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CRS Report for Congress

Aging Infrastructure: Dam Safety

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Aging Infrastructure: Dam Safety

Summary

While dams have multiple benefits (balanced against financial and environmental costs), they can also present a risk to public safety and economic infrastructure. This risk stems from two sources: the possibility of a dam failure and the damage it would cause. Although dam failures are infrequent, age, construction deficiencies, inadequate maintenance, and seismic or weather events contribute to the possibility. To reduce the risk, regular inspections are necessary to identify potential problems. Corrective action can then be taken to remedy those deficiencies. Congress is often called upon to fund remedial actions, as a way to prevent the larger catastrophes. The 110th Congress will likely see proposals for improving dam safety and may oversee existing safety programs.

To identify deficiencies that could cause dam failures, the federal government established inspection requirements for the nation's federal dams. Once deficiencies are identified, most agencies finance repairs through their operation and maintenance accounts. Funding mechanisms vary for larger rehabilitation activities. At the Bureau of Reclamation, for example, most larger repairs are conducted with annual appropriations to its dam safety program. At some other agencies, dam rehabilitation must compete with other construction projects for funding.

The federal agencies with dam safety responsibilities include the Tennessee Valley Authority, the Federal Energy Regulatory Commission (FERC), and the Departments of Agriculture, Defense, Energy, the Interior, Labor, and State. At nonfederal dams, safety is generally a state responsibility, though some federal assistance has been provided. The National Dam Safety Program, which is authorized through FY2011 by P.L. 109-460, helps states improve their dam safety programs and train inspectors. In addition, FERC and the Department of Labor's Mine Safety and Health Administration require regular inspections at the nonfederal dams within their jurisdiction. Even so, there are concerns that most state dam safety programs have inadequate staff and funds to effectively inspect or monitor all of the dams for which they are responsible. Further, there are concerns that states, local governments, and other nonfederal dam owners may not have the financial resources to maintain and rehabilitate their dams.

The collapse of the I-35W bridge in Minnesota highlighted the potential for unexpected infrastructure failure. This may result in a review of the safety of other elements of our nation's inventory of critical infrastructure such as dams, levees, tunnels, and bridges — and a call for additional funding to resolve any deficiencies. Congress has periodically been urged to provide federal support for rehabilitation work at nonfederal dams. Demand for such assistance is likely to increase, but currently no federal policy describes the conditions under which federal funding is appropriate, nor has Congress established criteria for prioritizing funding among nonfederal projects.

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Introduction[1]

Dams provide broad economic and social benefits, including flood control, hydroelectric power, recreation, navigation, and water supply for drinking, irrigation, and industrial uses. Dams also entail financial costs (for construction and for operation and maintenance) and sometimes environmental costs (e.g., loss of riverine habitat). Dams also can present a risk to public safety, local and regional economies, and the environment.

Prior to September 11, 2001, Congress had expressed an increasing interest over several decades in dam safety. In recent years, congressional interest has focused largely on securing and protecting U.S. dams and water storage facilities from terror attacks. Hurricane Katrina and the disastrous failure of levees that once protected New Orleans, however, have renewed congressional interest in the structural integrity of major water infrastructure.

The modern period of congressional concern began in the 1970s with dam failures that resulted in loss of life and billions of dollars in property losses.[2] Congress and private groups interested in dam safety noted that, while states and localities are responsible for the maintenance and safety of 95% of the nation's dams, large numbers of older dams lacked the maintenance needed to guarantee operational integrity and prevent failure. These aging dams represented then — and continue to present — a potential hazard to downstream populations.

A first essential task was to develop accurate data on the nation's dams: their number, type, structural condition, and other information useful for making decisions about dam safety policy and priorities. This was achieved in 1972 with the creation of the National Inventory of Dams (NID)[3] — a computerized, periodically updated[4] catalogue of U.S. dams, maintained by the U.S. Army Corps of Engineers, that

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[1] This report was originally written by Kyna Powers with assistance from Richard Sachs.

[2] In 1972, failure of a mine tailings dam at Buffalo Creek, WV, flooded a 16-mile valley and killed 125 people. In 1976, Teton Dam (ID) failed, causing $1 billion in property damage and killing 11 people. Kelley Barnes Dam (GA) failed in 1977, killing 39 people and causing an estimated $2.8 million in damage. More recently, the 2003 failure of the Silver Lake Dam (MI) caused more than $100 million in damage, and the Kaloko Dam (HI) failed in March 2006, killing 7 people.

[3] The NID was first authorized in the National Dam Inspection Act of 1972 (P.L. 92-367) and later consolidated under the Water Resources Development Act of 1996, National Dam Safety Program Act (P.L. 104-303, Title II §215; 33 U.S.C. §467). The NID is available at [http://crunch.tec.army.mil/nid/webpages/nid.cfm].

[4] The NID was last updated in February 2005.

presently lists 79,777 public and private dams.[5] For the purposes of the NID, a dam is defined as "any artificial barrier that has the ability to impound water ... for the purpose of storage or control of water" that (1) is greater than 25 feet in height with a storage capacity of more than 15 acre-feet[6] (af), (2) is greater than 6 feet in height with a storage capacity of more than 50 af, or (3) poses a significant threat to human life or property should it fail.

Federal and nonfederal dams in the NID were constructed for a variety of purposes. By far, the greatest number of dams — more than 40% — were constructed primarily for recreational purposes. Other purposes served by dams, in descending order, include fire protection (20.0%), flood control (19.8%); irrigation (11.8%); water supply (9.3%); fish and wildlife (4.2%); hydroelectric (2.8%); debris control (2.0%); mining (tailings dams; 1.8%); and navigation (0.1%). Many dams serve multiple purposes. For approximately 9.7% of the dams in the NID, the purposes are unspecified.[7]

Over 56% of dams in the NID are privately owned. (See **Figure 1**.) Slightly more than 20% are owned and operated by local governments. About 4.8 % of dams are owned by states and 2.4% by public utility companies. The federal government owns only 4.7% of all NID dams, but this small number (3,771) includes the dams many Americans view as iconic: the great hydroelectric dams of the West, like Grand Coulee and Hoover.[8] The ownership of some NID dams is not indicated in the database because that information was not reported to the Corps.

While the federal government owns less than 5% of NID dams, more than 30% of all dams in the NID inventory were funded, designed, or constructed with federal resources, most of them through the Department of Agriculture's Natural Resources Conservation Service (NRCS). NRCS's involvement in dam construction stems primarily from the Watershed Protection and Flood Prevention Act of 1954,[9] which authorized it to cooperate with states and local agencies to undertake works of improvement for flood prevention and other purposes. Under this act and an earlier law to build projects in 11 designated watersheds, NRCS has helped build more than 10,000 upstream flood control dams beginning in 1948. These are generally relatively small dams owned by public or private entities other than the federal

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[5] Other sources cite different figures; the online NID data is used throughout this report unless otherwise specified. When appropriate, these data are referred to as *NID Data, 2006.*

[6] One acre-foot of water is the amount of water that will cover an acre of land to a depth of one foot, approximately 326,000 gallons.

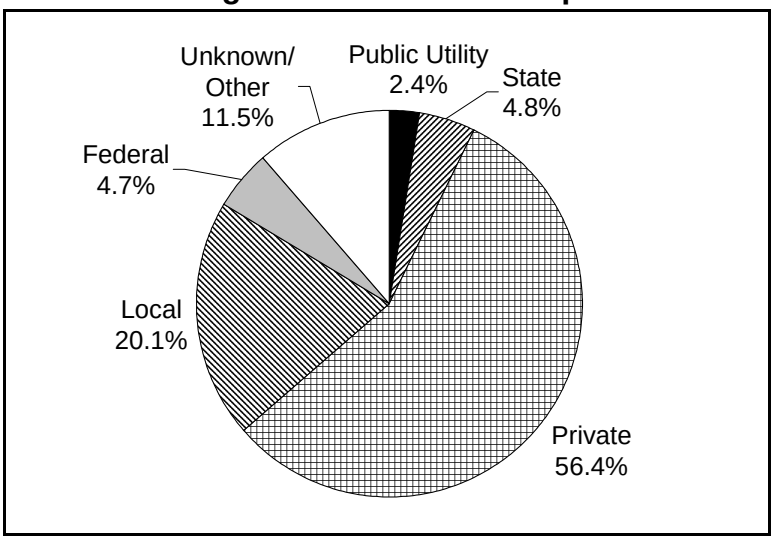
[7] *NID Data, 2006*.

[8] U.S. Dept. of Homeland Security, Federal Emergency Management Agency, *The National Dam Safety Program Fiscal Years 2000-2001* (Washington, DC: December 2001), p. 6 (Hereafter, cited as *FEMA report*, 2000-2001).

[9] P.L. 566 (83rd Cong.).

government. These nonfederal entities are principally responsible for the dams' operation, maintenance, and security.[10]

Figure 1. Dam Ownership



Excluding the NRCS, which does not administer any dams, nine federal agencies operate, or regulate dam safety at approximately 8,500 sites (including non-NID dams).[11] Six federal agencies operate NID dams: the Department of Defense (862), Department of the Interior (751), Department of Agriculture (326), Tennessee Valley Authority (83), Department of Energy (16), and State Department (7). In addition, three agencies regulate but do not operate NID dams: FERC regulates 1,775 hydropower dams; the Department of Labor's Mine Safety and Health Administration regulates 745 dams; and the Nuclear Regulatory Commission regulates 11 dams. While dams administered by one agency are not generally regulated by another agency, there are cases where private hydroelectric projects, regulated by FERC, are located at federal dams.

Congressional interest in dam safety generally falls into three areas: (1) dam security and the potential for acts of terrorism at major U.S. dam sites; (2) prevention of potential dam failures due to structural deficiencies; and (3) recovery from dam failures. This report focuses on the second category, because it is a topic that will likely become more important as the nation's dams age; further, it has gained additional attention in the aftermath of Hurricane Katrina.

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[10] U.S. Dept. of Agriculture, Natural Resources Conservation Service, *A Report to Congress on Aging Watershed Infrastructure* (Washington, DC: June, 2000), pp. 1-2. Hereafter cited as *NRCS Report*, 2000.

[11] *FEMA Report*, 2000-2001, p. 8-9. This figure differs from the NID-based data on dam ownership shown in **Table 2**. Some of these dams may not qualify for inclusion in the NID.

Dam Failure Risk

While dams have multiple benefits, their failure or misoperation could threaten public safety, local and regional economies, and the environment. Risk has two primary components: (1) the damage and deaths associated with dam failure or misoperation, and (2) the likelihood of such a failure.

Potential Damage

To quantify the potential harm associated with a dam's failure, the Interagency Committee on Dam Safety prepared a hazard potential classification system.[12] As described in **Table 1**, the three hazard ratings (low, significant, and high) do not indicate the likelihood of failure, but reflect the *amount and type of damage* that a failure would cause. Hazard ratings for each dam are included in the NID. From 2000 to 2006 the number of high-hazard dams increased from 9,921 to 11,811. According to the Federal Emergency Management Agency (FEMA), development below dams is the primary factor increasing dams' hazard potential.[13]

Table 1. Hazard Level: Description and Number

Hazard Classification	Result of Failure or Misoperation	Number of Dams
High Hazard	— Loss of life is probable. — Other economic or environmental loss possible, but not necessary for this classification.	11,811
Significant Hazard	— No probable loss of human life. — Could result in economic loss, environmental damage, and disruption of lifeline facilities, etc.	13,407
Low Hazard	— No probable loss of human life. — Few economic or environmental losses; losses are generally limited to the owner.	54,349

Source: *NID Data*, 2006. The hazard level of 210 dams was not reported to the Corps for inclusion in the NID.

Likelihood of Failure

While catastrophic dam failures are fairly infrequent, states reported 1,090 dam safety incidents — including 125 failures — between 1999 and 2004.[14] A number

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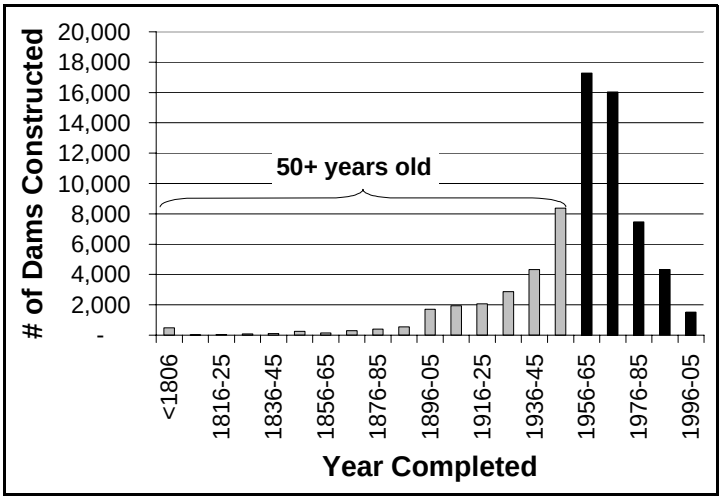
[12] Interagency Committee on Dam Safety. *Federal Guidelines on Dam Safety: Hazard Potential Classification System for Dams (FEMA 333).* (October 1998, reprinted January 2004).

[13] U.S. Dept. Of Homeland Security, Federal Emergency Management Agency. *Dam Safety and Security in the United States: A Progress Report on the National Dam Safety Program in FY 2002 and 2003 (FEMA 466)*, April 2004.

[14] National Performance of Dams, Dam Incidents Statistics Calculator, at [http://npdp. (continued...)

of factors, including age, construction deficiencies, inadequate maintenance, and seismic or weather events, contribute to the likelihood of dam failure. For example, some failures are the direct result of flows larger than the dams were built to withstand. With the exception of seismic or weather events, age is a leading indicator of dam failure. In particular, the structural integrity and operational effectiveness of dams may deteriorate with age, and some older dams may not comply with current dam safety standards established in the 1970s.[15] Overall, more than 30% of all dams in the NID are at least 50 years old, the designed lifespan of many dams, and more than 17,000 will cross this threshold over the next 10 years. (See **Figure 2.**) According to the Association of State Dam Safety Officials, in 2003, approximately 3,243 U.S. dams had deficiencies that left them more susceptible to failure.[16] In 2000, another report estimated that more than $30 billion will be needed to repair and rehabilitate the nation's aging dams.[17]

Figure 2. Construction of Federal and Nonfederal Dams



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[14] (...continued)
stanford.edu/index.html]. This database provides a low estimate of dam safety incidents, since reporting is voluntary; few private or local dams are included.

[15] Eugene P. Zeizel and Robert H. Dalton, "Aging of Dams and Urban Development Require Major Dam Rehabilitation Efforts: A Growing Problem in Floodplain Management," presented at the Annual Conference of the Association of State Flood Plain Managers, Charlotte, NC (June 3-8, 2001). This report indicated that 85% of all U.S. dams (not just NID dams) will be more than 50 years old by 2020.

[16] Association of State Dam Safety Officials, *State by State Statistics on Dams and State Safety Regulation , 2004.* See [http://www.damsafety.org/documents/Word/2004Stats.doc]. In 2003, FEMA reported that there were more than 2,600 unsafe dams based on a report by the American Society of Civil Engineers entitled *The 2003 Progress Report for America's Infrastructure* (September 4, 2003).

[17] Raul F. Silva, "A Methodology and Estimate of the National Cost for Dam Safety Rehabilitation," presented at a conference of the Association of State Dam Safety Officials, Providence, RI (September 27, 2000).

Managing Dam Safety

Following dam failures at Buffalo Creek (WV, 1972), Teton Dam (ID, 1976), and Kelly Barnes Dam (GA, 1977), legislative and executive actions established a program for monitoring the nation's dams and set guidelines for dam safety at federal facilities. Subsequent legislation promotes state dam safety programs and facilitates rehabilitation activities at federal and some nonfederal dams.

Federal Management

Through legislative and executive actions, the federal government has become involved in multiple areas of dam safety. First, in 1972, Congress passed the National Dam Inspection Act (P.L. 92-367), which authorized the Corps to undertake a program of national dam inspections and to establish the National Inventory of Dams. Activities under this law provided the impetus for broad scale monitoring and a centralized location for information on many of the nation's dams.

In 1977, following the failure of Teton Dam and Kelly Barnes Dam, President Jimmy Carter ordered a review of federal dam safety activities, and subsequently the *ad hoc* Interagency Committee on Dam Safety released safety guidelines for dams regulated by federal agencies.[18] The *Federal Guidelines for Dam Safety* establish a basic structure for agencies' dam safety programs. In general, the guidelines encourage federal agencies and dam owners regulated by federal agencies to abide by uniform safety standards. They direct that each agency with dam safety responsibilities have a dam safety officer and that the agencies coordinate with other agencies. They also establish guidelines for staff training, periodic evaluations, documenting dam safety activities, and operation and maintenance.

Congress also enacted the Reclamation Safety of Dams Act (P.L. 95-578, 43 U.S.C. §508) in 1978 to set more detailed guidelines for the Bureau of Reclamation.[19] This act authorizes Reclamation to preserve the structural stability of its dams and related facilities by performing modifications.

State Dam Safety Programs

States have primary responsibility for the safety of 95% of the nation's dams. According to the Association of State Dam Safety Officials, every state but Alabama and Delaware[20] has a dam safety regulatory program.[21] Typically these programs include "(1) safety evaluations of existing dams, (2) review of plans and

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[18] Interagency Committee on Dam Safety and U. S. Dept. of Homeland Security, Federal Emergency Management Agency, *Federal Guidelines for Dam Safety* (June 1979 reprinted April 2004).

[19] While the Bureau of Reclamation manages the most dams, the U.S. Army Corps of Engineers manages the most NID dams.

[20] Alabama has 1,403 dams and Delaware has 61 dams.

[21] Association of State Dam Safety Officials, *State by State Statistics on Dams and State Safety Regulation — 2004.*

specifications for dam construction and major repair work, (3) periodic inspections of construction work on new and existing dams, and (4) review and approval of emergency action plans."[22] Many state dam safety programs are poorly funded. In 2004, state budgets for dam safety averaged $742,000,[23] ranging from less than $50 per state-regulated dam (IA, IN, KS, MS, OK and TX) to more than $16,000 per dam regulated by Puerto Rico.[24]

Federal Support for State Dam Safety Programs. While federal activities in the 1970s generally focused on increasing dam safety information and strengthening requirements at the nation's federal dams, subsequent legislation began to address the safety of nonfederal dams. In 1996, Congress created the National Dam Safety Program (NDSP)[25] and assigned responsibility for administering it to FEMA. The NDSP is the nation's principal dam safety program; previously, there was no comprehensive national effort devoted to nonfederal dam safety and the safety of downstream populations.

Management of the NDSP. The NDSP is a mechanism for federal and state cooperation that includes an Interagency Committee on Dam Safety (ICODS) with the Director of FEMA as its chair. ICODS, which was initially formed in 1980, is composed of representatives from FERC, the International Boundary Water Commission, the Nuclear Regulatory Commission, the Tennessee Valley Authority, and the Departments of Agriculture, Defense, Energy, the Interior, Labor, and Homeland Security (FEMA). ICODS is responsible for coordinating information exchange among federal dam safety agencies.[26]

The act also established a National Dam Safety Review Board (NDSRB) consisting of five representatives appointed from federal agencies, five state dam safety officials, and one representative from the U.S. Society on Dams. All the representatives are appointed by the director of FEMA. This board advises the FEMA director on dam safety issues, including the allocation of grants.[27]

Assistance to States. The National Dam Safety Act establishes two state assistance programs with budget authorizations. These include the following:

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[22] Ibid.

[23] Average of reported state budgets; excludes Delaware, Louisiana, Michigan, Nevada, South Carolina, and South Dakota, which did not report their dam safety budgets. Association of State Dam Safety Officials, *State by State Statistics on Dams and State Safety Regulation — 2004.*

[24] Ibid.

[25] National Dam Safety Program Act, P.L. 104-303, Title II §215 (33 U.S.C. §467).

[26] P.L. 107-310, ICODS' authority is limited to coordination among federal entities only.

[27] National Dam Safety Program Act, P.L. 104-303, Title II §215 (33 U.S.C. §467)

- Training for State Inspectors. At the request of states, FEMA provides technical training to dam safety inspectors.

- Assistance to State Dam Safety Programs. States working toward or meeting minimal requirements are eligible for assistance grants. The objective of these grants is to upgrade state programs using the *ASDSO Model State Dam Safety Program* as a guide. The model state dam safety program includes a recommendation that dams be inspected at least every five years.

Allocation of state assistance grants is determined by the NDSRB and the director of FEMA. In FY2000 and FY2001, FEMA distributed $8 million to states with existing dam safety programs to assist with buying equipment, conducting dam inspections, and developing Emergency Action Plans (EAPs). This money is not available for rehabilitation activities.

Reauthorization of the NDSP. The NDSP was reauthorized in 2002 as the Dam Safety and Security Act of 2003 (P.L. 107-310, 43 U.S.C. §467). P.L. 107-310 made several changes to the existing program, including the addition of (1) a new goal for the program that encompasses dam security; (2) a goal for states to obtain authority to require owners to improve security; (3) a limitation on the authority of ICODS to exchange information among federal entities only; (4) a clearer definition of the role of the NDSRB in relation to the states, and encouragement to maintain an effective national program to enhance dam safety and protect human life and property; and (5) the addition of two new research components on (a) information technology to store, query, and distribute dam safety data related to dam performance (failures, large storm events, earthquakes, etc.), and (b) dam safety vulnerability assessments and management of sensitive dam information.

P.L. 107-310 authorized the program for an additional four years and increased the total authorized funding to $8.6 million annually through FY2006 with funds available until expended. Specified funding authorizations include an increase for research from $1.0 million to $1.5 million for each fiscal year. The program retains the authorized levels for dam safety training at $500,000, and increases authorized funding for staff from $400,000 to $600,000 for the same time period.

The enactment of P.L. 109-460 authorized an average of $9.96 million annually for FY2007 through FY2011 for FEMA-administered research, dam safety training, and maintaining the NID.

Reducing Dam Failures

As the nation's dams age, they are likely to develop various deficiencies. For example, dams' foundations can show signs of seepage, cracking, and movement. To prevent failure or misoperation, these deficiencies must be identified and corrected.

Identifying Unsafe Dams

The first step toward rectifying dam-safety issues is to identify safety deficiencies. Such deficiencies are often identified by engineers during informal inspections, or during formal inspections conducted by senior engineers. Formal inspections are generally conducted after major seismic or weather events, and on a periodic basis. As described below, the frequency and type of periodic inspections varies across agencies.

Inspections of Federal Dams. Each of the six federal agencies that operate federal dams is responsible for maintaining dam safety by performing maintenance, inspections, and rehabilitation work. The *Federal Guidelines for Dam Safety*, established in 1979 by President Carter, provide basic guidance for agencies' dam safety programs. Specifically, this document recommends that agencies formally inspect each dam at least once every five years. As shown in **Table 2**, however, most agencies under the Department of the Interior require more frequent inspections. These inspections are typically funded through the agencies' operations and maintenance (O&M) budgets.

Table 2. Agency-Owned Dams by Hazard Level and Frequency of Formal Inspections

Agency	Number of Dams by Hazard Level			Frequency of Formal Inspections[a]
	Total	Significant	High	
Department of Agriculture				
Forest Service	326	70	29	5 years
Department of Defense				
Air Force	29	0	0	5 years
Army	191	24	30	5 years
Corps of Engineers	608	90	470	5 years
Navy	34	4	4	5 years
Department of the Interior				
Bureau of Reclamation	435	24	343	3 years
Bureau of Indian Affairs	64	19	44	3 years
Bureau of Land Management	2	2	0	3 years
Fish and Wildlife Service	177	22	11	2.5 years
National Park Service	72	30	13	5 years
Department of State				
International Boundary Water Commission	7	1	5	5 years
Tennessee Valley Authority	83	15	63	5 years
Department of Energy	16	2	1	5 years

Source: *NID Data*, 2006.

a. Inspection frequency obtained from agency officials in Nov. 2004.

Inspection of Nonfederal Dams. Inspecting nonfederal dams is generally a state responsibility, but the states are often poorly funded. According to the Association of State Dam Safety Officials, 10 state regulators are needed for every 250 dams to do the job of carrying out their responsibilities.[28] However, the average number of dams per FTE is 395 and only two states (CA and FL) and one territory (PR) have the recommended number of staff.[29]

Federal Involvement. While regulating nonfederal dams is generally a state responsibility, the federal government has assumed regulatory authority over certain nonfederal dams. As described below, two federal agencies — FERC and the Department of Labor's Mine Safety and Health Administration (MSHA) — participate in inspections of certain private dams. In addition, the NRCS may become involved with inspections at the dams it constructed.

Private Hydropower Dams. Under the 1920 Federal Power Act, FERC (formerly the Federal Power Commission) regulates more than 2,500 nonfederal hydropower dams.[30] Pursuant to the *Federal Guidelines on Dam Safety* and FERC Order 122,[31] FERC's regional engineers are to inspect each high-hazard dam annually and outside consultants are to inspect these dams every five years. Low-hazard dams are to be inspected every three years. The federal government recovers the costs of these and FERC's other activities from the hydropower industry. In general, FERC's dam safety program has received positive recognition.[32]

Private Mining Dams. Under the Mine Safety and Health Act,[33] MSHA regulates 745 private dams. Under these regulations, dams used for surface mining are normally inspected every two years and those used for underground coal mines are to be inspected every four years.[34]

NRCS-Constructed Flood Control Dams. Since 1948, the NRCS has constructed more than 10,500 flood control dams. These dams were turned over to local entities under contracts that stipulate the nonfederal responsibility for operation and maintenance of the dams. Therefore, the dam owners are responsible for conducting inspections pursuant to state regulations. As resources permit, however,

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[28] Association of State Dam Safety Officials, *Model State Dam Safety Program* (1998).

[29] Association of State Dam Safety Officials, *State By State Statistics on Dams and State Safety Regulation — 2004.*

[30] *FEMA Report*, 2000-2001, pp. 8-9. Of these 1,775 are included in the NID (261 significant-hazard and 697 high-hazard dams).

[31] FERC, Order 122, 46 *Fed. Reg.* 9036 (January 28, 1981), 18 C.F.R. §12.

[32] U.S. Dept. of Energy, Office of the Inspector General, *FERC Dam Safety Program*, DOE/IG 0486, (October 2000).

[33] P.L. 91-173, as amended by P.L. 95-164 (30 U.S.C. §801). See [http://www.msha.gov/REGS/ACT/ACTTC.HTM].

[34] Discussion with Kelvin Wu, Chief, Mine Waste & Geotechnical Engineering Division, Mine Safety and Health Administration, Washington, DC, on November 19, 2004.

NRCS may use funding appropriated under the Small Watershed Rehabilitation Act[35] to help dam owners assess specific structural or operational problems. In certain situations, NRCS will conduct an inspection as part of this assessment process.

As amended by §2505 of the 2002 farm bill (P.L. 107-171),[36] the Small Watershed Rehabilitation Program is authorized to receive both mandatory funding through the Commodity Credit Corporation and discretionary funding to be authorized through agriculture appropriations each year. Mandatory funding amounts were to start at $45 million in FY2003 and increase by $5 million each year through FY2007, while discretionary funding was authorized at $45 million in FY2003 and was to grow by $10 million each year through FY2007. To date, congressional appropriators have prohibited mandatory funding each year while providing a portion of the discretionary funding that had been authorized. Actual appropriations were $29.8 million in FY2003, $29.6 million in FY2004, $27.3 million in FY2005, and $31.2 million in FY2006. The FY2007 budget request was $15.3 million, but Congress authorized $31.2 million (H.Rept. 109-463);(S.Rept. 109-266).

Dam Rehabilitation

Federal Dam Rehabilitation

After dam safety deficiencies have been identified, rehabilitation activities should be undertaken. However, most federal agencies do not have funding available to immediately undertake all non-urgent repairs. Rather, they generally prioritize their rehabilitation needs — based on various forms of risk assessment — and schedule these activities in conjunction with the budget process. At some agencies, dam rehabilitation needs must compete for funding with other construction projects. Rehabilitation activities at the two major dam-owning agencies are described below.

Department of Defense, Army Corps of Engineers. At the Corps, most dam deficiencies are addressed through the normal O&M procedures. However, "rehabilitation or modification of Corps' dams for safety purposes is accomplished through the Major Rehabilitation Program and the Dam Safety Assurance Program."[37] The purpose of the Major Rehabilitation Program "is to allow accomplishment of significant, costly, one-time structural rehabilitation or major replacement work (other repairs related to dam safety are accomplished under the normal O&M program)." [38] This program does not apply to facilities that were turned over to local interests for operation, maintenance, and major replacements after they were constructed by the Corps. The Dam Safety Assurance Program, however, applies to all dams built by the Corps regardless of current ownership. Specifically, this program "provides for modification of completed Corps dam

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[35] §313 of the Grain Standards and Warehouse Improvement Act of 2000 (P.L. 106-472).

[36] §2505 of the Farm Security and Rural Investment Act of 2002 (2002 Farm Bill).

[37] Army Corps of Engineers, *Dam Safety Preparedness*, EP1110-2-13 (June 1996), p. 5-1.

[38] Ibid.

projects which are potential safety hazards in light of current engineering standards and criteria.... This program is intended to facilitate upgrading of those project features which have design or construction deficiencies."[39] The Corps schedules rehabilitation under all of these programs based on funding availability.

U.S. Department of the Interior, Bureau of Reclamation. After Reclamation's engineers conduct dam safety inspections, through the Safety Evaluation of Existing Dams (SEED) account, any corrective action is carried out through the Initiate Safety of Dams Corrective Action program (ISCA).[40] Authority for Reclamation's dam safety program originates in the Reclamation Safety of Dams Act of 1978 (P.L. 95-578) and 1984 amendments (P.L. 98-404). Through ISCA appropriations, Reclamation focuses funding on priority structures "based on an evolving identification of risks and needs." Prior to recent legislation, Reclamation needed to submit a report to Congress for approval of modifications exceeding $750,000. The 108th Congress increased that ceiling to $1,250,000.[41] Costs incurred due to "age and normal deterioration of the structure" are considered normal operating costs and are cost-shared, with rates depending on the purposes for which the structure was constructed (project purposes). Furthermore, "modifications resulting from new hydrologic or seismic data or changes in the state of the art criteria" are cost-shared, with 15% of the costs paid by the project purposes.

Rehabilitating Nonfederal Dams

In 2002, a task committee of the Association of State Dam Safety Officials estimated that $36.2 billion was needed to rehabilitate nonfederal dams and that $10.1 billion was needed by 2014 for repairs to "the nation's most critical dams."[42] Responsibility to undertake this rehabilitation generally falls to dam owners.

State Rehabilitation Funding. While the federal government does provide some direct funding for rehabilitating nonfederal dams, states and dam-owners bear the brunt of the costs. Most states have little funding to repair their own dams, let alone those dams owned by local governments, public utilities, and private entities. According to the task committee of the Association of State Dam Safety Officials, in 2003, nine states (AZ, MA, MD, NJ, NY, OH, PA, UT, and WI) have loan or grant programs to repair unsafe dams. These programs generally focus on publicly owned dams. Additional information on these programs is provided in the Task Committee's 2003 report and is recreated in **Table 3.**[43]

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[39] Ibid.

[40] FY2001 Bureau of Reclamation Budget Justification, p. BW-384.

[41] A Bill to Authorize Additional Appropriations for the Reclamation Safety of Dams Act of 1978, P.L. 108-439.

[42] A Task Committee of the Association of State Dam Safety Officials, *The Cost of Rehabilitating our Nation's Dams: A Methodology, Estimate, and Proposed Funding Mechanisms* (December 2002, revised October 2003), p. 4. See [http://www.damsafety coalition.org/files/pdf/asdsoreport.pdf].

[43] Ibid.

Table 3. State Grants for Dam Rehabilitation as of October 2003

State	Program Type	Program Name	Source and Amount of Funding	Eligibility	Loan/Grant Amount	Term of Loan
AZ	Loan or grant	Dam Repair	Legislature, lien fund, inspection fees, filing fees, principal and interest from previous loans	State engineer determines dam to be dangerous to life, non-emergency	Loan for the cost of the project, or grant for a portion of project costs	Term of loan is up to 20 years at 3-6% interest depending on the length
MD	Loan and planning assistance	Maryland Environmental Service	State agency/ non-profit corporation	Counties, utilities and private groups. Need to have established service district for water supply, resource reclamation, dredging or storm water		
MA	Grants		Funding via Dept. of Environmental Management. No new appropriation as of Oct. 2003.	Local communities for repairs or removal	75% of the project, local share can be in-kind contributions	
NJ	Revolving loan fund New grant fund for municipally owned dams	Dam Restoration and Clean Water Trust Fund	$20M-$5M for state high hazard dams, $15M loans. In 2000 an additional $9.5[a] was added	Local units of governments, private owners can be co-applicants	Cost of project for loans Up to 100% for grants	Up to 20 years at 2% assessed against real estate benefitted
NY	Grants	Clean Water/Clean Air Bond Act	$17M bonding	Municipality for dam safety projects	75% of eligible project (25% local match) $300,000 cap per project	

State	Program Type	Program Name	Source and Amount of Funding	Eligibility	Loan/Grant Amount	Term of Loan
OH	Revolving loan fund	Ohio Water Development Authority	Revolving loan fund	Owner must be under mandate from ODNR. *Dam Safety Loan Program*- local units of government, state districts. *Dam Safety Linked Deposit Program*- private ownership/orgs.		5-25 years at lower than market rate
PA	Revolving loan fund	Pennvest	Revolving loan fund, $2B from state general purpose funds	Projects associated with wastewater, water supply or stormwater	Up to cost of project	20-30 years at low interest
UT	Loans or grants	Utah Board of Water Resources	$4.5[a] from general revenue and 0.8 cent sales tax (created originally to deal with flood control problems)	High hazard dam owners. Mandated repairs	80-95% grant for irrigation or water supply dams, loans or grants for other owners	
WI	Grants	DNR Municipal Dam Grant Program	$11.5M of bonding over 10 years. Currently fully subscribed	Local units of government and Lake Districts	50-50 grants up to a $200,000 maximum	

Source: Association of State Dam Safety Officials. *The Cost of Rehabilitating Our Nation's Dams: A Methodology, Estimate and Proposed Funding Mechanism* Appendix B (Dec. 2002, revised Oct. 2003). See [http://www.damsafetycoalition.org/files/pdf/asdsoreport.pdf].

a. Units not included in source table.

Federal Funding. While the federal government does help fund improvements to state dam programs, little federal funding is available for rehabilitating nonfederal dams. FEMA and NRCS are the primary sources of federal support for nonfederal dam rehabilitation.

FEMA. As described above, the Department of Homeland Security, through FEMA, runs the National Dam Safety Program which offers training and other assistance to state dam safety programs, though it generally does not provide rehabilitation funding. Legislation in the 109th Congress would have extended the NDSP and authorized funding through FY2011 and would have provided a total of $350 million to FEMA for a grant program for states to rehabilitate and repair publicly owned dams. Authorized funding would have been $50 million for FY2007

and $100 million annually through FY2011. Through other programs, FEMA may provide assistance to reduce the flood damage a failure would cause.[44] However, this assistance generally does not include funding for rebuilding or rehabilitating dams.

NRCS. Many upstream flood control dams were built with assistance from the NRCS and turned over to local sponsors. Many of these dams are now nearing the end of their design life and some have significant rehabilitation needs. The NRCS has estimated that more than $540 million is needed to rehabilitate these dams.[45] In 2000, Congress enacted legislation authorizing $90 million in discretionary funding over five years to rehabilitate aging flood-water retention projects.[46] Funds are to be allocated based on an annual ranking of requests for rehabilitation assistance. For FY2002, Congress appropriated $10 million for this dam rehabilitation program.

For FY2003, the Administration did not include the program in its budget request. However, the 2002 farm bill[47] established the Small Watershed Rehabilitation Program, and included $275 million in mandatory funding for the program through FY2007. The Small Watershed Rehabilitation Program is significant because it is the first federal initiative to dedicate funding assistance to repair nonfederal dams (rather than tear down or build new dams). It uses a cost-share formula providing for 65% federal-35% local funding. In the past, cost sharing has been an equal responsibility of the federal government and local sponsors for most purposes.

Other Agencies. In general, federal agencies such as the Corps and Reclamation do not rehabilitate nonfederal dams. As described above, however, the Corps does sometimes repair structural deficiencies that resulted from its participation in the design or construction of the nonfederal dam. Though quite rare, Congress has also directed federal agencies to use their dam safety appropriations to rehabilitate a nonfederal dam that it did not help design or build.[48] However, representatives from the Corps and Reclamation have testified that they do not support such congressional direction.[49]

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[44] See FEMA's Mitigation Grant Programs at [http://www.fema.gov/government/grant/index.shtm].

[45] *NRCS Report*, 2000, pp. 1, 15.

[46] The Grain Standards and Warehouse Improvements Act of 2000, P.L. 106-472, §313.

[47] §2505 of the Farm Security and Rural Investment Act, P.L. 107-171.

[48] See, for example, Goshen Dam (VA). Information from Charles Pearre, U.S. Army Corps of Engineers, Washington, DC, on February 2, 2005.

[49] U.S. Senate, Energy and Natural Resources Subcommittee on Water and Power, *Miscellaneous Water and Hydroelectric Project Bills*, S.Hrg. 108-271 (108th Congress), p. 28.

Conclusions

As the nation's dams age and development continues in floodplains, the structural integrity of this infrastructure will become a more significant public safety issue. In the aftermath of Hurricane Katrina, dams' planned capacity to withstand floods and other natural disasters has come under increased scrutiny. However, it is unclear to what extent there will be a widespread re-evaluation of flood and earthquake ratings at high-hazard dams. Such an evaluation could raise additional policy questions. For example: (1) what criteria should be used to determine whether current risks are acceptable; (2) if risks are not acceptable, should the dam be improved, or should other activities (e.g., changes to the design and or placement of downstream development) be undertaken; and (3) who should pay?

Regardless of whether dams were constructed to withstand an earthquake or flood of "appropriate" magnitude, they may have age-related deficiencies that need to be corrected to maintain current levels of safety. Therefore, it is likely that appropriations requests for safety inspections and rehabilitation activities will continue and may increase. It should be noted, however, that there currently are no clear criteria for prioritizing dam rehabilitation funding across agencies.

It is also unclear to what extent the federal government will fund inspection and rehabilitation activities at nonfederal dams. Through the National Dam Safety Program, the federal government provides training and assistance to state dam safety programs; authorization of appropriations for this program was extended through FY2011. Further, Congress has authorized appropriations for rehabilitation activities at several nonfederal dams. While there is likely to be an increasing demand for such assistance, there is currently no federal policy that describes the conditions under which federal funding is appropriate, nor has Congress established criteria for prioritizing funding among nonfederal projects.