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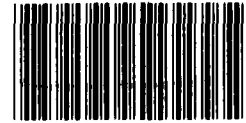
RESOURCES, COMMUNITY,  
AND ECONOMIC DEVELOPMENT  
DIVISION

B-211328

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by the Office of Congressional Relations.

The Honorable James A. McClure  
Chairman, Committee on Energy  
and Natural Resources  
United States Senate

RELEASED



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Dear Mr. Chairman:

Subject: Information on Unsafe Conditions at Specific Dams  
Located on Federal Lands (GAO/RCED-83-209)

Your June 8, 1983, letter asked that we provide you with information on unsafe conditions at specific dams located on Federal lands. In subsequent discussion with your office, it was agreed that we would provide you with the following information on four dams on National Park Service and Forest Service lands: (1) safety deficiencies identified, (2) the status of agency actions to correct the identified safety deficiencies, and (3) the reasons for failure, if any, to take corrective actions.

We found that the Bureau of Reclamation and a Corps of Engineers contractor had identified unsafe conditions at three National Park Service (Department of the Interior) dams located in the North Carolina portion of the Blue Ridge Parkway and at a privately owned dam operated under a permit issued by the U.S. Forest Service (Department of Agriculture) in Deerlodge National Forest, Montana.

Although local Park Service and Forest Service officials have been aware of the unsafe conditions at these dams for at least 4 years, minimal corrective action has been taken to repair the dams. Park Service and Forest Service officials acknowledged that the failure of the dams could result in the loss of life and/or property, but as of April 1983 they had not taken action to implement most Bureau and Corps recommendations, including interim actions to diminish the dangers posed by the dams pending their repair.

The Park Service has not taken action because while it agrees with the Bureau's assessment of the danger that the conditions of these dams present, it does not believe the conditions justify immediate repair, nor does it believe interim action, such as lowering the level of the lake, would diminish

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dangers enough to justify reducing the benefits provided by the dams.

The Forest Service has not required the dam owner to take all actions recommended by the Corps because the Regional Forester decided in 1980 that it would not be fair to hold the owners responsible until Federal or State funding became available to definitely prove the extent of the unsafe conditions. Forest Service headquarters officials agreed to review the adequacy of this decision after we brought it to their attention.

#### OBJECTIVES, SCOPE, AND METHODOLOGY

Prior to receipt of your request we were involved in a survey effort on dam safety to identify the adequacy and effectiveness of dam safety functions for Federal and non-Federal dams located on Federal lands. To respond to your request, we reviewed dam inventory records of the National Park Service and Forest Service to identify dams with unsafe conditions. We also obtained and analyzed pertinent agency dam safety policies, procedures, and regulations. We also held discussions with Park Service and Forest Service dam safety representatives at headquarters and regional and district offices to discuss the implementation of policies, procedures, and regulations.

We reviewed dam safety files and records for the four dams on Forest Service and Park Service lands and visited three Park Service-owned dams in the North Carolina portion of the Blue Ridge Parkway and one privately owned dam in Deerlodge National Forest, Montana, to observe conditions at the dams. These dams were selected for visits based on information that the dams might present safety problems.

The dam on Forest Service land was selected because it was privately owned and was listed in a Corps inventory of unsafe dams. The three National Park Service dams were selected because they were in close proximity to one another and listed by the Bureau as being in poor condition. On all our visits to the dams we were accompanied by a Parkway maintenance person, a forest ranger, or an engineer. We also interviewed the president of a water users association in Montana and State dam safety officials in Montana and North Carolina to discuss safety problems at specific dams. We did not obtain written comments from the Department of the Interior or the Department of Agriculture, but we did discuss the report contents with selected National Park Service and Forest Service officials.

Except for not obtaining written Department comments, our review was done in accordance with generally accepted government auditing standards. Our work was conducted between January and June 1983.

IMPORTANCE OF DAM SAFETY

Dams can present significant dangers to people and property. For example, the 1976 collapse of the Teton Dam in Idaho killed 11 people and caused an estimated \$400 million in property damages. More recently, the 1982 failure of the Lawn Lake Dam in Rocky Mountain National Park took two lives, left two people missing, and caused an estimated \$31 million in damages to Federal, State, and private property.

In April 1977 President Carter issued a memorandum to all Federal agencies involved with dams, directing them to assess the adequacy of their dam safety programs. The President also directed the Federal Coordinating Council for Science, Engineering, and Technology to develop proposed Federal dam safety guidelines. In an October 1979 memorandum to all Federal agencies involved with dams, President Carter directed the agencies to adopt and implement the guidelines, as applicable. The Coordinating Council identified 19 Federal agencies with dam safety responsibilities (see enclosure I).

SAFETY CONDITIONS AT THREE  
NATIONAL PARK SERVICE DAMS

The National Park Service owns and operates 13 dams within the Blue Ridge Parkway, which extends through Virginia and North Carolina. In May 1979, as part of the Federal safety evaluation of existing dams, the Bureau of Reclamation evaluated safety conditions at four of these dams<sup>1</sup> which had the potential to cause loss of life if they failed. Based on its evaluations, the Bureau classified the overall safety condition of three of the four dams--Bass Lake, Trout Lake, and Price Lake--as poor. The Bureau defined "poor" condition as:

"A potential dam safety deficiency for normal operating conditions is recognized. Major damage has occurred at one or more of the essential elements or may be anticipated to occur during normal operating conditions."

According to Bureau dam safety classifications, a dam in "poor" condition could fail under normal operating conditions, whereas a dam in "fair" condition would fail only during an event (such as a major flood) with a remote chance of occurring. The Chief of the Bureau's Division of Dam and Structural Safety said a "poor" classification falls between the Corps' dam safety ratings of "unsafe" and "emergency."

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<sup>1</sup>The Bureau performs an independent safety examination and dam analysis for other Department of the Interior agencies on request.

When the Bureau inspected the dams in May 1979, its inspectors were accompanied by Park Service personnel. The Bureau notified the Park Service that the three dams were in poor condition by issuing interim reports in 1980 and final reports in 1982. Despite the Bureau's concern about the poor condition of the dams and the potential danger to people living downstream, the Park Service has not taken interim action to diminish the dangers that the Bureau identified pending Park Service acceptance and implementation of the actions and repairs recommended by the inspection teams. The Park Service has not taken interim corrective action because it believes interim action, such as lowering the level of the lakes, would not diminish dangers enough to justify the loss of benefits provided by the dams. The Park Service agrees with the Bureau's assessment of the dangers posed by the conditions of the dams, but it does not believe the conditions of the dams justify immediate corrective action.

### Trout Lake Dam

Trout Lake Dam is an earth-fill dam 26 feet high and 300 feet long that impounds a 146-acre-foot<sup>2</sup> reservoir used for recreation. The Park Service built the dam in 1951 on the site of an earlier, privately constructed dam that had failed by overtopping. The streambed area downstream from the dam is heavily used for recreation, and people live in low-lying areas a few miles downstream.

A Bureau safety evaluation team, accompanied by Park Service personnel, examined the dam in May 1979 and again in August 1981. In its final report, dated August 12, 1982, the Bureau stated that the Park Service dam was classified in poor condition because

--the spillway<sup>3</sup> was seriously inadequate and could not pass even a 100-year flood (a flood of such magnitude that it would probably occur every 100 years) without overtopping, which would probably cause a dam failure, and

--an unexplained depression 6 feet in diameter had appeared on the downstream face of the dam.

The Bureau recommended that the Park Service take the following actions to obtain information needed to upgrade the classification of the dam to "fair":

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<sup>2</sup>The amount of water needed to cover 1 acre 1 foot deep, or 325,857 gallons.

<sup>3</sup>A passage for surplus water to run over or around a dam.

--Determine the risk and downstream hazard for different floods and their frequencies up to and including the maximum probable flood (MPF)<sup>4</sup>--the spillway could pass only 6 percent of the MPF outflow.

--Sample, test, and analyze the dam embankment and foundation and install seepage-measuring devices.

During our April 1983 visit to the dam, we observed that the Park Service had done little maintenance on the dam. Brush and trees were growing on the downstream face of the dam, which also contained animal burrows. The creek bed was washed out around the primary spillway outlet, and the concrete surrounding the outlet was cracked and crumbling. In June 1983 the Chief of Maintenance for the Parkway told us that maintenance personnel repaired these items after our visit.

The Chief of Maintenance told us that the agency plans to have a study done in the fall of 1983 to determine the necessary spillway size and find alternative ways to modify the dam to prevent failure from overtopping. The Park Service plans to transfer funds to the Bureau, which will negotiate with an architect-engineer (A&E) firm to do the study. The Park Service selected Trout Lake as the only dam on which to do such a study at this time, because the spillway is the least adequate of the three dams classified as poor--Trout Lake Dam, which is 32 years old, would fail during a 40-year flood. After the study is completed and the A&E firm makes its recommendations, the Park Service plans to determine which alternative to pursue and obtain the necessary funding. The Chief of Maintenance told us the Park Service has no funds budgeted for repairing the dam; thus, after selecting an alternative, the Park Service will need to budget and request the funding to make any needed repairs.

Until such time as the Park Service makes the needed repairs to the spillway, it will have done little to minimize the dangers identified by the Bureau. Because of the dam's classification as poor and the potential threat to the people living downstream, the Bureau, in its transmittal letter to the report, recommended that the Park Service consider breaching and removing the dam instead of repairing it. Another alternative other agencies commonly use to reduce the danger posed by an unsafe dam is to lower or drain the lake until repairs can be made. Although the Bureau recommended that the Park Service select and implement its resolution of the problems without delay, the Park Service has neither breached the dam, lowered the level of the lake behind the dam to reduce the potential

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<sup>4</sup>The greatest flood that could possibly occur at a specific point on a given stream, given local weather and geographic conditions.

hazard until it can repair the dam, nor moved swiftly to make the recommended repairs.

The Park Service does not believe the condition of the dam justifies immediate corrective action, and it believes interim action, such as lowering the level of the lake, would not diminish dangers enough to justify the loss of recreation benefits provided by the dam. However, since our April visit, the Park Service has increased the frequency of maintenance checks, to at least once a month and after any heavy rainfall, and it has begun developing an early warning system.

#### Bass Lake Dam

Bass Lake Dam is an earth-fill dam constructed by a private party in 1936. The dam is 30 feet high and 500 feet long and impounds a 270-acre-foot recreation lake. People live in the low-lying area downstream from the dam, and the area immediately below the dam is being developed for residential housing.

In May 1979 a Bureau safety evaluation team, accompanied by Park personnel, examined the dam, and in August 1981 personnel from the Bureau's Structural Review Branch reexamined the dam. In its final report, dated August 24, 1982, the Bureau stated that the Park Service dam was classified in poor condition for the following reasons:

- The water outlet gate was reported to be inoperable..
- Large trees and bushes were growing on the embankment, and water was seeping through the embankment.
- The spillway could not pass the MPF without the dam being overtopped, resulting in a likely dam failure (the spillway can pass only 15 percent of the MPF outflow).
- The stability of the dam could not be verified without doing sampling and testing.
- The spillway inlets might become blocked during flooding.

The Bureau's report stated that the Park Service would need to take several actions before the dam could be reclassified as satisfactory. More specifically, the Bureau recommended that the Park Service:

- Examine the outlet structure and rehabilitate it as needed.
- Conduct a sampling and testing program to assess the potential for failure by piping or structural instability (piping occurs when uncontrolled seepage washes material out of a dam, creating voids, or "pipes").

- Install measuring devices to monitor the rate of seepage through the dam.
- Study the effects of floods up to and including the MPF to determine risks to life and property.
- Install a log boom (line of connecting, floating timbers) to ensure that the spillway inlet does not become plugged with debris.
- Fill in animal burrows in the dam.
- Remove trees, roots, and brush on the dam.

The Park Service had not implemented any of the Bureau's recommendations at the time of our visit. We observed heavy brush on the dam and numerous animal burrows in the dam itself and verified that the dam had no log boom. In June 1983 the Parkway Chief of Maintenance told us that the Park Service had made some repairs since our visit. He said that maintenance personnel had removed vegetation and had filled in animal burrows. The Park Service also plans to install a log boom and seepage-monitoring devices later this year and arrange to have the Bureau examine the outlet structure in July 1983 under a transfer of funds from the Park Service.

The Chief of Maintenance also told us the Park Service plans to arrange for studies at some time in the future on the remaining items identified in the Bureau report, but he did not know whether funds would be available. According to the Chief, the studies would identify the problems and repair alternatives, but the actual repair of dam deficiencies would be deferred until the Park Service selected an alternative, budgeted the work, and requested funding.

As with Trout Lake Dam, until such time as the Park Service makes the needed repairs at Bass Lake Dam, it will have done little to minimize the dangers identified by the Bureau. The Bureau suggested that the Park Service consider breaching and removing the dam rather than repairing it. Another alternative other agencies commonly use to reduce the danger posed by an unsafe dam is to lower or drain the lake until repairs can be made. However, even though the Bureau contends that operating this dam under normal conditions creates the potential for loss of life, the Park Service does not believe breaching the dam or lowering the lake is warranted. It does not believe either that the condition of the dam justifies immediate repair or that interim action, such as lowering the lake level, would diminish dangers enough to justify the loss of historic benefits provided by the dam.

Price Lake Dam

Price Lake Dam is an earth-fill dam with a concrete center spillway section. Dam construction was completed in 1963. The dam, which is 30 feet high and 400 feet long, impounds a 350-acre-foot recreation lake. The dam is immediately above a picnic grounds and fishing waters, and people live in low-lying areas a few miles downstream.

In May 1979 a Bureau safety evaluation team, accompanied by Park Service personnel, inspected Price Lake Dam. In its final report, dated May 27, 1982, the Bureau said the Park Service dam was classified in poor condition for the following reasons:

- A potential for piping (voids caused by uncontrolled seepage) existed behind the spillway abutment walls.
- The dam could not safely pass the MPF (the spillway can pass only 40 percent of the MPF).
- The 100-year flood encroaches on the dam freeboard (the area between the high water mark and the crest of the dam) and adds to the possibility of overtopping from severe waves or plugging the spillway.

The Bureau report recommended that the Park Service take the following actions to bring the condition of the dam to "fair":

- Continually monitor seepage flows.
- Determine the earthquake risk and earthquake effects.
- Study the effects of the MPF and one-half the MPF to determine damage potential and risk to life.
- Examine the outlet conduit and gate valve every 6 years.
- Install a log boom and fill animal burrow holes.
- Sample and analyze the properties of the embankment and foundation to determine the potential for earthquake failure.

The Park Service has long been aware of a seepage problem at Price Lake Dam. The dam has been repaired twice to stop excessive seepage. When the reservoir was filled for the first time in 1958, seepage appeared which required extensive additional work to repair. In 1977, water passing through the dam washed out fill material and created a depression in the dam. To remedy the problem the Park Service had to excavate and replace part of the dam. In May 1978 the North Carolina State Dam Safety Office expressed its concern to the Corps that the



Park Service's remedial actions had not corrected the hazard presented by the condition of the dam. In July 1978, the Corps interceded with Park Service officials, urging them to correct the reported unsafe condition.

At the time of our April 1983 visit to the dam, we observed considerable silt at one seepage monitoring box. The box was full of silt, and silt trailed along the watercourse leading from the seep. We observed silt at a second seep as well. According to the Dam Safety Engineer for the State of North Carolina and the Chief of the Bureau's Division of Dam and Structural Safety, the silt conditions we observed at this dam were an indication of piping--voids created by uncontrolled seepage. However, the Parkway Chief of Maintenance disagreed with this assessment and told us the amount of silt was minor and not a cause for concern. We noted during our visit that the dam had no log boom and that animal burrows were present on the face of the dam.

The Parkway Chief of Maintenance told us that every 2 weeks Park Service personnel are monitoring seepage flows through the dam; also, they will install a log boom and fill animal burrows at the dam by the fall of 1983. He said the Park Service will examine the outlet conduit and gate valve every 6 years and make a flood and earthquake analysis at some future time.

As with the other two dams, the Park Service does not believe that it is justified to either take immediate corrective action or to lower the lake level.

SAFETY CONDITIONS AT A  
DAM ON FOREST SERVICE LAND

Delmoe Lake Dam is a privately owned and operated earth-fill dam in the Deerlodge National Forest, Montana. It is 60 feet high and 290 feet long and normally impounds 6,800 acre-feet of irrigation water. The dam was constructed about 1914 by a private party and now is operated by a water users association under a permit that the Forest Service issued in 1947. According to a Corps-funded study, a failure of the dam could extensively damage part of an interstate highway and endanger many lives.

In June 1979 an engineering firm under contract to the Corps inspected the dam as a part of a national dam inspection program. The inspectors rated the dam as "unsafe" because the spillway was inadequate. Floods much smaller than the MPF would overtop the dam and cause it to fail. The dam would fail when only 22 percent of the MPF entered the reservoir. The report also cited other conditions as additional problem areas affecting safe project operations:

--The spillway had no log boom to catch debris.

- The spillway was unlined, which could result in erosion.
- The spillway retaining dike could erode and fail, which would allow spillway water flows to reach the dam embankment.
- The riprap<sup>5</sup> on the upstream face of the dam was inadequate, allowing wave erosion.
- Seepage patterns and evidence of silt suggested that the stability of the downstream slope was inadequate.

The inspection report stated that the dam owner would need to take several actions to maintain or improve project safety. These actions are summarized as follows:

- Immediately develop and install a downstream warning system for use in the event of dam overtopping or structural failure.
- Install a spillway log boom.
- Reinforce and raise, as required, the spillway dike.
- Inspect the entire length of both outlet conduits, repairing as necessary.
- Repair or replace outlet valves as required.
- Repair riprap on the upstream face of the dam.
- Remove all brush and trees from the dam.
- Régrade the downstream toe of the dam and provide a toe berm with filter protection.
- Conduct engineering studies to determine the detailed MPF and modify the spillway to safely handle the MPF.
- Install instruments to determine soil characteristics and strengths of the dam embankment and foundation.
- Conduct a seismic study.
- Conduct a stability analysis and modify the embankment section as required.
- Conduct periodic inspections by qualified engineers at not longer than 5-year intervals.

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<sup>5</sup>A layer of rock placed on an embankment slope to prevent erosion.

--Install and monitor seepage weirs.

The president of the water users association that owns the dam told us the association was not going to implement most of the report recommendations because it disagrees with them. He said the association had repaired the riprap on the upstream face and removed the brush and trees from the dam.

During our April 1983 visit to the dam, we were unable to verify that the upstream riprap had been repaired because of snow on the dam. We did observe that concrete structures for flashboards had been built recently on the dam spillway (flashboards are heavy planks which are placed across the spillway to raise the level of the reservoir). Forest Service personnel told us the use of flashboards reduces the spillway capacity and increases the hydraulic pressure on the dam. The president of the water users association acknowledged that the association had built the concrete structures for flashboards but said it did not plan to use them.

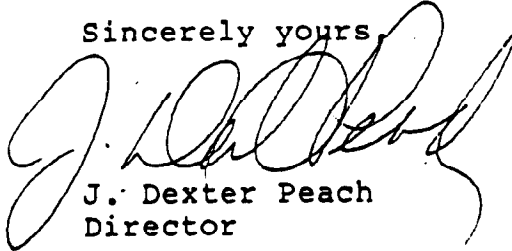
The Regional Forester told us the Forest Service agreed with the inspection report recommendations, but he believed the inspection criticisms were unfair to the dam owners. He said the inspection report classified the dam as unsafe based on indicators rather than definite proof that a problem existed. He believed that Federal or State funding to properly address the problem was necessary. The Regional Forester decided that, until such funds are provided, it was neither prudent nor advisable to take actions against the permittees. We were told by the Forest Service Associate Deputy Chief for National Forest System that the regional position had not been reviewed by Forest Service headquarters personnel before we brought it to their attention. After our discussion with headquarters personnel, they told us they would review the regional position to determine if it is still valid and if action should be taken against the water users association.

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As requested by your office we did not obtain Department of the Interior or Department of Agriculture comments on the information presented in this report. However, we did discuss the report contents with Park Service and Forest Service dam safety officials and their comments are included in the report where appropriate.

As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of the report until 10 days from the date of its issuance. At that time we will send copies to interested parties and make copies available to others upon request.

Sincerely yours,

A handwritten signature in black ink, appearing to read "J. Dexter Peach". The signature is fluid and cursive, with a large initial "J" and a long, sweeping underline.

J. Dexter Peach  
Director

FEDERAL AGENCIES WITH RESPONSIBILITIES  
FOR DAM SAFETY

Department of the Army:  
Corps of Engineers

Department of Agriculture:  
Agricultural Research Service  
Agricultural Stabilization and Conservation Service  
Farmers Home Administration  
Forest Service  
Rural Electrification Administration  
Soil Conservation Service

Department of the Interior:  
Bureau of Reclamation  
Bureau of Indian Affairs  
Bureau of Land Management  
Fish and Wildlife Service  
National Park Service  
Mining Enforcement and Safety Administration<sup>1</sup>  
Bureau of Mines  
Geological Survey

Nuclear Regulatory Commission

International Boundary and Water Commission

Federal Energy Regulatory Commission

Tennessee Valley Authority

Source: "Improving Federal Dam Safety," a report of the  
Federal Coordinating Council for Science Engineering  
and Technology, November 15, 1977.

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<sup>1</sup>Currently the Mining Safety and Health Administration,  
Department of Labor.