Center for American Progress

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Ensuring Public Safety by Investing in Our Nation's Critical Dams and Levees

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Introduction and summary

Seven years ago, Hurricane Katrina pushed ashore in Louisiana, devastating the city of New Orleans and crippling an entire region. Massive storm surges overtook the city's levees and washed away entire neighborhoods, leaving more than 1,800 dead and displacing more than 1 million more. The sum of property damages alone was more than $200 billion, with the overall damage to the regional economy totaling billions more.[1] Making Katrina all the more tragic was the disaster's preventability—if only those responsible for the region's storm defenses and levees had taken action in the decades leading up to August 29, 2005.

The costs of this failure to act continue to mount. Since Katrina, repairing and upgrading the levee and flood-protection systems around New Orleans has cost the federal government $14 billion, and expenditures by the Federal Emergency Management Agency for displaced residents have run upwards of $30 billion.[2]

But for those familiar with the condition of America's water infrastructure, Hurricane Katrina was just the most devastating example of the kinds of failures that are now neither rare nor unexpected. Every year flooding alone kills an average of 94 people and causes roughly $7.2 billion in damages nationwide, and these figures exclude the devastation inflicted by storm surges similar to those that overtook New Orleans in 2005.[3] Over the past century we have increasingly relied on manmade structures such as dams and levees to protect us from natural disasters, and since the early 1900s we have built these structures by the thousands in almost every state.

There are currently more than 84,000 dams and approximately 100,000 total miles of levees in the United States. In addition to helping prevent floods and enabling the movement of freight up and down inland waterways, these structures are also relied upon to provide water for drinking and irrigation, to generate electricity, to help combat forest fires, and to provide recreational opportunities. They are critical components of our national economy and improve our quality of life in underappreciated ways every day.

But despite their tremendous importance to thousands of communities across our country, a frightening number of dams and levees have been allowed to fall into disrepair. A combination of aging and government neglect means many of these structures struggle to remain operational or even structurally sound. More alarming still is that changing settlement patterns have resulted in hundreds of dams and levees never designed to protect human life now being expected to safeguard the thousands who have moved into nearby flood zones.

Meanwhile, federal, state, and local efforts to monitor and repair levees and dams are piecemeal and drastically underfunded, characterized by a lack of clear leadership and a dearth of critical information. Hundreds of dams across the country whose failure would put lives in danger are years overdue for inspection, while we have almost no information at all on the condition of the vast majority of American levees.

Additionally, advances in scientific research and in our understanding of aquatic habitats and hydrological processes shed light on the negative environmental consequences of building and maintaining some kinds of dams. On hundreds of rivers throughout the United States, thousands of aging dams—many of which are no longer serving the purpose for which they were built—contribute to water quality degradation, biodiversity damage, and fisheries harm. While some efforts are being made to assess these damages and remove dams when environmentally and economically appropriate, the pace of dam removal in these instances remains slow.

Despite these risks, funding authorization for the National Dam Safety Program, which helps states formulate plans for inspecting and repairing dams under their jurisdiction, expired a year ago, and Congress has been slow and miserly in its efforts to reauthorize the program. The Senate proposes to maintain the current inadequate level of funding for the program—in fiscal year 2011, the National Dam Safety Program received just $11 million—while the House has proposed a funding cut. Neither proposal has moved forward since being introduced earlier this year.

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In this report we will detail the following:

- The conditions of our nation's dam and levee infrastructure and exactly how we have arrived at this point
- The relative responsibilities of local, state, and federal agencies for maintaining dam and levee safety
- The steps needed to bring these structures into a state of good repair or, where appropriate, to breach them

- Policy recommendations, including immediately reauthorizing the National Dam Safety Program, creating a National Levee Safety Program, and increasing federal spending on both infrastructure types by at least a combined $1 billion annually

If we do not make changes soon to the way we monitor and maintain our nation's dams and levees, catastrophes such as Hurricane Katrina striking an ill-prepared New Orleans or the failure of the Kaloko Reservoir Dam in Hawaii that killed seven people in 2006, will continue to occur—likely with greater frequency. The combination of extreme weather and flooding resulting from global warming and our aging dam and levee infrastructure means that without action, thousands of lives and communities are at risk and avoidable public costs will rise. It is time that policymakers stop simply hoping that the worst will not occur and finally devote the resources and political will required to ensure the safety and prosperity of the American public.

America's dams

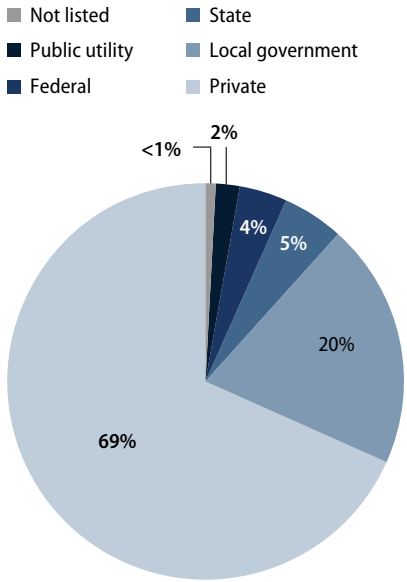
According to the Army Corps of Engineers's National Inventory of Dams, there are roughly 84,130 dams in the United States.[4] Dams can be found in every state and provide a range of economic and environmental benefits, including flood control, fire protection, water supply, hydroelectric power, waste management, river navigation, and wildlife habitat. Consider the following:

- The reservoirs that dams create provide clean water for consumption and industrial use, and a full 10 percent of U.S. cropland is irrigated by water stored behind dams.[5]
- The hydroelectric power that dams produce comprises the United States's largest source of renewable energy and in 2010 amounted to 257 billion kilowatt-hours, or 6.2 percent of the energy consumed in the United States that year.[6]
- Dams are also critical for containing mine waste—there are more than 1,300 mine-tailing impoundments in the United States—and for enabling the movement of goods down inland waterways.[7]

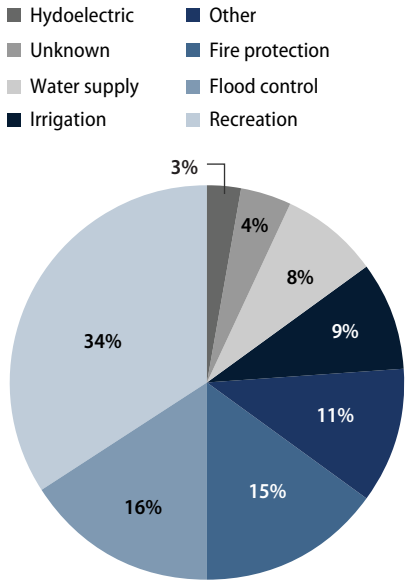
But most dams don't look like the massive, federally owned concrete structures that usually come to mind. Almost 70 percent of dams are privately owned, and local governments own twice as many dams as the federal government and states combined.[8] Most of these dams are constructed solely of compacted earth and rock, and more than 2,000 of them were built before 1900.[9] Nevertheless, many of these less-visible dams are still of great economic importance to hundreds of communities across the nation and protect thousands of people from both flooding and drought. While behemoths such as the Hoover Dam are among America's greatest engineering achievements and provide power and useable water to millions of Americans, the majority of dams throughout the country are much smaller and far less complex in their design. But despite their lack of recognition, these dams improve our quality of life every day and are essential tools for responsible water management.

FIGURE 1

Dam ownership



Dams by primary purpose



Source: "National Inventory of Dams," available at http://geo.usace.army.mil/pgis/f?p=397:12:.

Current state of infrastructure

While dams can provide a wide range of benefits, when improperly monitored and maintained they can also pose a significant danger to those living nearby. Unfortunately, this is now a frightening reality in many communities across the country, as decades of neglect have left thousands of Americans vulnerable to dam failures.

There are many reasons for the increasing danger posed by our nation's dams, but the first is simple: age. Many of America's dams were built in the first half of the 20th century to help mitigate the impact of major flooding events such as those seen in early 1900s and to help provide electricity and water for America's rapidly expanding industrial and agricultural sectors. These dams helped facilitate economic growth, but many have now reached the end of their intended design lives.

More than 28,000 dams—one-third of all dams in the United States—are already older than 50 years old, which is the standard lifespan of a dam's usefulness.[10] If we do not build significant numbers of new dams in the coming years, roughly 55 percent of dams will reach this milestone by 2020, and approximately 70 percent of American dams will be more than 50 years old by 2030.[11]

The aging of our dams, coupled with inadequate upkeep, has resulted in thousands of dams developing structural problems that could contribute to their failure. These include settling and cracking concrete, internal corrosion of soil embankments, rusting and bursting pipes, and shifting dam foundations.[12] Significant development of areas upstream of many older dams has also replaced more absorptive natural surfaces—such as grassland and forest floors—with concrete and asphalt, increasing the volume of runoff into dam reservoirs and increasing the pressure on the structures, particularly during large storms.[13] According to the Association of State Dam Safety Officials, as of 2008, the last year for which complete data are available, 4,404 dams nationwide were rated as "deficient," meaning structural or hydraulic problems were making them vulnerable to failure.[14] Potentially making matters worse, the Army Corps of Engineers has also recently become concerned that hydraulic fracturing, or "fracking"—an increasingly popular method of extracting natural gas from beneath the earth's surface—could undermine dam foundations and compromise their structural integrity even further.[15]

Aging and neglect, however, are not solely responsible for the increased public risk posed by dilapidated dams. Increased settlement downstream of dams means that many dams never intended to protect human life now are being required to meet much higher safety standards than they were originally designed to meet, and in many cases the required upgrades have simply not been made.[16] Largely due to such development, the number of dams classified as "high hazard"—meaning that dam failure or misoperation will likely result in the loss of human life—has grown rapidly in recent decades, from 9,281 in 1998 to 13,990 today.[17] In 2008 more than 2,000 high-hazard dams were also among the 4,404 deficient dams, meaning they not only held the potential to take lives but were also at significant risk of failure.[18] These figures do not even take into account the additional 12,662 dams classified as "significant hazard," meaning that while their failure may not result in a loss of life, it could still result in substantial economic or environmental damage.[19]

Unfortunately, these figures have not remained statistical abstractions, and in recent years failures of at-risk dams have already begun to inflict heavy costs on unsuspecting communities. In May 2003 the Silver Lake Dam in Michigan failed, causing more than $100 million in damages and putting 1,100 workers in two nearby iron mines temporarily out of work. In March 2004 the Big Bay Lake Dam in Mississippi failed, destroying 48 homes and damaging 53 more, along with damage to two churches, three businesses, and a fire station. And in 2006 the failure of the privately owned Kaloko Reservoir Dam in Hawaii released more than 300 million gallons of water, washing away houses and farms, severely damaging a state highway, and killing seven people.[20]

These tragic losses of life and property are not the only costs imposed by aging dams throughout the United States, as older dams have also caused environmental damage. Many dams built during the past century were not designed with environmental concerns in mind, and their construction has significantly damaged thousands of local ecosystems. By altering the physical, chemical, and biological states of rivers, dams can harm water quality, reduce biodiversity, hinder the essential flow of sediments and nutrients downstream, and prevent the migration of many fish species such as Atlantic and Pacific salmon.[21]

These changes not only produce environmental hazards but also impose economic costs for hundreds of communities as fisheries and sources of clean water disappear. While states including Washington and Maine are already in the process of removing some dams to mitigate these impacts, and some federal initiatives have been undertaken to help restore the health of affected rivers, thousands of dams throughout the country that have outlived their usefulness or are falling apart have not yet even been assessed to determine whether removal—technically known as "breaching"—would be beneficial.[22]

If states, localities, and the federal government wish to avert future disasters and improve natural resource management, spending on dam inspection, maintenance, and repair will have to increase. In 2009 the Association of State Dam Safety Officials estimated that repairing all of America's nonfederally owned dams would cost approximately $51.46 billion over the next 12 years, while the cost of repairing only high-hazard dams would still total $16 billion.[23] Of this $16 billion, $8.7 billion would be required for publicly owned dams and $7.3 billion for privately owned ones.[24]

These cost estimates are not specific recommendations for additional federal spending but are simply calculations for the amounts that will be needed from all sources to make the required repairs. Some costs could be avoided by breaching dams where there is a strong environmental or economic case to do so, although these proposed funding levels are still modest compared to the economic benefits derived from dams by the American taxpayer and far less than what will have to paid out in the event of multiple dam failures. Without these increases in funding, dam failures and near-failure events will likely occur with greater frequency, costing states billions of dollars and endangering the lives of thousands of Americans.

In 2009 the Association of State Dam Safety Officials estimated that repairing all of America's nonfederally owned dams would cost approximately $51.46 billion over the next 12 years, while the cost of repairing only high-hazard dams would still total $16 billion.

States' role in dam safety

State governments hold the majority of responsibility for monitoring dam conditions and enforcing safety standards. States regulate almost 9 out of every 10 dams in the United States, and every state but one has a state agency explicitly responsible for inspecting and maintaining dams.[25] The exception is Alabama, which despite having more than 2,000 dams listed in the National Inventory of Dams database, contains no such dam-safety entity.[26]

The vast majority of states may have such agencies, but they are almost invariably underfunded and understaffed. In 2011 the 50 states combined spent only $43.7 million on dam safety, with the average state agency budget for dam-related expenditures standing at a mere $912,000.[27] With such limited funds, states were able to employ only 417 full-time equivalent staff to maintain the safety of the vast majority of the nation's dams—a mathematically impossible task.[28] Dam-inspection procedures vary from basic visual inspections to intensive procedures involving engineers and other experts, according to the Association of State Dam Safety Officials.[29] While some states such as California and Hawaii manage to keep the workload of their employees within realistic limits—at 20.9 and 28.4 state-regulated dams per employee, respectively—many others have allowed these ratios to balloon to ridiculous levels. In Iowa there are 1,256 dams per full-time equivalent staff member, while in South Carolina the figure is an incredible 1,506 dams per employee.[30]

What's more, as state budgets were slashed in response to the Great Recession of 2007–2009, the situation in many states has only deteriorated. Total state spending on dam safety in 2011 was down $15.3 million from 2008 levels, while the number of high-hazard dams in need of attention has only continued to rise.[31]

This lack of financial support has resulted in state dam authorities regularly failing to keep up with required inspections, let alone enforce regulations or make repairs when they are responsible for doing so. As of 2009, 30 percent of high-hazard dams nationwide hadn't even been inspected within the past five years, which is the absolute maximum allowable delay between thorough dam inspections recommended by federal dam-safety guidelines. To cite just two examples, as of 2011, half of the high-hazard dams in the state of Maine were two years to seven years overdue for mandated inspection, while the more than 100-year-old Kaloko Reservoir Dam in Hawaii had somehow never once been inspected by a state dam-safety official before its catastrophic failure in 2006.[32]

TABLE 1

Dam Safety Statistics by State, 2010

State	Dams counted in the National Inventory of Dams*	State-regulated dams	High-Hazard Potential Dams (all jurisdictions)**	Total Budget	State dam safety FTEs (full-time equivalent employees)	State-regulated dams/FTE
Alabama***	2228	N/A	201	$0	0	N/A
Alaska	96	85	25	$285,337	2	42.5
Arizona	346	247	142	$476,000	5.5	44.9
Arkansas	1229	1256	170	$374,200	4.8	261.7
California	1468	1254	807	$11,142,000	60	20.9
Colorado	1822	1758	367	$1,475,019	13	135.2
Connecticut	726	3381	233	$750,000	6	563.5
Delaware	86	48	65	$891,500	1.25	38.4
Florida	892	882	75	$1,387,125	20.5	43
Georgia	4606	4053	484	$619,549	7.5	540.4
Hawaii	138	142	75	$754,000	5	28.4
Idaho	443	596	122	$240,249	2	298
Illinois	1504	1594	201	$335,000	4.7	339.1
Indiana	1142	1084	279	$392,000	5	216.8
Iowa	3374	3768	101	$140,000	3	1256
Kansas	6087	6132	230	$368,066	9.18	668
Kentucky	1050	967	277	$1,550,420	5	193.4
Louisiana	557	548	33	$800,909	5.2	105.4
Maine	647	618	77	$58,900	2.5	247.2
Maryland	340	416	68	$422,987	4.75	87.6
Massachusetts	1602	1523	341	$1,230,151	7.7	197.8
Michigan	927	1019	161	$304,000	3.5	291.1
Minnesota	1021	1115	47	$378,000	5.4	206.5
Mississippi	3533	3828	274	$266,775	4	957
Missouri	5099	677	1588	$584,470	5	135.4
Montana	2917	2895	196	$620,947	7.6	380.9
Nebraska	2368	2382	126	$351,455	10	238.2
Nevada	516	653	149	$230,604	2.35	277.9
New Hampshire	653	833	106	$852,000	8.5	98
New Jersey	804	1676	217	$1,254,000	13	128.9

State	Dams counted in the National Inventory of Dams*	State-regulated dams	High-hazard potential dams (all jurisdictions)**	Total budget	State dam safety FTEs (full-time equivalent employees)	State-regulated dams/FTE
New Mexico	519	307	210	$544,322	6	51.2
New York	1982	5726	403	$1,386,500	12.49	458.4
North Carolina	3382	4478	1255	$1,205,710	18	248.8
North Dakota	869	1188	32	$275,720	4.5	264
Ohio	1577	1535	427	$1,574,295	14	109.6
Oklahoma	4758	4539	364	$166,972	5.35	848.8
Oregon	958	1330	135	$244,000	2.93	453.9
Pennsylvania	1546	3325	852	$2,502,295	28	118.8
Rhode Island	215	667	87	$189,966	1.6	416.9
South Carolina	2421	2380	204	$65,000****	1.58	1506.3
South Dakota*****	2520	2348	91	N/A	3	782.7
Tennessee	1216	661	300	$362,146	8	82.6
Texas	7173	7122	914	$2,104,634	29	546.6
Utah	818	601	252	$770,600	13	46.2
Vermont	367	453	56	$226,000	2.25	201.3
Virginia	1642	1690	184	$617,404	8	211.3
Washington	763	1030	227	$1,330,303	8.5	121.2
West Virginia	562	363	380	$624,729	6	60.5
Wisconsin	1163	953	252	$752,000	6.25	152.5
Wyoming	1429	1518	96	$222,028	5.28	287.5
Total	**84101**	**87644**	**13958**	**$43,700,287**	**417.66**	**Av. 207.9**

*Includes all NID-sized dams regulated by state or federal agencies. The NID includes dams more than 25' in height or that store more than 50 acre-ft of water. The NID also includes dams classified as "high hazard" or "significant hazard" potential regardless of size.

**Includes federal, state, local, and privately-operated dams.

***Alabama is the only state that does not keep data on its dams. Alabama is also the only state without an agency tasked with dam inspection and maintenance.

**** The Association of State Dam Safety Officials estimated this budget based on the number of FTEs reported. South Carolina reported their FTEs but not their budget.

***** In 2010, South Dakota had 3 FTE employees and a budget of $150,000 for dam inspection and maintenance. In 2011, they did not report a budget to the Association of State Dam Safety Officials. Unlike Alabama, however, South Dakota does have the legislative authority to run a dam safety program.

Source: Army Corps of Engineers, "National Inventory of Dams," (last accessed September 14, 2012); and Association of State Dam Safety Officials, "2011 Statistics on State Dam Safety Regulation" (2012), available at http://www.damsafety.org/media/Documents/STATE_INFO/STATISTICS/2011_StateStats(1).pdf; and Association of State Dam Safety Officials, "Dam Safety in the States," available at http://damsafety.org/community/states/?p=2827bd14-b6e3-49a9-a465-b2a3531afe5c (last accessed September 14, 2012).

Federal role in dam safety

Despite states shouldering the vast majority of responsibilities, the federal government also plays an important role in dam safety. An important distinction must be made, however, between federal maintenance of federally owned dams and federal assistance to states and localities for the maintenance of nonfederally owned dams. The federal government does both, but the size and nature of these efforts differ greatly.

The federal government does a fairly good job of maintaining its own dams, particularly since the 1970s, when multiple high-profile and deadly dam failures led to a renewed emphasis on establishing safety standards and providing regular maintenance. The 1972 National Dam Inspection Act allowed the Army Corps of Engineers to create a national dam-inspection program and to establish the National Inventory of Dams, while the 1979 Federal Guidelines for Dam Safety established the basic structure for federal agencies' dam-safety programs.[33]

But there have still been some notable failures. Case in point: the 2008 bursting of a Tennessee Valley Authority dam that flooded areas west of Knoxville with more than 1 billion gallons of toxic coal ash. The federal government's record on dam safety, however, is substantially superior to those of most states overall.

As of 2008, nine federal agencies operated and maintained more than 2,000 dams nationwide and directly regulated the operation of more than 2,500 more.[34] To coordinate the dam safety and maintenance initiatives of all of these separate departments, the Interagency Committee on Dam Safety was created in 1980 and continues to operate today under the oversight of the Federal Emergency Management Agency.[35] The costs of federal dam operation, maintenance, inspection, and regulation are all paid from the agencies' annual congressional appropriations. (see Table 2 on following page)

TABLE 2
Federally owned and operated dams

Department	Number of dams*
Department of Defense	862
Department of the Interior	751
Department of Agriculture	326
Tennessee Valley Authority	83
Department of Energy	16
Department of State	7
Federal agencies responsible for inspecting and regulating nonfederally owned dams	
Agency	Number of dams*
Federal Energy Regulatory Commission	1,775
Mine Safety and Health Administration	745
Nuclear Regulatory Commission	11

*Figures as of 2008

Source: Nic Lane, "Aging Infrastructure: Dam Safety" (Washington: Congressional Research Service, 2008), available at http://www.fas.org/sgp/crs/homesec/RL33108.pdf.

Federal assistance to states to promote dam safety in state-owned dams is a comparatively more-recent undertaking. The most comprehensive federal program charged with this task is the National Dam Safety Program, which seeks to help states develop their own dam-safety programs by providing them with training, technical assistance, and research funding, although no funds can be used for actual dam repair. The program was created by Congress in 1996 and is administered by the Federal Emergency Management Agency. Since that time it has helped increase the percentage of high-hazard dams that have a designed Emergency Action Plan from just 35 percent in 1999 to 69 percent today. The program has also helped many state programs begin tackling their backlogs of required inspections.[36]

Unfortunately, limited funding has constrained the impact of the program, and its future is currently unknown. Allocated only $11 million in fiscal year 2011, the legislation authorizing the program was allowed to expire in September 2011.[37] Currently, bills reauthorizing the program have been introduced in the House and Senate, but they have not yet been passed into law. The House proposal, sponsored by Rep. Russ Carnahan (D-MO), would appropriate an annual total of $10.9 million to the program for FY 2012 (ending this month) through FY

2015.[38] The Senate version, sponsored by Sens. Daniel Akaka (D-HI) and John Boozeman (R-AK), would provide the program with $13.9 million annually for FY 2012 through FY 2016.[39]

Whatever total the final version of the bill ends up being, the National Dam Safety Program will cease to exist without its passage, removing a critical pillar of support for already struggling state agencies.

The executive branch also supports some dam maintenance and repair functions at the state and local level. Since the 1940s, the Department of Agriculture's National Resources Conservation Service has provided funding to construct approximately 11,000 small watershed dams, which it then handed over to state and local control.[40] Unfortunately, many of these dams were then neglected for decades. But in 2000 Congress stepped in to help repair the dams it had assisted in building and created the Watershed Rehabilitation Program within the service.

Since then the program initiated 163 rehabilitation projects throughout the country. In FY 2012 it was actually allocated more funds—$15 million—than the National Dam Safety Program was in its last official year of existence, despite the Watershed Rehabilitation Program's much more limited focus.[41]

All of these funding streams combined, however, will not come close to meeting the maintenance and repair needs of America's dams. If localities, states, and the federal government do not take action soon, more communities will be threatened by deteriorating dams, and catastrophes such as those in Michigan, Mississippi, and Hawaii will become an even more common occurrence.

America's levees

According to the National Committee on Levee Safety, there are approximately 100,000 miles of constructed levees in the United States.[42] These are mostly earthen embankments built along the sides of rivers, their tributaries, or on coastlines to protect low-lying areas from flooding. The federal government is responsible for the oversight of only roughly 14,000 miles of this system, with the bulk of responsibility falling on state and local governments and private-property owners.[43] According to estimates by the Federal Emergency Management Agency, as much as 43 percent of the U.S. population may live in counties containing levees.[44]

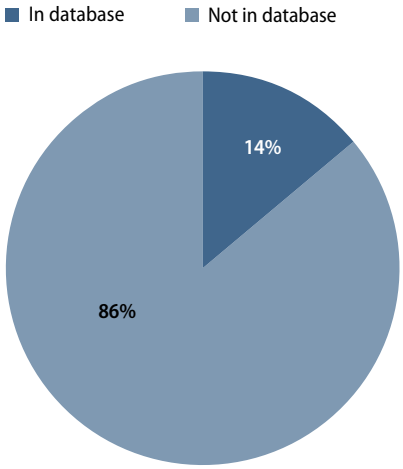
Many of these levees were built in the early 20th century in response to a series of devastating floods. Some were built by local communities, others by private interests, and many were constructed by partnerships between state and local governments and the Army Corps of Engineers, as authorized in the Flood Control Acts of 1917, 1929, and 1936.[45] A significant number of additional levees were also built from the 1960s through the 1980s in order to remove surrounding communities' designation as "special flood hazard areas" under the National Flood Insurance Program, thereby allowing property owners to avoid having to purchase flood insurance.[46]

These levees now protect millions of people in all corners of the country and have enabled property development in many previously uninhabitable flood plains. Levees are also relied upon to protect massive expanses of infrastructure—including roads, highways, railways, bridges, water-treatment plants, utility systems, and port facilities—as well as industry and manufacturing. Without these unassuming earthen embankments, annual flooding events and storm surges would inflict billions of dollars more in damages every year and make settlement in many of these areas far more dangerous.

FIGURE 2

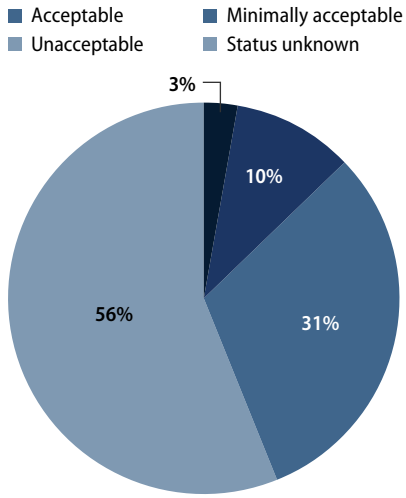
U.S. levee mileage in the National Levee Database

Based on estimate of total U.S. levee mileage of 100,000 miles



Inspection rating of levee mileage in the National Levee Database

Total levee mileage in database is 14,455 miles



Source: Army Corps of Engineers, National Levee Database, available at http://nld.usace.army.mil/egis/f?p=471:1

Current state of infrastructure

Despite their critical importance to protecting life and property throughout the United States, levees are experiencing many of the same problems as our dams, posing an increasing threat to public safety. As with dams, age is beginning to catch up with many levee systems constructed in the first half of the 20th century. According to the National Committee on Levee Safety, the average age of levees in the federal system is now approximately 50 years old—the intended design life of many levees—while numerous nonfederal levees may date back more than 100 years.[47] These structures have received even less attention than dams, and many have begun to be worn down by the waters they are meant to contain or are no longer adequate due to changing river conditions.

As with dams, many levees originally designed only to protect sparsely populated farmland or woodlands are now responsible for safeguarding thousands of lives due to settlement in adjacent areas. Even those designed to meet the National Flood Insurance Program's minimum protection level—thereby avoiding the need to qualify nearby communities as special flood hazard areas—are

far less reliable than many believe them to be. These levees are designed to provide protection up to only the 1-percent-annual-chance event—the so-called 100-year flood—which many mistakenly believe means that a flood of that magnitude will not occur for another 100 years.

In reality, this level of protection corresponds to a 26 percent chance of flooding during the span of a typical 30-year mortgage, according to the Federal Emergency Management Agency.[48] Many homeowners and policymakers in levee-protected areas simply do not understand their risk, often resulting in irresponsible planning and low flood-insurance purchase rates, amplifying the severity of damage and losses experienced during flooding events.

Perhaps the most frightening aspect of our nation's levee system, however, is just how much we don't know about their condition, location, or hazard potential. While just more than 14,000 miles of federally managed levees are documented in at least some fashion in the Army Corps's National Levee Database and are considered a part of the Levee Safety Program, we have almost no information on the approximately 86,000 remaining miles of levees not under federal oversight. (see Figure 1) No comprehensive national census of America's levees has ever been conducted, and the only way in which the Army Corps acquires any information on nonfederal levees is through the voluntary submission of information by states or localities, most of which know extremely little about their own levees.

Of the 14,455 miles of levees in the National Levee Database, only 3 percent received an "acceptable" rating when inspected.

The little information we do have is not particularly encouraging: Of the 14,455 miles of levees in the National Levee Database, only 3 percent received an "acceptable" rating when inspected; 31 percent received a "minimally acceptable" rating; and a full 10 percent received an "unacceptable" rating.[49] A minimally acceptable rating means that one or more elements of the levee are in unacceptable condition, but that these weaknesses will not prevent the levee system from performing as it is supposed to during a flood.[50] Levees rated as unacceptable are those with serious deficiencies that could compromise their effectiveness during flooding events or those that have not addressed such deficiencies noted in past inspections within the required timeframe. Such levees are currently protecting lives and property in Dallas, Sacramento, St. Paul, and Tulsa, to name just a few cities.[51]

While estimating a total price tag for all required levee repairs is impossible given this lack of information, the National Committee on Levee Safety has estimated that establishing a comprehensive national levee-safety program would require a federal investment of roughly $878 million per year for at least the first five years,

paired with an additional $360 million per year from states, localities, and private owners.[52] This is a modest investment, particularly when considered against the costs of damages resulting from levee failures or breaches, which may amount to more than $5 billion annually, according to the committee's estimates.[53]

Indeed, Army Corps levee systems already provide on average a 6-to-1 return ratio on flood damages prevented compared to initial costs, and some larger, more robust systems such as the Mississippi River and Tributaries system provide return ratios of up to 24-to-1.[54] We will have to pay for levees one way or another, and what policymakers must decide is whether they want to pay now for necessary inspections and repairs or pay far more in the future to rebuild entire communities in the wake of preventable disasters and to completely reconstruct levee systems that have failed or deteriorated beyond the point of repair.

States' role in levee safety

As is the case with dams, states and localities assume the vast majority of the responsibility for maintaining levee safety, although an exact breakdown of relative responsibilities or even ownership percentages is nearly impossible to determine due to the lack of any comprehensive levee records. Part of the reason for this lack of documentation is that states have been neglecting their levees for decades, and many do not even have agencies with any explicit authority to inspect or regulate levees. As of 2009 only 10 states kept any listing of levees within their borders, and only 23 had an agency with any responsibility for levee safety.[55] In many states this was the same underfunded and understaffed body already attempting to regulate dam safety.

While responsible for almost all of the approximately 86,000 miles of levees outside of the federal system, localities and states are also responsible for the maintenance of a good portion of the more than 14,000 miles of levees in the Army Corps's Levee Safety Program. While some are actually maintained by the Army Corps, many are only inspected, and the responsibility for addressing the problems the Army Corps identifies falls on local sponsors. Thanks to these inspections and the periodic maintenance they encourage, these levees are generally in better condition than their nonregulated counterparts, but their effectiveness can still be undermined by the failures of levees outside of the system.

We saw this during the Mississippi River flooding of 2011. While federally maintained and regulated levees largely performed as intended, smaller levees along

nearby tributaries failed from Illinois to Louisiana, resulting in damages estimated at $5 billion and the inundation of a full 1 percent of total U.S. cropland.[56]

Federal role in levee safety

Until recently the federal government played almost no role in monitoring or maintaining levee safety, and even now its initiatives are extremely limited. There is currently no centralized federal program assigned to regulate, inspect, or repair levees nationwide or to set safety and construction standards. States and localities have been largely left on their own and receive no substantial federal funds to establish or operate levee-safety programs.

Most current federal involvement in levee safety was initiated in response to the devastating impact of Hurricane Katrina in 2005, which was in part caused by the failure of federally maintained levees and flood-control systems. In 2006 the Army Corps of Engineers established its Levee Safety Program, and in 2007 the Water Resource Development Act assigned to it the responsibility of creating the National Levee Database to serve as an inventory of all federally overseen levees, as well as non-federal levees for which information was voluntarily provided.[57] In 2009 the Corps launched a massive effort to perform detailed engineering inspections of all levees in their program and populate the database, largely funded by a one-time $90 million appropriation in the American Recovery and Reinvestment Act.[58]

Most current federal involvement in levee safety was initiated in response to the devastating impact of Hurricane Katrina in 2005, which was in part caused by the failure of federally maintained levees and flood-control systems.

The database was finally launched in 2011, representing a significant step forward for the nation's levee system even though, as previously noted, it contains information on only about 14 percent of the levees in the United States. To help expand the breadth of the database's coverage, the Army Corps has recently been working with the Federal Emergency Management Agency to integrate levee data collected by the National Flood Insurance Program into the database.[59] Unfortunately, the Army Corps program simply does not have the authority or funds to inspect the remaining 86,000 miles of levees spread throughout the country, nor does it have the resources to powerfully incentivize states to take up this task on their own.

The Water Resource Development Act of 2007, however, also created the National Levee Safety Committee, tasked with aggregating levee-safety data, assessing the nation's needs, and making policy recommendations to Congress. While this committee has done an excellent job fulfilling these tasks, it has no authority to take any substantive action, and most of its recommendations have been ignored by lawmakers.

Principal among these recommendations is the establishment of a National Levee Safety Program modeled on the National Dam Safety Program. This idea has received support from both the American Society of Civil Engineers and the Association of State Dam Safety Officials but has yet to become a reality.[60] Taken together, these programs represent a significant improvement from the near-total lack of information about levee conditions available before Hurricane Katrina. As they currently stand, however, the funding and extent of these programs are insufficient to adequately address the nation's levee-safety needs.

Policy recommendations

To bring America's levees and dams into a state of good repair and ensure that they continue to be drivers of economic growth and not threats to public safety, the federal government will have to take a number of quick and decisive steps. In this section, we detail these steps and offer guidance on how they might best be implemented. To rebuild, repair, and maintain America's levees and dams going forward, the Center for American Progress recommends that Congress:

- Immediately pass a short-term reauthorization of the National Dam Safety Program
- Establish a National Levee Safety Program based on the National Dam Safety Program model
- Increase federal spending on dams and levees by at least $1 billion annually
- Require federal and state agencies receiving federal funds to conduct assessments of when dam breaching is the most sensible option

We'll now detail these recommendations.

Immediately pass a short-term reauthorization of the National Dam Safety Program

Without the National Dam Safety Program, states would lose an invaluable source of technical assistance, expertise, and funding for program design and research. State dam-safety programs are already struggling to keep up with ever-increasing workloads, and allowing the program to permanently expire would only further undermine these efforts.

A short-term reauthorization of the program would also allow for crucial dam-safety work to continue, while providing Congress with a timeframe to consider revamping and significantly strengthening the program. Policymakers should consider what reforms could make the program more effective, whether to expand the program's scope to include levee safety, how to leverage additional state and local funds,

and how efforts could be best coordinated with the Department of Agriculture's Watershed Rehabilitation Program to ensure that dam-safety investments are made as efficiently as possible.

The training of additional state inspectors and the immediate development of Emergency Action Plans for the almost-3,000 high-hazard dams still lacking them should also be highly prioritized. Once these decisions have been made, a longer-term reauthorization of a revamped National Dam Safety Program should be passed without delay.

Establish a National Levee Safety Program based on the National Dam Safety Program model

A National Levee Safety Program should be created as soon as possible to provide the financial support and expertise needed by states to establish effective levee-safety programs. This program should have the authority to distribute grants, provide training, fund research, and develop national levee-safety standards. It could also assist in helping the Army Corps populate the National Inventory of Dams by collecting information on nonfederal dams and improving coordination between federal agencies and their state and local counterparts.

As noted previously, policymakers should also consider whether the functions of a levee-safety program could just as easily be assigned to the National Dam Safety Program, thereby creating a single program responsible for both types of critical water-management infrastructure. This would allow for better coordination of flood-prevention efforts and would simplify interactions with state agencies. But even if levee safety is not added to the responsibilities of the National Dam Safety Program, both programs should at least remain under the auspices of the same agency to enable the best possible planning integration and coordination.

Increase federal spending on dams and levees by at least $1 billion annually

To bring America's dams and levees into a state of good repair and minimize the probability of preventable disasters, the federal government will have to increase its annual financial commitment to dam- and levee-safety initiatives by a substantial amount. We recommend that federal spending be increased by at least $1 billion annually, which would divided in the following way:

- **$250 million** to fund a one-time inventory of all repairs required on dams and levees throughout the country, including a national survey of levees to record their location, dimensions, ownership, and condition. The balance of funds in future years would then be used to repair the levee system.
- **$500 million** to be granted to states annually for the repair or breaching of state and local public high-hazard dams. States should be required to match these funds at a rate of 50 cents to each federal dollar.
- **$250 million** should be used for the repair or breaching of federally owned high-hazard dams.

With these additional funds, federal and state agencies could finally develop a comprehensive database of America's levees and could begin to make necessary repairs both to aging levees and dams whose deteriorating conditions pose a threat to public safety and thousands of local economies. This spending alone will likely not be enough to complete all necessary repairs, but by introducing a matching requirement and assisting states in the evaluation of their repair needs and the development of their safety programs, these funds will also leverage additional state and local spending and help agencies at those levels allocate their spending in the most efficient possible way.

Require federal and state agencies receiving federal funds to conduct assessments of when dam breaching is the most sensible option

Due to changes in communities' economic, environmental, and recreational needs, many aging dams in the United States have ceased to serve the function for which they were originally designed or are simply providing far fewer benefits than they once did. In many of these cases it may make more economic and environmental sense to simply breach these dams rather than spend millions on their repair.

The Federal Emergency Management Agency and the Army Corps of Engineers, as well as any state agencies accepting federal funds, should be required to assess whether breaching is the most sensible course of action for any dam being considered for renovation. This will help ensure that funds are not wasted on high-hazard dams that no longer provide benefits substantial enough to justify their continued maintenance. The plan will also remove expensive, dangerous, and environmentally harmful structures.

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If all of these proposals are adopted, Congress and the American people could be confident that we would be well on our way to upgrading and modernizing some of our nation's most critical infrastructure and addressing some of our nation's most worrisome safety concerns. We don't need another failed dam or levee to result in economic or personal tragedy. If the federal government, states, and localities step up to the plate, the so-called 100-year flood could finally become as rare as it sounds.

Conclusion

Dams and levees played a vital role in America's economic development throughout the 20th century. They provided drinking water for bustling metropolises, irrigated millions of acres of the American breadbasket, generated billions of kilowatts of renewable energy, and helped prevent thousands of wildfires throughout the nation. They have saved an incalculable number of lives by preventing floods and allowed for the safe settlement of many areas that just 100 years ago would have been uninhabitable. Some of these structures are among mankind's greatest engineering marvels, while thousands of others remain inconspicuously tucked away on small rivers and lakes, quietly serving and protecting millions and allowing for a quality of life that many take for granted.

It is precisely because of these critical structures' anonymity, however, that the United States now finds itself confronted with a system of dams and levees in a shameful state of disrepair. For decades policymakers have underinvested in inspections, maintenance, and renovations and simply hoped that no catastrophe would occur on their watch. Predictably and tragically, this has done little to mitigate the inevitable effects of aging, and disasters such as the dam failures in Michigan, Mississippi, and Hawaii and the devastation inflicted by Hurricane Katrina serve as reminders of the tremendous costs of such negligence.

We now find ourselves at a critical juncture, as a staggering percentage of our dams and levees have either just surpassed the extent of their intended design lives or will do so in very near future. Additionally, climate change will only increase the pressures faced by our flood control infrastructure, as changing weather systems undermine the assumptions of river and storm activity that our nation's dams and levees were designed to control. While the price tag associated with their repair and modernization may at first appear daunting, the costs of inaction are exponentially higher and will likely not be measured only in dollars spent but, more importantly, in lives lost. This is why CAP recommends that immediate action to acquire a complete inventory of national repair needs and to begin addressing these needs as soon as possible. This effort will require the combined work of the federal gov-

ernment, states, and local communities and will not be completed overnight, but it must be undertaken to ensure that economic growth is not further undermined, and that public safety is protected.

The thousands of engineers and laborers who worked to construct our nation's dams and levees over the past century intended them to protect communities and improve America's overall quality of life. To allow the products of their labor to become a danger to those same communities and a liability for their children and grandchildren is to betray an essential public trust. We have a responsibility to those engineers, to the millions of Americans currently living in the shadow of dams and levees, and to future generations to stop shirking our responsibility for the upkeep of our dams and levees and to bring them into a state of good repair befitting of the world's largest and most-prosperous economy.

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