2.1 Communication Systems

(*Outline the communication systems available to the EAP Coordinator. Note, if applicable, the presence of portable radios, and include a rating of the cell phone coverage at the dam site.*)

2.2 Prescripted Messages

The following prescripted messages may be used as a guide to communicate the status of an event. *(Add information as necessary; however, keep in mind that clarity and brevity are the most important qualities of these messages.*)

Event Level 3

- This is the *(EAP Coordinator)*. I am making this call in accordance with the *(Template Lake Dam)* EAP.
- An unusual event has been detected at *(Template Lake Dam)*.
- The EAP has been activated, currently at Level 3.
- If a problem occurs, flooding along (*Template Creek*) is possible.
- The situation is being monitored to determine if any evacuation warnings are necessary.
- We will keep you apprised of the situation. The best telephone number to reach me during this event is … (*state the best number to reach you*).

Event Level 2

- This is the *(EAP Coordinator)*. I am making this call in accordance with the *(Template Lake Dam)* EAP.
- Problems have occurred with *(Template Lake Dam)*.
- The EAP has been activated, currently at Level 2.
- Flooding along (*Template Creek*) is possible.
- **Prepare to evacuate** along the (*identify potential evacuees/evacuation limits along Template Creek*).
- We will keep you apprised of the situation. The best telephone number to reach me during this event is … (*state the best number to reach you*).

Event Level 1

- This is the *(EAP Coordinator)*. I am making this call in accordance with the *(Template Lake Dam)* EAP.
- Failure of *(Template Lake Dam)* is imminent.

- The EAP has been activated, currently at Level 1.
- Flooding along (*Template Creek*) will occur.
- **Immediately evacuate** along the (*identify potential evacuees/evacuation limits along Template Creek*).
- We will keep you apprised of the situation. The best telephone number to reach me during this event is … (*state the best number to reach you*).

2.3 Public Affairs Plan

In the event of an unusual or an emergency condition, the (*Public Relations Director*) will be alerted and briefed on the situation. The (*Public Relations Director*) will prepare and deliver a message for public release based on the existing conditions and information from the *(Engineering Director or designee)*, or other sources.

Preparation of warning messages should begin as soon as their potential need is apparent so that they can be issued promptly upon determination of a Level 2 or Level 1 event. Where time is available for its preparation, the initial message should contain all pertinent information. However, in some cases, an emergency condition may be declared with little or no advance notice. The following example messages provide a model for the first announcements in such cases for Event Levels 2 and 1. Subsequent announcements should provide additional details.

Announcement for Possible Dam Failure Problem (Event Level 2)

THE (*agency*) ANNOUNCED AT (*time*) TODAY THAT AN EMERGENCY CONDITION EXISTED AROUND *(Template Lake Dam)* DUE TO (*general description of problem*). THE DAM IS LOCATED (*generalized location of dam for public*), INDIANA.

THE (*agency*) SPOKESPERSON SAID THAT THE WATER LEVEL OF THE (*Template Lake*) WAS BEING LOWERED (*reason*).

THE SPOKESPERSON EMPHASIZED THAT THE DRAWDOWN OF THE LAKE WAS BEING CARRIED OUT UNDER CONTROLLED CONDITIONS AND THERE IS NO IMMEDIATE DANGER OF THE DAM FAILING. HOWEVER, AS A PRECAUTIONARY MEASURE, (*description of potential evacuees/evacuation areas downstream of dam*) SHOULD PREPARE TO EVACUATE.

ADDITIONAL INFORMATION WILL BE RELEASED AS PROMPTLY AS POSSIBLE.

Announcement for Possible Dam Failure Imminent or in Progress (Event Level 1)

URGENT, URGENT : THE (*agency*) ANNOUNCED AT (*time*) TODAY THAT AN EMERGENCY CONDITION EXISTED AROUND *(Template Lake Dam)* DUE TO (*general description of problem*). THE DAM IS LOCATED (*generalized location of dam for public*), INDIANA.

ATTEMPTS TO SAVE THE DAM ARE UNDERWAY BUT THEIR SUCCESS CANNOT BE DETERMINED AS YET. (*description of potential evacuees/evacuation areas downstream of dam*) SHOULD EVACUATE TO HIGH GROUND **IMMEDIATELY !**

IF THE DAM FAILS, WATER WILL TAKE (*describe time for flood wave to travel from dam breach to point of interest*). AREAS CLOSER TO THE DAM WILL BE FLOODED SOONER.

ADDITIONAL INFORMATION WILL BE RELEASED AS PROMPTLY AS POSSIBLE.

Media Contacts

(*Identify the primary source through which emergency announcements are released to the news media. It is suggested that the National Weather Service be used for this purpose. The telephone number appears below:*)

NATIONAL WEATHER SERVICE (24-hour telephone number): (317) 856-0367

(*List several radio and television stations that are likely to provide coverage to the area in danger, along with the 24-hour phone numbers of the news rooms of these stations. Specify that these sources should be contacted only if the primary source cannot be reached.*)

[*Note to preparer: Add a tab sheet before this page, with the tab label indicating "Figure 2.1." The notification flow chart is by no means limited to these sections. This is only meant to give a basic guideline of what types of organizations should be contacted in the case of an unusual event. Additional contacts can and should be added by the owner/operator as necessary to have an efficient EAP command structure developed for rapid notification, communication and action. Contents should be relegated to vital emergency participants.*]

EVENT LEVEL 3 NOTIFICATION
UNUSUAL EVENT, SLOWLY DEVELOPING

Person Observing or Learning of emergency

(EAP Coordinator)

PRIMARY CONTACT

<NAME>	<TELEPHONE NUMBER>
(Home)	**<Telephone Number>**
(Cell)	**<Telephone Number>**
Email	**<Email Address>**

ALTERNATE CONTACT

<NAME>	<TELEPHONE NUMBER>
(Home)	**<Telephone Number>**
(Cell)	**<Telephone Number>**
Email	**<Email Address>**

Suggested EAP Coordinator Message

- This is the *(EAP Coordinator)*. I am making this call in accordance with the *(Template Lake Dam)* EAP.
- An unusual event has been detected at *(Template Lake Dam)*.
- The EAP has been activated, currently at Level 3.
- If a problem occurs, flooding along (*Template Creek*) is possible.
- The situation is being monitored to determine if any evacuation warnings are necessary.
- We will keep you apprised of the situation. The best telephone number to reach me during this event is … (*state the best number to reach you*).

[1]

[2]

(*PUBLIC RELATIONS*)

(*The chief responsibility of this branch is to inform the media of the unusual event through official press releases. Potential members of the branch include the dam owner, town leaders and those organizations in charge of community relations. List a primary and alternate contact for each element of the branch. Include work, home, cell phone, and/or pager numbers to ensure that the individual or organization can be reached at any time.*)

(*ENGINEERING*)

(*The engineering branch is responsible for assisting in event determination and evaluation, technical aspects of the dam, and other tasks concerning the condition of the dam. Member(s) of this branch are also responsible for coordinating emergency efforts at the dam site to limit downstream damage and maintaining contact with various groups until the event is terminated. Potential members of the branch include an on-call engineer, an emergency contractor, and other technical resources. List a primary and alternate contact for each element of the branch. Include work, home, cell phone, and/or pager numbers to ensure that the individual or organization can be reached at any time.*)

[2a]

[2b]

NATIONAL WEATHER SERVICE

24-HOUR NO.	(317) 856-0367
Alternative #	(317) 856-0368

(*WARNING/EVACUATION*)

(*This branch is comprised of organizations that are responsible for the notification of potential evacuees and the preparation to evacuate downstream of the dam. Members of the branch should include local law enforcement and emergency response units, as well as the Indiana Department of Homeland Security and the local Emergency Management Agency. List a primary and alternate contact for each element of the branch. Include work, home, cell phone, and/or pager numbers to ensure that the individual or organization can be reached at any time.*)

NOTE:

1) **[1b] DENOTES SUGGESTED SEQUENCE**

LEGEND:

1) **CALLS BY EAP COORDINATOR**
2) **SECOND LEVEL CALLS (as warranted)**
3) **THIRD LEVEL CALLS (as warranted)**

(TEMPLATE LAKE DAM) EMERGENCY ACTION PLAN	NOTIFICATION FLOW CHART FOR EVENT LEVEL 3
	(MONTH&YEAR) / FIGURE 2.1

[*Note to preparer: Add a tab sheet before this page, with the tab label indicating "Figure 2.2." The notification flow chart is by no means limited to these sections. This is only meant to give a basic guideline of what types of organizations should be contacted in the case of an unusual event. Additional contacts can and should be added by the owner/operator as necessary to have an efficient EAP command structure developed for rapid notification, communication and action. Contents should be relegated to vital emergency participants.*]

EVENT LEVEL 2 NOTIFICATION
EMERGENCY EVENT, RAPIDLY DEVELOPING

Person Observing or Learning of emergency

(*EAP Coordinator*)

PRIMARY CONTACT

<NAME>	<TELEPHONE NUMBER>
(Home)	**<Telephone Number>**
(Cell)	**<Telephone Number>**
Email	**<Email Address>**

ALTERNATE CONTACT

<NAME>	<TELEPHONE NUMBER>
(Home)	**<Telephone Number>**
(Cell)	**<Telephone Number>**
Email	**<Email Address>**

[R1a]

Suggested EAP Coordinator Message

- This is the *(EAP Coordinator)*. I am making this call in accordance with the *(Template Lake Dam)* EAP.
- Problems have occurred with *(Template Lake Dam)*.
- The EAP has been activated, currently at Level 2.
- Flooding along (*Template Creek*) is possible.
- **Prepare to evacuate** along the (*identify potential evacuees/ evacuation limits along Template Creek*).
- We will keep you apprised of the situation. The best telephone number to reach me during this event is … (*state the best number to reach you*).

[1]

(*WARNING/EVACUATION*)

(*This branch is comprised of organizations that are responsible for the notification of potential evacuees and the preparation to evacuate downstream of the dam. Members of the branch should include local law enforcement and emergency response units, as well as the Indiana Department of Homeland Security and the local Emergency Management Agency. List a primary and alternate contact for each element of the branch. Include work, home, cell phone, and/or pager numbers to ensure that the individual or organization can be reached at any time.*)

ENDANGERED RESIDENTS

DISPATCH TO CONTACT ENDANGERED RESIDENTS. (MESSAGE: **PREPARE TO EVACUATE**)

[2]

(*ENGINEERING*)

(*The engineering branch is responsible for assisting in event determination and evaluation, technical aspects of the dam, and other tasks concerning the condition of the dam. Member(s) of this branch are also responsible for coordinating emergency efforts at the dam site to limit downstream damage and maintaining contact with various groups until the event is terminated. Potential members of the branch include an on-call engineer, an emergency contractor, and other technical resources. List a primary and alternate contact for each element of the branch. Include work, home, cell phone, and/or pager numbers to ensure that the individual or organization can be reached at any time.*)

[2a]

NATIONAL WEATHER SERVICE

24-HOUR NO.	(317) 856-0367
Alternative #	(317) 856-0368

[3]

(*PUBLIC RELATIONS*)

(*The chief responsibility of this branch is to inform the media of the emergency event through official press releases. Potential members of the branch include the dam owner, town leaders and those organizations in charge of community relations. List a primary and alternate contact for each element of the branch. Include work, home, cell phone, and/or pager numbers to ensure that the individual or organization can be reached at any time.*)

NOTE:

1) **[1b] DENOTES SUGGESTED SEQUENCE**
2) **[R1a] DENOTES REDUNDENCY SEQUENCE**

LEGEND:

CALLS BY PROPERY MANAGER ——————
SECOND LEVEL CALLS ——————
THIRD LEVEL CALLS (as warranted) - - - - - - - - - - - - - - - - - -

(TEMPLATE LAKE DAM) EMERGENCY ACTION PLAN	NOTIFICATION FLOW CHART FOR EVENT LEVEL 2	
	(MONTH&YEAR)	FIGURE 2.2

[*Note to preparer: Add a tab sheet before this page, with the tab label indicating "Figure 2.3." The notification flow chart is by no means limited to these sections. This is only meant to give a basic guideline of what types of organizations should be contacted in the case of an unusual event. Additional contacts can and should be added by the owner/operator as necessary to have an efficient EAP command structure developed for rapid notification, communication and action. Contents should be relegated to vital emergency participants.*]

EVENT LEVEL 1 NOTIFICATION

EMERGENCY EVENT, IMMINENT DAM FAILURE OR FLASH FLOOD

Person Observing or Learning of emergency

(EAP Coordinator)

PRIMARY CONTACT

<NAME>	<TELEPHONE NUMBER>
(Home)	**<Telephone Number>**
(Cell)	**<Telephone Number>**
Email	**<Email Address>**

ALTERNATE CONTACT

<NAME>	<TELEPHONE NUMBER>
(Home)	**<Telephone Number>**
(Cell)	**<Telephone Number>**
Email	**<Email Address>**

[R1a]

Suggested EAP Coordinator Message

- This is the *(EAP Coordinator)*. I am making this call in accordance with the *(Template Lake Dam)* EAP.
- Problems have occurred with *(Template Lake Dam)*.
- The EAP has been activated, currently at Level 1.
- Flooding along (*Template Creek*) is possible.
- **Immidiately evacuate** along the (*identify potential evacuees/evacuation limits along Template Creek*).
- We will keep you apprised of the situation. The best telephone number to reach me during this event is … (*state the best number to reach you*).

[1] [2] [3]

(*WARNING/ EVACUATION*)

(*This branch is comprised of organizations that are responsible for the notification of potential evacuees and the preparation to evacuate downstream of the dam. Members of the branch should include local law enforcement and emergency response units, as well as the Indiana Department of Homeland Security and the local Emergency Management Agency. List a primary and alternate contact for each element of the branch. Include work, home, cell phone, and/or pager numbers to ensure that the individual or organization can be reached at any time.*)

ENDANGERED RESIDENTS

DISPATCH TO CONTACT ENDANGERED RESIDENTS. (MESSAGE: **EVACUATE IMMEDIATELY!**)

(*ENGINEERING*)

(*The engineering branch is responsible for assisting in event determination and evaluation, technical aspects of the dam, and other tasks concerning the condition of the dam. Member(s) of this branch are also responsible for coordinating emergency efforts at the dam site to limit downstream damage and maintaining contact with various groups until the event is terminated. Potential members of the branch include an on-call engineer, an emergency contractor, and other technical resources. List a primary and alternate contact for each element of the branch. Include work, home, cell phone, and/or pager numbers to ensure that the individual or organization can be reached at any time.*)

[2a]

NATIONAL WEATHER SERVICE

24-HOUR NO.	(317) 856-0367
Alternative #	(317) 856-0368

(*PUBLIC RELATIONS*)

(*The chief responsibility of this branch is to inform the media of the emergency event through official press releases. Potential members of the branch include the dam owner, town leaders and those organizations in charge of community relations. List a primary and alternate contact for each element of the branch. Include work, home, cell phone, and/or pager numbers to ensure that the individual or organization can be reached at any time.*)

NOTE:

1) **[1b] DENOTES SUGGESTED SEQUENCE**
2) **[R1a] DENOTES REDUNDENCY SEQUENCE**

LEGEND:

CALLS BY PROPERY MANAGER ——————

SECOND LEVEL CALLS _____

THIRD LEVEL CALLS (as warranted) - - - - - - - - - - - - - - - - - -

(TEMPLATE LAKE DAM) EMERGENCY ACTION PLAN	NOTIFICATION FLOW CHART FOR EVENT LEVEL 1	
	(MONTH&YEAR)	FIGURE 2.3

[*Note to preparer: Add a tab sheet before this page with the tab label indicating "Table 3.1."*]

SECTION 3.
EXPECTED ACTIONS

3.1 Action Data Sheets

After the *(EAP Coordinator)* (or Acting *(EAP Coordinator)*) has determined the event level and has made the appropriate notifications, the *(EAP Coordinator)* shall take action, using the Action Data Sheets as a guide. Table 3.1 is an index of the Action Data Sheets.

The Action Data Sheets should be reviewed the *(Engineering Director or designee)* and/or the (*On-Call Engineer*) when possible and time permits. If an event is not covered, adapt an Action Data Sheet of a similar event and event level. If resources described in the Action Data Sheets are not available, adapt with the available resources.

Table 3.1
Action Data Sheet Index

Event	Event Level	Action Data Sheet
Flooding	3	A3
	2	A2
	1	A1
Earthquake	3	B3
	2	B2
	1	B1
Seepage	3	C3
	2	C2
	1	C1
Cracking	3	D3
	2	D2
Movement	3	E3
	2	E2
Overtopping	1	F1
Gate Failure	3	G3
	2	G2
	1	G1
Blocked Gates	3	H3
Instruments	3	I3
Sabotage	3	J3
	2	J2
	1	J1

[*Include only the events and event levels that correspond with Table 1.1.*

Compose a separate Action Data Sheet for each entry. These should not exceed one page in length. Using the Action Data Sheet templates provided as guides, the preparer should add similar pages for the other event types (e.g. earthquake, seepage, etc.) applicable to the dam]

EVENT: (*FLOODING*)	Sheet
LEVEL: 3	A3

RECOMMENDED ACTIONS

Time/Date Completed

(EAP Coordinator):

A. Make sure notifications on Figure 2.1 have been made.

B. (*Describe a course of action that closely monitors the situation. Careful observation and inspection of every part of the dam is necessary; this should be done without compromising the safety of anyone performing these tasks. Clearly describe potential problems so that the individual(s) carrying out the inspection know what may be dangerous. Off-site areas and/or instrumentation may also need to be monitored. If necessary, confer with the On-Call Engineer and/or the Engineering Director or designee to determine any preventative action that must be taken. Additionally, develop a plan to avoid dam failure and minimize damage downstream.*)

C. Record all information, observations, and actions on an Event Log Form (Form 3.1).

D. Contact the *(Engineering Director or designee*) at least daily to report the latest observations and conditions. If conditions change significantly, contact the *(Engineering Director or designee*) immediately.

(Engineering Director or designee):

A. (*Describe a course of action to be followed by this position. In general, this will be to review all pertinent information in order to recommend appropriate actions to the EAP Coordinator. If necessary, contact local emergency contractors and/or other individuals that may be able to assist in monitoring the situation.*)

(*On-Call Engineer*):

A. Provide decision support and technical support to the *(Engineering Director or designee*) as appropriate.

EVALUATION / DECISION

Evaluate conditions at least daily, or whenever conditions change significantly. Using Table 1.1 and/or Table 3.1, determine whether:

A) The event can be terminated (*Specify parameters for which this is an acceptable decision*)

B) The event remains at the current Event Level 3 (*Specify parameters for which this is an acceptable decision*).

C) The event warrants escalation to Event Level 2 (*Specify parameters for which this is an acceptable decision*).

Based on this determination, follow the appropriate actions below.

A) TERMINATION	B) EVENT LEVEL 3	C) EVENT LEVEL 2
Go to **Termination and Follow-up** (Section 4)	Continue recommended actions on this sheet	Go to **Event Level 2 or Event Level 1 Notification Chart**

EVENT: *(FLOODING)*	Sheet
LEVEL: 2	A2

RECOMMENDED ACTIONS

Time/Date Completed

(EAP Coordinator):

A. Make sure notifications on Figure 2.2 have been made.

B. (*Decribe a course of action that closely monitors the situation. Careful observation and inspection of every part of the dam is necessary; this should be done without compromising the safety of anyone performing these tasks. Clearly describe potential problems so that the individual(s) carrying out the inspection know what may be dangerous. Off-site areas and/or instrumentation may also need to be monitored. If necessary, confer with the On-Call Engineer and/or the Engineering Director or designee to determine any preventative action that must be taken. Additionally, develop a plan to avoid dam failure and minimize damage downstream.*)

C. Record all information, observations, and actions on an Event Log Form (Form 3.1).

D. Contact the *(Engineering Director or designee*) at least daily to report the latest observations and conditions. If conditions change significantly, contact the *(Engineering Director or designee*) immediately.

(Engineering Director or designee):

A. (*Describe a course of action to be taken by this position. In general, this will be to review all pertinent information in order to recommend appropriate actions to the EAP Coordinator. If necessary, contact local emergency contractors and/or other individuals that may be able to assist in monitoring the situation.*)

(*On-Call Engineer*):

A. Provide decision support and technical support to the *(Engineering Director or designee*) as appropriate.

EVALUATION / DECISION

Evaluate conditions at least twice daily, or whenever conditions change significantly. Using Table 1.1 and/or Table 3.1, determine whether:

A) The event warrants downgrade to Event Level 3 (*Specify parameters for which this is an acceptable decision*). All contacts on Event Level 2 Notification Flow Chart shall be notified of downgrade from Event Level 2 to Event Level 3.

B) The event remains at the current Event Level 2 (*Specify parameters for which this is an acceptable decision*).

C) The event warrants escalation to Event Level 1 (*Specify parameters for which this is an acceptable decision*).

Based on this determination, follow the appropriate actions below.

A) EVENT LEVEL 3	B) EVENT LEVEL 2	C) EVENT LEVEL 1
Go to **Event Level 3 Notification Chart**	Continue recommended actions on this sheet	Go to **Event Level 1 Notification Chart**

EVENT: *(FLOODING)* LEVEL: 1	Sheet A1

RECOMMENDED ACTIONS

Time/Date Completed

(EAP Coordinator):

A. Make sure notifications on Figure 2.3 have been made.
B. (*Describe a course of action that closely monitors the situation. If necessary, confer with the On-Call Engineer and/or the Engineering Director or designee to determine any preventative action that must be taken. In most cases, dam failure will be imminent, so most efforts should be directed toward the minimization of human loss of life, injury or property damage.*)
C. Record all information, observations, and actions on an Event Log Form (Form 3.1).
D. Establish a means to keep in frequent contact with the *(Engineering Director or designee)* until Event Level 1 is terminated.

(Engineering Director or designee):

A. (*Describe the course of action to be followed by this position. In general, this will be to review all pertinent information in order to recommend appropriate actions to the EAP Coordinator. If necessary, contact local emergency contractors and/or other individuals that may be able to assist in monitoring the situation.*)

(*On-Call Engineer*):

A. Provide decision support and technical support to the *(Engineering Director or designee)* as appropriate. Send a qualified individual to the site as soon as possible.

EVALUATION / DECISION

Evaluate the situation as events progress, or whenever conditions change. Determine whether:

A) The event remains at the current Event Level 1.
B) The event can be terminated (*Specify parameters for which this is an acceptable decision*).

Based on this determination, follow the appropriate actions below.

A) EVENT LEVEL 1	B) TERMINATED	
Continue recommended actions on this sheet	Go to **Termination and Follow-up** (Section 4)	

3.2 Locally Available Equipment, Labor, and Materials

(*Provide a list of resources stored on-site that are available in an emergency.*

Additionally, supply a list of the address and phone number(s) of any nearby companies (e.g. heavy equipment rental, crane service, etc.) that may be needed and are willing to provide service in the case of an emergency event. Since dam emergencies do not just occur during business hours, it is important that these companies have a 24-hour contact number.)

3.3 Unusual or Emergency Event Log

Use the Unusual or Emergency Event Log (Form 3.1) on next page to record actions and events during an Unusual or Emergency Event and the time that the action or event occurred. A copy of this form is also provided in the inside pocket of the front cover of binder for use during an active event.

FORM 3.1
UNUSUAL OR EMERGENCY EVENT LOG

(Template Lake Dam)

YOU ARE (CIRCLE ONE): *(EAP Coordinator)* / Designated Staff / *(Engineering Director or designee)* / (*On-Call Engineer*) / (*Sheriff*) / Other _____

DETECTION

When did you detect/get notified of the event?
How did you detect/get notified of the event?

LEVEL DETERMINATION

What initial level has the *(EAP Coordinator or designee)* assigned to the event?

ACTIONS AND EVENT PROGRESSION

Date	Time	Action/Event Progression	Taken By

ACTIONS AND EVENT PROGRESSION (continued)

Date	Time	Action/Event Progression	Taken By

SECTION 4
TERMINATION AND FOLLOW-UP

Once EAP operations have begun under Event Level 3, 2, or 1, the EAP operations must eventually be terminated and follow-up procedures completed. As shown on Figure i, EAP operations can only be terminated after completing operations under Event Level 3 or 1. If Event Level 2 is declared, the operations must be designated Event Level 3 or 1 before terminating the EAP operations.

4.1 Termination Responsibilities

(*Identify the individual responsible for terminating EAP operations. This must not necessarily be the EAP Coordinator. Describe notification protocol to be followed once EAP activities have been terminated.*

Outline any special actions that are to be taken prior to termination of a Level 1 event that did not result in dam failure. These actions should ensure the safety of people and property downstream. Do not terminate the EAP unless it is certain that there is no further threat.)

4.2 Follow-up

Event Level 3 – (*Describe the EAP review process following the termination of a Level 3 event. Ensure that all parties that participated in the EAP activities are involved in the review process. Impose a time frame within which the review is to be completed. During the review, document any EAP procedures that were followed effectively, as well as any ways that the EAP could be improved, and insert this document into Appendix C of the EAP.*)

Event Level 2 or 1 – (*Describe the EAP review process following the termination of a Level 2 or 1 event. Ensure that all parties that participated in the EAP activities are involved in the review process. Impose a time frame within which the review is to be completed. During the review, document any EAP procedures that were followed effectively, as well as any ways that the EAP could be improved, and insert this document into Appendix C of the EAP. In addition, note any extra measures that must be taken due to the increased severity of the event.*)

Event That Has Caused Loss of Life, Injury or Property Damage – (*In addition to the course of action outlined above for Event Level 2 or 1, note any special procedures that must be followed in the event of loss of life, injury or property damage. In general, a closer look should be taken at the EAP operations. As before, impose a reasonable time frame on the completion of these activities, and insert any conclusions into Appendix C of the EAP.*)

SECTION 5
MAPS, FIGURES AND SUPPORTING DATA

(*Include any maps and figures that may prove useful during EAP operations. Typically, these include:*

- *Location and Vicinity Map*
- *Emergency Access Routes Map*
- *Estimated Dam Failure Flood Inundation Map*
- *Reservoir Area and Capacity Curve*
- *Principal Spillway Rating Curve*
- *Emergency Spillway (Top of the Dam) Rating Curve*
- *Annotated Site Pictures*
- *Schematic Plan of the Dam*

Depending on the specific dam, one or more of the above-mentioned exhibits may not be appropriate. Similarly, include any other maps, charts or figures deemed relevant in the case of an emergency event.)

APPENDIX A
WARNING AND EVACUATION

This appendix is available for inserting local warning and evacuation plans developed by (*the Warning/Evacuation branch*).

APPENDIX B
INUNDATION MAP DOCUMENTATION

INUNDATION AREA

(*Describe in detail the dam-failure flood inundation map provided in Section 5. Explain the method and model(s), if appropriate, used to calculate this data, making sure to thoroughly document all assumptions. Present the results from the analysis in a manner that complements the dam-failure flood inundation area map. If appropriate, summarize the numerical results in tabular format at the end of the appendix. Include cross-section number, miles downstream of dam, maximum flow, maximum elevation, maximum depth, time to peak and floodwave arrival data.*)

(*It is strongly suggested that a detailed dam breach analysis utilizing appropriate modeling techniques be undertaken as part of the EAP preparation process. However, in lieu of timely availability of a detailed dam breach analysis, a Rule-of-Thumb determination of potential dam-failure inundation limits may be made by conservatively assuming the breach flood wave height just downstream of the dam as 0.4H, where H is the total dam height. Then assume that the breach flood wave height would be halved every 10 miles downstream of the dam. In other words, the breach flood wave height is assumed at 0.3H at a point approximately 5 miles downstream the dam and 0.2H at a point approximately 10 miles downstream the dam, so on, until the breach flood wave height is generally contained within channel limits and/or to the point where no other downstream structures would be impacted. The breach wave heights in between each 5-mile estimation point may be interpolated from the above estimates. Once the estimated breach wave height is determined for various points along the downstream stream reach as discussed above, these calculated breach flood wave heights would then need to be added to the flow line elevation at each point to calculate the expected dam failure inundation elevation at that point. An approximate dam-failure inundation map could then be generated by drawing the limit of inundation resulting from the calculated elevations.*)

EMERGENCY EVACUATION PLANNING ZONES

(*Emergency evacuation planning zones are specific segments or portions of dam-failure flood inundation areas downstream from Template Lake Dam that:*

1. *Define the potential area of impact resulting from each type and/or severity of event.*
2. *Allow response personnel to prioritize evacuation activities for the populations at risk in terms of distance downstream from the dam and flood wave travel times.*

Local response organizations should define appropriate emergency evacuation planning zones and appropriate evacuation centers in emergency operations appendices specific to Template Lake Dam.)

APPENDIX C
PAST EAP ACTIVITY

This Appendix is the placeholder for copies of past EAP activity reports, Annual Review Verification Statements that must be completed after the annual review is performed, and Periodic Test Memos to be included after periodic tests have been performed.

APPENDIX D
EAP REVIEW AND REVISION

EAP Annual Review

(*Identify the individual responsible for conducting the annual review of the EAP. Explain in detail the review procedure and all parties involved. Describe what, if any, post-review actions should be taken. Note that an EAP Annual Review Verification Statement should be completed upon conclusion of the review.*)

EAP Periodic Test

(*Identify the individual responsible for coordinating the Periodic Test of the EAP. Explain in detail the components of the test and all those expected to participate. Describe any post-test actions and their implications for the EAP.*)

Revision

(*Identify the individual responsible for ensuring that the EAP documents are revised. The EAP held by this individual is the master document. Explain the procedure by which revisions are made, and how to ensure that changes are made in all existing copies of the EAP. Emphasize the necessity that all copies remain updated and identical.*)

FORM D.1
EAP ANNUAL REVIEW VERIFICATION STATEMENT

Name of Dam: *(Template Lake Dam)*

Date of Drill: _____

A. The current EAP is on hand and all revisions have been inserted.
B. The emergency procedures observed during the drill were in accordance with the EAP.
C. The readiness evaluated in the drill was acceptable.
D. The communications network is correct and was verified.
E. The training of personnel is sufficient and acceptable.
F. The EAP Annual Review procedures were followed.

Additional Comments: _____

_____ _____

(individual responsible for conducting EAP Annual Review) Date

_____

(printed name)

_____ _____

(EAP Coordinator) Date

_____

(printed name)

APPENDIX E
EAP DISTRIBUTION

(*List the individuals that maintain a copy of the EAP document. Include name, title, address, telephone number, email address, and EAP copy number. Note that the number of recipients must be kept at a minimum in order to ensure efficient updates.*)

APPENDIX F
SUPPLEMENTARY INFORMATION

This appendix contains background information and pertinent data, and is also the place holder for any other key supplementary information such as emergency materials, service contracts, and any other relevant material for (*Template Lake Dam*) and other similar information that may be placed in this appendix by individual plan holders for quick reference during an event.

PERTINENT DATA[1]

A. GENERAL	
Name of Dam	
Name of Reservoir	
Owner	
County	
River or Stream	
Watershed Basin	
National Inventory of Dams Number	
Hazard Potential Classification	
Required Spillway Capacity (% PMF Design Flood)	
Year Constructed	
Legal Description (of Dam)	
Latitude	
Longitude	
B. DAM	
Type	
Crest Elevation (ft., NAVD 1988)	
Crest Width (feet)	
Crest Length (feet)	
Embankment Height (feet)	
Upstream Slope	
Downstream Slope	
C. SPILLWAY SYSTEM	
1. Principal Spillway	
Type	
Control Sill Elevation	
Dimensions	
Freeboard above Control Sill Elevation (feet)	
Discharge during Design Storm (cfs)	
Terminal Structure	

PERTINENT DATA (CONT'D)

2. Emergency Spillway	
Type	
Control Sill Elevation (ft, NAVD 1988)	
Length of Control Section (feet)	
Freeboard above Control Sill Elevation (feet)	
Discharge during Design Storm (cfs)	
Terminal Structure	
3. Combined Spillway	
Total Spillway Discharge Capacity (cfs)	
Freeboard at Peak of Design Flood (feet)	
D. OUTLET WORKS (Drawdown Facility)	
Type	
Dimensions	
Control Structure (valve, gate, stoplogs, etc.)	
Inlet / Outlet Inverts (ft, NAVD 1988)	
Discharge Capacity at Normal Pool (cfs)	
E. RESERVOIR	
Normal Pool Elevation (Feet)	
Reservoir Area at Normal Pool (Acres)	
Estimated Storage at Normal Pool (Acre-feet)	
Reservoir Area at Top of Dam (Acres)	
Estimated Storage at Top of Dam (Acre-feet)	
F. DRAINAGE BASIN	
Drainage Area (square miles)	
Description	

NOTES: 1. *Identify the document/study/inspection from which the pertinent data was gathered.*

APPENDIX G
GLOSSARY

Abutment. The undisturbed natural material of the valley side against which the dam is constructed. The left and right abutments are defined as being on the right and left side of an observer looking downstream.

Acre-Foot. A term used in measuring the volume of water that would cover one acre to a depth of one foot. It is equal to 43,560 cubic feet.

Appurtenant structure. A structure necessary for the operation of a dam such as outlets, trash racks, valves, spillways, power plants, tunnels, etc.

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

Channel. A general term for any natural or artificial watercourse.

Conduit. A closed channel to convey water through, around, or under a dam.

Culvert. A closed channel to convey water.

Crest of Dam. Top of dam.

Cross section. A sectional view of a dam formed by passing a plane through the dam perpendicular to the axis.

Dam. A barrier constructed across a watercourse for the purpose of impounding or diverting water.

a. Embankment dam. Any dam constructed of excavated natural materials or of industrial waste materials.
b. Concrete dam. Any dam constructed of concrete materials.

Dam failure. The uncontrolled release of reservoir contents.

Drain, toe. A system of pipe and/or pervious material along the downstream toe of a dam used to collect seepage from the foundation and embankment and convey it to a free outlet.

Drainage area. The area that drains to a particular point on a river or stream.

Drawdown. The difference between a water level and a lower water level in a reservoir within a particular time. Used as a verb, it is the lowering of the water surface due to release of water from the reservoir.

EAP Operations. All actions taken by the dam owner and other involved agencies to address an unusual or emergency event.

Earthquake. A sudden motion or trembling in the earth caused by the abrupt release of accumulated stress along a fault.

Emergency Action Plan (EAP). A comprehensive, single-source document providing accurate and current instructions intended to help dam owners/operators save lives, minimize property damage, and minimize environmental impacts caused by large releases from a dam, dam failure, or other events that present hazardous conditions.

Emergency Event. An event which takes place or a condition which develops that is of a serious nature that may endanger the dam, or endanger persons or property, and demands immediate attention.

Filter (filter zone). A band of granular material graded (either naturally or by selection) so as to allow seepage through or within the layers while preventing the migration of material from adjacent zones.

Flood. A temporary rise in water levels resulting in inundation of areas not normally covered by water. may be expressed in terms of probability of exceedance per year such as one percent chance flood or expressed as a fraction of the probable maximum flood of other reference flood. Some related terms are:

a. Flood, Inflow Design (IDF). That flood used in the design of a safe dam and its appurtenant works particularly for sizing the spillway and outlet works, and for determining maximum temporary storage and height of dam requirements.

b. Flood, Probable Maximum (PMF). The largest flood reasonably expected at a point on a stream because of a probable maximum storm and favorable runoff conditions.

Freeboard. Vertical distance between a stated water level and the top of dam.

Gate. A movable, watertight barrier for the control of water.

a. Outlet gate. A gate controlling the flow of water through a reservoir outlet.

b. Slide gate (sluice gate). A gate that can be opened or closed by sliding in supporting guides.

Height, hydraulic. The vertical distance between the maximum design water level and the lowest point in the original streambed.

Height, structural. The vertical distance between the lowest point on the dam crest and the lowest point of the excavated foundation.

Hydrograph, breach or dam failure. A flood hydro graph resulting from a dam breach.

Hydrograph, flood. A graphical representation of the flood discharge with respect to time for a particular point on a stream or river.

Hydrograph, unit. A hydrograph with a volume of one inch of runoff resulting from a storm of a specified duration and aerial distribution. Hydrographs from other storms of the same duration and distribution are assumed to have the same time base but with ordinates of flow in proportion to the runoff volumes.

Incident Command System (ICS). A management system designed to control personnel, equipment, supplies, and communications at the scene of an unusual or emergency event. An Incident Command System is typically deployed at the beginning of an event until the management of the on- scene operations are no longer needed. The structure of the Incident Command System can be expanded or contracted depending on the changing needs of the event. The Incident Command System allows agencies of all kinds to effectively communicate using common terminology.

Incident Manager. The Incident Manager is the highest ranking official available at the scene of an unusual or emergency event. All personnel involved in the operating procedures of the dam or emergency operations should be trained in the fundamentals of ICS.

Instrumentation. An arrangement of devices installed into or near dams (i.e., piezometer, inclinometer, strain gage, survey points, etc.) that provide measurements that can be used to evaluate performance parameters of a structure.

Intake. Any structure in a reservoir, dam or river for the purpose of directing water into a conduit, tunnel, canal or pipeline.

Inundation map. A map delineating the area that would be submerged by a particular flood event.

Length of dam. The length along the top of the dam between contact abutments. This also includes the spillway, power plants, navigation lock, fish pass, etc., where these form part of the length of the dam. If detached from the dam, these structures should not be included.

Outlet. An opening through which water can be discharged.

Parapet wall. A wall built along the top of a dam (upstream or downstream edge) used for safety of vehicles and pedestrians, to prevent overtopping caused by wave runup, or ornamentation.

Phreatic surface. The free surface of water seeping at atmospheric pressure through soil or rock.

Piezometer. An instrument for measuring pressure head.

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

Probability. The likelihood of an event occurring within a given period of time.

Probable Maximum Flood (PMF). The maximum runoff condition resulting from the most severe combination of hydrologic and meteorological conditions that are considered reasonably possible for the drainage basin under study.

Probable Maximum Precipitation (PMP). Theoretically, the greatest depth of precipitation for a given duration that is physically possible over a given size storm area at a particular geographical location.

Public Information Officer (PIO). A Property staff member designated by the *(EAP Coordinator)*. During EAP operations, the PIO will be the contact person at the Property for the media, and will keep the media informed of the EAP operations.

Relief Wells. A line of vertical wells or boreholes to facilitate drainage of the foundation and abutments and to reduce water pressure.

Reservoir. A body of water impounded by a dam and in which water can be stored.

Reservoir surface area. The area covered by a reservoir when filled to a specified level.

Riprap. A layer of stone, precast blocks, bags of cement or other suitable material, generally placed on the upstream slopes of an embankment or along a watercourse as protection against wave action, erosion, or scour. It consists of pieces of relatively large size as distinguished from a gravel blanket.

Seepage. Flow or movement of water through a dam, its foundation, or its abutments.

Slope. Inclination from the horizontal, measured as the ratio of horizontal units to corresponding vertical units.

Spillway. A structure over or through which flow is discharged from a reservoir. If the rate of flow is controlled by mechanical means such as gates, it is considered a controlled spillway. If the elevation of the spillway crest is the only control, it is considered an uncontrolled spillway.

Spillway channel. An 'open channel or closed conduit conveying water from the spillway inlet downstream.

Spillway crest. The lowest level at which water can flow over or through the spillway.

Spillway, chute. An inclined channel, usually separate from the dam, to convey reservoir overflow into the natural channel below the dam or into an adjacent natural drainage channel.

Standing Operating Procedures (SOP). A comprehensive, single-source document providing accurate and current instructions for normal operation, maintenance, monitoring, and inspection of a dam and appurtenant features.

Stoplogs. Timbers or steel beams placed on top of each other with their ends held in guides on each side of a channel or conduit so as to provide a cheaper or more easily handled means of temporary closure than a bulkhead gate.

Storage. The retention of water or delay of runoff either by planned operation, as in a reservoir, or by temporary filling of overflow areas, as in the progression of a flood wave through a natural stream channel. Definitions of specific types of storage in reservoirs are:

a. Dead Storage. The reservoir volume between the invert of the lowest intake and the reservoir bottom.

b. Active Storage. The reservoir volume between the normal reservoir water surface elevation and the invert of the lowest intake.

c. Flood Storage. The reservoir volume between the crest of the dam and the normal reservoir water surface elevation.

Unusual Event. An event which takes place, or a condition which develops, that is not normally encountered in the routine operation of the dam and reservoir, or necessitates a variation from the operating procedures.

APPENDIX B

REFERENCES

REFERENCES

(Used throughout the manual)

- Arkansas Soil and Water Conservation Commission
  Inspection and Maintenance Manual for Arkansas Dam Owners, 2002
  101 East Capitol, Suite 350
  Little Rock, Arkansas 72201

- Association of State Dam Safety Officials
  Compendium of State Dam safety Inspection Forms, 1997
  450 Old East Vine Street
  Lexington, Kentucky 40507

- Colorado Division of Water Resources, State Engineer's Office
  Dam Safety Manual, 2002
  1313 Sherman Street
  Denver, Colorado 80203

- Department of the Army, U.S. Army Corps of Engineers
  Instrumentation for Concrete Structures, EM 1110-2-4300, 1987
  Washington, D.C. 20314-1000

- Department of the Army, U.S. Army Corps of Engineers
  Evaluation and Repair of Concrete Structures, EM 1110-2-2002, 1995
  Washington, D.C. 20314-1000

- Department of the Army, U.S. Army Corps of Engineers
  Seepage Analysis and Control for Dams, EM 1110-2-1901, 1993
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