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Responsibilities Related to Imminent/Potential Dam Failures***

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OPR: W/SR12 (Ben Weiger)

Certified by: W/SR1 (Judson Ladd)

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Steven G. Cooper for	<u>4/27/06</u>
Bill Proenza	Date
Director, Southern Region	

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1. **Purpose.** The purpose of this Supplement is to describe regional and field office responsibilities and procedures related to dam failures.

2. **Procedures.**

2.1 SRH Responsibilities: The Southern Region (SR) Hydrologic Services Branch (HSB), in collaboration with the SR River Forecast Centers (RFC) and the Office of Hydrologic Development, will provide training on the dam failure related applications and product templates, as required. SR HSB will also post dam failure related information on the SR Intranet and work with the SR Regional Operations Center to disseminate potential or imminent dam failure information to NWSH.

2.2 WFO Responsibilities: In the event of a known or potential dam failure which will or could cause high flows and pose a risk to life and property, Weather Forecast Offices (WFOs) are responsible for issuing watches and warnings for areas/points in their County Warning Area (CWA) downstream of the dam.

Upon notification of a dam failure or potential dam failure, a WFO will perform the following steps:

- a. **Confirm the report:** If a report of a dam failure, or potential dam failure, was received from someone other than a reliable source (e.g., owner of the dam, emergency services personnel, local law enforcement officials, etc.), or the report seems suspicious, the WFO should attempt to confirm the report. Obtain as much information as possible regarding the suspected failure and record it on a form similar to those provided in Appendices B and C.

b. Issue Product:

- (1) If the dam has already failed or failure is expected, the WFO will issue a Flash Flood Warning (FFW) for the flood plain downstream of the dam as quickly as possible. The warning should initially be qualitative, emphasizing the life- threatening nature of the situation and urging people in the affected area to take immediate life-saving actions. Information received from reliable sources should be included in the warning along with specific identification of the source(s).

Other non-weather related emergency products, such as those defined in NWS Instruction 10-518, Section 5 (e.g., EVI, CEM), may also be issued to supplement the FFW, after coordination with the dam owner and emergency management officials.

- (2) If the dam has not yet failed, but the owner or operator has expressed concern for the safety of the dam, and a failure or large release is possible, the WFO should issue a Flash Flood Watch (FFA) for the flood plain downstream of the dam. The watch should emphasize the potential danger, so people in the affected area can begin to take appropriate action.

Other non-weather related emergency products, such as those defined in NWS Instruction 10-518, Section 5 (e.g., EVI, CEM), may also be issued to supplement the FFA, after coordination with the dam owner and emergency management officials.

c. Contacts: After issuance of the initial product, the following persons/offices should be contacted:

- (1) River Forecast Center (RFC) - to brief on the situation, request support, and pass along information about the dam.
- (2) Dam Owner (if not already contacted) - obtain as much information as possible concerning the dam failure or problem.
- (3) Adjacent WFO if the failure is likely to affect their CWA as well.
- (4) Meteorologist-in-Charge (MIC) and Service Hydrologist/Hydro Focal Point (if they are not on station at time of notification) - to brief on the situation.
- (6) SRH - Regional Operations Center/SR HSB - to brief on the situation.

d. Issue Follow-up Watches/Warnings/Statements: The WFO should coordinate follow-up watches/warnings/statements with the RFC, dam owner, and/or local emergency management officials.

Quantitative data (e.g., time and magnitude of the crest, area expected to be inundated, etc.) should be incorporated into the follow-up watches/warnings/statements whenever possible. If such data is not yet available from the RFC, WFOs should utilize the dam failure scenario information contained in Emergency Action Plans (EAP), if available. WFOs should be familiar with the EAP dam failure scenarios available for dams in their service area. The assumptions and conditions used to generate these scenarios vary from state to state. If EAP dam failure scenarios are not available, WFOs may use dam catalog information or “Rules of Thumb” guidelines for dam failures (see Appendix A) to provide preliminary quantitative information. In most cases, inclusion of quantitative information will be limited to the follow-up messages (i.e., the Flash Flood Statement) issued after the initial warning.

When the impact downstream of the dam is not known, the WFO can issue a warning for the area from the dam to a given location and a watch downstream of that point. When river forecast guidance is available from the RFC for locations impacted by a dam failure, and sudden flooding is not expected within 6 hours, the WFO can issue river-based flood warnings (FLW) and statements (FLS) to handle the remainder of the event. In this case, a statement should be issued stating that future information on this event will be available under the FLW and FLS product headers.

2.3 RFC Responsibilities: SR RFCs will provide the highest level of support to the WFOs in their service area during potential/imminent dam failure situations. This support should include providing preliminary quantitative information, if required, to the affected WFO. More sophisticated procedures (i.e. simplified or full versions of Dam Break model) will be executed at the RFCs as soon as possible and as data availability allows. RFC support will continue as long as flooding persists. If the flood wave is expected to reach an RFC river forecast point, the RFC will issue River Forecast Guidance (RVF) as is done for other flood events.

2.4 Dam Failure Forecasts: SR WFOs are not expected to execute dam break models to obtain quantitative information on dam failures. This responsibility falls to the RFCs. WFOs, in collaboration with their servicing RFC, are expected to use the dam failure scenario information from dam EAPs or dam break models, if available, to obtain quantitative information on a flood wave resulting from a dam failure. If dam EAP or dam break model scenario information is not available, WFOs may use dam catalog information or “Rules of Thumb” guidelines for dam failures to provide preliminary quantitative information on a flood wave resulting from a dam failure. WFOs should take the lead in collecting information needed by the RFCs to conduct dam break modeling.

2.5 Pre-Event Operational Readiness: SR WFOs should be prepared to take all necessary actions should a dam fail. This preparation should include (1) staff familiarization with the major dams located in the CWA; (2) readily available up-to-date procedure documentation; (3) preformatted watches/warnings/statements using the GHG/WARNINGEN dam failure product templates; and (4) dam failure logs (see sample logs in appendix B and C). The WFOs should also maintain close liaison with the local emergency services personnel regarding actions to be taken during a dam failure.

WFOs should ensure that their point-of-contact (POC) information/24-hour office telephone number and their service backup office's POC information/24-hour office telephone number are contained in the notification list of all high and significant risk dam EAPs within their CWA. WFOs should ensure that the NWS is placed as high as possible on the notification list. To justify the position on the notification list, WFO staff should explain the agency mission and the benefit of the Emergency Alert System in alerting downstream communities. Copies of dam EAPs available in the CWA should be kept on station. WFOs will provide copies of the dam EAPs (if available) to their servicing RFC and service backup offices. Dam failure drills should be conducted annually. WFOs should participate in dam failure exercises sponsored by dam owners.

SR WFOs may gather the necessary input data and execute the Simplified Dam Break Model (SMDBK) for a specific dam based on the following conditions:

- a. There are no imminent/potential dam failures expected.
- b. The servicing RFC has not already executed the SMDBK for the dam.

They should collaborate with their supporting RFC to provide technical support, guidance, and training on this activity. The final outputs from the WFO SMDBK model runs will be reviewed by the servicing RFC prior to storing the dam failure scenario information in the dam catalog and the dam failure related product templates. WFOs should share the SMDBK model scenario information with their servicing RFC and backup WFOs.

SR RFCs should be prepared to take all necessary actions should a dam fail or threaten to fail. This includes running Dam Break models, providing expert assistance, and performing pre-event dam failure analyses for dams that pose an imminent threat to the safety of the residents downstream from the dam. Such a determination should be a coordinated effort among the RFC, WFO, and when possible, the dam owner and/or other responsible state and federal agencies. RFCs should also participate in dam failure exercises sponsored by dam owners.

As part of the SR WFO/RFC collaborative dam failure project, WFOs should integrate generic default scenario information (reference project plan on the Intranet) into the WARNGEN dam failure FFW product template for high and significant risk dams in their service area. They should also collaborate with their supporting RFCs to integrate more detailed quantitative dam failure scenario information into the WARNGEN dam failure FFS product template for high and significant risk dams in their service area. WFOs should share their dam failure template files and associated input data files with their backup WFOs.

Appendix A – “Rules of Thumb” Guidelines for Dam Failures

The magnitude of flooding that occurs from a dam failure is related to several factors. The most important are:

- the volume of water impounded by the dam
- the starting water surface elevation or ‘head’
- size of the breach in the dam
- distance to the nearest downstream town
- the time it takes for a dam to fail

These guidelines are intended only to give general and quick guidance in the event of a dam failure. It is not implied that they represent exact solutions applicable to all situations.

The following three sections provide information on estimating the characteristics of a flood wave resulting from a dam failure. The first section discusses the height of the initial flood wave. The second section provides a means of estimating the speed at which the flood wave moves downstream. The third section describes a means of estimating the attenuation of the flood wave height as it moves downstream. The essentials in each section are underlined.

1. Adjacent to the dam, the maximum height of the flood wave generally should be no greater than half of the height of the water behind the dam before structural failure began. This assumes a rapid structural failure. If the failure takes a number of hours, the height will be less.

Ex. A 50-foot high dam is restraining a 40-foot high volume of water. The initial flood wave at the dam site in the event of a rapid failure will be no higher than 20 feet. The longer the structural failure takes, the lower the initial flood wave height will be.

2. A flood wave moving downstream is a complex phenomena which is affected by many channel characteristics, such as slope, cross-sectional area, and channel roughness. The average downstream speed of a flood wave is:

3-4 mph for normal/shallow slopes
5-7 mph for steeper slopes/foothills
8-10 mph for steep slopes/mountains

The flood wave will attenuate in height and speed very quickly as it spreads across the flood plain.

Ex. Teton Dam in Idaho, 262 feet high, failed structurally very quickly, in about one hour. The flood wave moved as follows:

5 miles in about ½ hour
10 miles in about 1 hour
20 miles in about 9 hours
50 miles in about 30 hours

Ex. Buffalo Creek Dam in West Virginia, 45 feet high, also failed very quickly, and the downstream flood wave moved as follows:

5 miles in about ½ hour
10 miles in about 1½ hours
15 miles in about 3 hours

3. A reasonable assumption for the attenuation of flood wave height is that the flood wave will be reduced by about half for each ten miles of travel downstream.

Ex. A dam restraining an 80-foot high volume of water collapses very quickly. Approximate wave heights downstream are as follows:

At the dam site - 40 feet
10 miles downstream - 20 feet
20 miles downstream - 10 feet
30 miles downstream - 5 feet
40 miles downstream - 2 feet
50 miles downstream - 1 foot

Appendix B- Dam Failure/Potential Dam Failure – Sample Report Log

1. Date/time report received _____
2. Name of person reporting failure _____
Phone number of person reporting failure _____
Address (if available) _____
Name of original source/witness of report _____
3. Is person reporting failure affiliated with local, county, state, or Federal Government?
Yes/No If yes, what agency or department? _____
4. Name of dam _____
County in which located _____
Name of river or stream _____
Name and distance of nearest downstream town _____
Name of dam owner (if known) _____
Estimated time of failure _____
Estimated breach width (if known) _____
Water surface elevation behind dam at time of failure (if known) _____
Dam height (if known) _____
Reservoir Length (if known) _____
Dam Crest Length (if known) _____
Type of Dam (earthen, concrete, etc.) _____
5. Has any other government agency/department been notified by the person making the report? Yes/No
If yes, what agency/department? _____
6. If dam has not failed but may, get description of current dam condition (cracked, over-flowing top/around sides, washing sides, sand boils, etc.)

7. Obtain any additional data available

8. Notification of appropriate RFC and SRH (ROC/HSB) _____

VERIFICATION -- Required if person reporting failure is other than government agency.

Dam failure /potential verified with _____ agency/department.

Name of person in agency/department _____

ACTION --- Determine whether:

- The dam has failed or failure is imminent.
- Dam has not failed but will probably fail within 12 hours.
- Dam has not failed but will probably fail and the failure is forecast to be greater than 12 hours after you were informed of the possibility.

Name of person completing this report _____

Appendix C – Sample Dam Incident Report Log

DAM INCIDENT REPORT LOG

CHECK ONE: ACTUAL FAILURE POTENTIAL FAILURE INFORMATION REPORT DRILL

DATE/TIME CALL RECEIVED: _____ CALL RECEIVED BY: _____

CALLER INFORMATION

Name	Agency	Telephone Number
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DAM INFORMATION

Dam Name	River/Stream	County
Lake Elevation (Feet)	Current Storage (Acre-Feet)	Max Storage (Acre-Feet)

SITUATION DESCRIPTION: (Ask Questions! Talk to the caller. From this description can you determine what product to issue?)

STOP! THINK: IS THIS DAM IN OUR CWA?

IF DAM IS OUTSIDE OUR CWA:

Which other office notified:	Name of person you notified:	Time of this notification:
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I notified _____ at the RFC

Yes, write their name here.

IF DAM IS INSIDE OUR CWA:

Additional information to collect from Dam Catalog:

Dam Type (earth, rock, etc.)	Nearest downstream town	Travel time to town (Minutes)
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Action taken:

Product Issued (Please attach)	Time Issued	<input type="checkbox"/> Watch/Warning Log completed and attached
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I notified the Service Hydrologist

SRH notified (if actual failure):	Name of person you notified:	Time of this notification:
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I notified _____ at the RFC

Yes, write their name here.

Appendix D – Dam Related Information Resources

The Hydrology section of the SR Intranet contains various information resource links to support WFO/RFC hydrologic operations during pre-event and potential/imminent dam failures. This includes the following:

1. American Association of Dam Safety Officials web page - This web page contains dam safety official contact information for each state. These officials can provide you information pertaining to dams in their state.
2. Corps of Engineers National Inventory of Dams web page – This web page provides you with access to the NID. It is the most current inventory of information for all dams in the Nation.
3. EAP Point-of-Contact Information for Federal Energy Regulatory Commission-regulated dams
4. WARNGEN/GHG Product Templates/User Documentation – Product templates to assist the WFOs with generating FFA/FFW/FFS dam break related products.
5. Training materials for the WARNGEN dam failure product templates
6. Detailed information about “Rules of Thumb” Guidelines for Dam Failures
7. WFO/RFC Collaborative Dam Break Project Plan/Procedures

The following resources are available from FEMA and the COE regarding Dam Emergency Action Plans information/contacts:

1. FEMA Publications on Dam Safety

<http://www.fema.gov/fima/damsafe/publications.shtm>

2. EAP Contacts at Corps of Engineer Dams

Contact the dam safety coordinator at the COE district offices in your service area.

Appendix E - Downstream Hazard Potential Definitions

The information below was extracted from the COE National Inventory of Dams web page. Definitions, as accepted by the Interagency Committee on Dam Safety, are as follows:

1. LOW HAZARD POTENTIAL

Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner’s property.

2. SIGNIFICANT HAZARD POTENTIAL

Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environment damage, disruption of lifeline facilities, or impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

3. HIGH HAZARD POTENTIAL

Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

Hazard Potential Classification	Loss of Human Life	Economic, Environmental, Lifeline Losses
Low	None expected	Low and generally limited to owner
Significant	None expected	Yes
High	Probable. One or more expected	Yes (but not necessary for this classification)