

**Forest Service Handbook
National Headquarters – Washington Office
Washington, DC**

**Forest Service Handbook 7509.11 – Dams Management Handbook
Chapter 60 - Failure Investigation and Reports**

Amendment: 7509.11-1993-1

Effective date: August 5, 1993

Duration: This amendment is effective until superseded or removed.

Superseded Directive: 1, August 8, 1990; Entire Handbook issued, December 1986

Approved by: F. Dale Robertson, Chief

Date approved:

Responsible Staff:

Explanation of changes: Following is an explanation of the changes throughout the directive by section.

Revises and updates entire Handbook. Significant changes in direction are as follows:

05: Moves select definitions from FSM 7500. Modifies definitions to agree with Glossary of Terms for Dam Safety, prepared by the Interagency Committee for Dam Safety (ICODS), and Federal Emergency Management Agency (FEMA).

08: Updates reference list and adds names and addresses of agencies, associations, and groups publishing reference materials related to dams and dam safety.

10: Changes chapter title from Project Files to Records and Files.

40: Changes chapter title from Safety Evaluation/Hazard Potential to Safety Inspections and Hazard Assessments. Replaces the term "safety evaluation" with "safety inspection" throughout.

42: Replaces the term "Hazard - Potential Evaluations "with" Hazard Assessment."

42.3: Adds hazard classification examples.

53: Adds direction on location of copies of emergency action plans.

54: Adds direction on testing emergency action plans.

62: Revises direction to exclude Regional dam or water resources engineer from serving on a dam failure investigation team in cases of potential or apparent conflict of interest.

70: Changes title from Dam Inventory to Management of Special Use and Other Non-Forest Service Projects. Previous direction contained in this chapter is moved to FSM 7514; moves direction from previous chapter 80 to chapter 70.

80: Changes title from Management of Special-Use and Other Non-Forest Service Projects to Planning and Design.

Completes previously reserved FSM 7520 and incorporates it into FSH 7509.11.

81: Provides guidance and definitions for four phases in the design schedule.

82: Provides guidance for planning and designing channel layout.

83: Provides guidance for assigning hazard classification.

This Handbook is now available electronically in the National Information Center in the same format as the paper copy. Henceforth, amendments to this Handbook will be issued to Forest Service units electronically on a document basis.

Table of Contents

60.2 - Objectives	4
61 - Notification of Structure Deficiency or Failure	4
62 - Assignment of Investigation Team	4
62.1 - Investigation Team Members	5
63 - Preparation of Failure Report.....	5
64 - Distribution of Failure Report.....	10

60.2 - Objectives

1. To establish procedures for investigating a dam failure and preparing the failure report (FSM 7518) for dams located on National Forest System lands regardless of ownership.
2. To ensure investigations of failures of structures not owned by the Forest Service are fully coordinated with State and other Federal agency investigations and to avoid unnecessary duplication of effort.
3. To coordinate review with requirements in FSM 6730, Accident Reporting and Investigation, for additional investigative and reporting procedures that may be necessary.

61 - Notification of Structure Deficiency or Failure

Report minor problems or deficiencies through normal organizational channels. When major instability or serious distress is identified that may lead to the loss of life, offsite damage, disrupt public utilities, or cause a major economic loss, activate the emergency action plan and notify the Regional Forester. Examples of serious distress would be severe deterioration of concrete, severe erosion in channels, movement or cracking of the embankment, or sudden excessive seepage. Determine the need for implementation of the emergency action plan by gauging the seriousness of the situation.

When failure of a dam is occurring or has occurred, implement the emergency action plan and notify the Regional Forester immediately. Notify the Washington Office emergency coordinator if one of the situations outlined in FSM 6732 exists.

62 - Assignment of Investigation Team

If loss of life or major damage has occurred, the chief investigator is normally appointed by the Regional Forester. The Forest Supervisor should appoint the chief investigator for other failures. When qualified individuals are not available on the Forest or within the Region, contact appropriate specialists from the Washington Office or other Regions. Except in cases of potential or apparent conflict of interest, the Regional dam or water resources engineer should be given an opportunity to be a member of the team.

In some instances, it may be technically desirable to include specialists from outside organizations on the investigating team. Because the failure may result in a lawsuit or claim against the Government, advice from the Office of the General Counsel and the Fiscal and Accounting Management Staff should be sought before including non-Forest Service personnel on the team.

62.1 - Investigation Team Members

The following are the recommended members or specialists to be included on a failure investigation team, and the hazard class on which to include them.

1. For any hazard class when failure caused injury, loss of life, or damage greater than \$100,000 include the following individuals:

- a. Regional dam or water resource development engineer;
- b. Forest Staff Officer for engineering activities;
- c. Qualified Forest Officer familiar with inspection and maintenance of the failed structure;
- d. Professionals from applicable disciplines to provide a thorough investigation of the failed structure, such as geotechnical, materials, or structural engineers; and
- e. Claims specialist.

2. For high- and moderate-hazard class, where there is no injury or loss of life, and damage is less than \$100,000, include the same individuals as in 1, except for the claims specialist.

3. For low-hazard class, where there is no injury or loss of life, and damage is less than \$100,000, include the following individuals:

- a. Regional dam or water resource engineer is optional, but should be offered the opportunity to participate.
- b. Forest Staff Officer for engineering activities;
- c. Qualified Forest Officer most familiar with the inspection and maintenance of the failed structure;
- d. Professionals from applicable disciplines to provide a thorough investigation of the failed structure, such as geotechnical, materials, or structural engineers.

63 - Preparation of Failure Report

(FS-7500-A) The investigating team shall prepare a full report of the circumstances and consequences of the failure.

In general, the failure report should answer the following questions:

1. What caused the situation or failure?
2. What could have prevented the situation or failure?

The report should provide information needed to improve future engineering work and to resolve claims or litigation.

Exhibit 01 is a recommended format for the report. The extent and detail of the discussion in each section will vary depending on the size, complexity, and significance of the failure.

63 - Exhibit 01

Failure Report (recommended format)

I. Structure Identification.

- A. Name and address of the owner.
- B. Name of the structure or project.
- C. Geographical location.
- D. Authorizing documents.

II. Structure Description.

- A. Structure type.
- B. Function.
- C. Structure length, height, width, spillway dimensions, and storage capacity.
- D. Administrative class.
- E. Hazard class.
- F. Date of construction.
- G. Original construction cost or value prior to failure, if known.

III. Damage and/or Injury Resulting From Failure.

- A. Discuss actual damage and relationship to claims for damage and/or injury resulting from the failure.
- B. Differentiate between Forest Service damage and damage to private property.

IV. Design and Construction Review. Discuss history of design and construction: dates, design criteria used, method of construction, problems encountered during construction and how resolved, design changes during construction, and inspections performed. Information may be available from the design file, plans and specifications, contract files, inspector's reports, correspondence files, and interviews with the designer, the inspector, and other Forest personnel.

63 - Exhibit 01--Continued

V. Inspection and Maintenance History.

- A. Discuss schedule of operation, maintenance, and safety inspections; when they were last performed; signs of distress; and repair recommendations included in inspection reports.
- B. Describe when recent maintenance was performed, what was done, and how. Information may be available in the project file for the structure and from interviews with Forest personnel.

VI. Events Leading Up to Failure. Discuss all pertinent facts and events that occurred prior to the failure. The following are possible sources of information:

- A. Pictures and detailed descriptions of the remaining structure, including actual measurements of the breach.
- B. Inspection of the surrounding stream drainages.
- C. Interviews with eyewitnesses and key personnel (include personal statements if pertinent).
- D. Precipitation and streamflow records in the immediate area.
- E. Correspondence pertaining to the structure.
- F. Current safety evaluation report.
- G. Forest investigation and survey reports made immediately following the failure.
- H. Project feasibility report.
- I. Design records.
- J. Construction records, particularly as-built drawings, change orders, and the final construction report for variations from the design.
- K. Results of field and laboratory materials testing.
- L. Emergency action plan.
- M. Operation and maintenance plan.

63 - Exhibit 01--Continued

N. Maintenance inspection and accomplishment reports.

VII. Actions Taken Following the Failure. Obtain information from investigative reports made immediately following the failure and from interviews with Forest personnel or other involved personnel.

VIII. Discussion of Facts and Possible Cause(s) of Failure. This section is an analysis of the possible cause or causes of failure, supported by the facts and circumstances determined by the investigating team. This discussion provides the basis for the conclusions and recommendations.

IX. Conclusion. This section presents the team's conclusions regarding the following two items:

A. The probable cause of failure.

B. Whether the failure indicates deficiencies in standards or improperly followed Forest Service standards, criteria, procedures, or administrative practices.

X. Recommendations. Recommendations should cover the following areas:

A. Repair, replacement, or abandonment of the failed structure.

B. Methods for improving or ensuring proper application of Forest Service standards, criteria, procedures, and administrative practices.

C. Improvements in methods, procedures, and policies for planning, design, construction, and maintenance to avoid such failures in the future.

XI. Appendix. Include all supplementary material deemed significant to the investigation, such as the original environmental analysis report, contour or site maps, inundation maps, aerial and ground photos of the structure before and after failure, claims for damage or injury, the failure report by the District Ranger, geotechnical and engineering geology reports, hydrology reports, operation and maintenance inspection reports, safety evaluation reports, precipitation and streamflow records for the applicable area, local newspaper reports, statements of eyewitnesses or key personnel, pertinent drawings, and specifications.

64 - Distribution of Failure Report

Prepare a minimum of four copies of the report. Distribute approved copies as soon as possible, but not later than 3 months after failure, to the following:

1. District Ranger.
2. Forest Supervisor.
3. Regional Forester.
4. Washington Office through the Regional Forester.