As dams age and downstream development increases, the number of deficient dams has risen to more than 4,000, including 1,819 high hazard potential dams. Over the past six years, for every deficient, high hazard potential dam repaired, nearly two more were declared deficient. There are more than 85,000 dams in the U.S., and the average age is just over 51 years old.

WATER AND ENVIRONMENT

FACTS ABOUT

DAMS

WATER AND ENVIRONMENT

DAMS

2009 GRADE **D**

RAISING THE GRADES

SOLUTIONS

THAT WILL WORK **NOW**

- **A** = Exceptional
- **B** = Good
- **C** = Mediocre
- **D** = Poor
- **F** = Failing

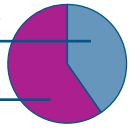
AMERICA'S INFRASTRUCTURE G.P.A. **D**

ESTIMATED 5-YEAR FUNDING REQUIREMENTS FOR **DAMS**

Total investment needs
$12.5 BILLION

Estimated spending
$5.05 BILLION

Projected shortfall
$7.45 BILLION



- ★ **ENCOURAGE** or require effective state dam safety programs that provide adequate funding, staff, and statutory authorities;
- ★ **DEVELOP** emergency action plans for every high hazard dam by 2011;
- ★ **ESTABLISH** a national funding program and parallel state programs to repair nonfederally owned dams;
- ★ **INCLUDE** dam failure inundation mapping as part of the National Flood Insurance Program;
- ★ **EDUCATE** the public about dam safety risks;
- ★ **ENCOURAGE** individuals to educate themselves on the location and condition of dams in their area.

CONDITION

Dams provide essential benefits, including drinking water, power generation, flood protection, irrigation, and recreation. They may be publicly owned and operated by federal agencies, states, cities and municipalities or privately owned and operated by businesses and corporations. Typically earth embankments or concrete structures, dams can reach heights of up to 770 feet and store billions of gallons of water. A dam's "hazard potential" is classified on the basis of the anticipated consequences of failure, not the condition of the dam. The classifications include "high hazard potential" (anticipated loss of life in the case of failure), "significant hazard potential" (anticipated damage to buildings and important infrastructure), and "low hazard potential" (anticipated loss of the dam or damage to the floodplain, but no expected loss of life).

The National Inventory of Dams (NID), which is maintained by the U.S. Army Corps of Engineers (USACE), shows that the number of dams in the U.S. has increased to more than 85,000, but the federal government owns or regulates only 11% of those dams.[3,5] Responsibility for ensuring the safety of the rest of the nation's dams falls to state dam safety programs. Many state dam safety programs do not have sufficient resources, funding, or staff to conduct dam safety inspections, to take appropriate enforcement actions, or to ensure proper construction by reviewing plans and performing construction inspections. For example, Texas has only 7 engineers and an annual budget of $435,000 to regulate more than 7,400 dams.[3] That means each inspector is responsible for more than 1,050 dams. Worse still, Alabama does not have a dam safety program despite the fact that there are more than 2,000 dams in the state. And in some states many dams are specifically exempted from inspection by state law. In Missouri there are 740 high hazard potential dams that are exempted because they are less than 35 feet in height. The task for the states is an enormous challenge. (See Table 1.1)

While the total number of dams is increasing, the number of high hazard potential dams is also increasing at an alarming rate, now totaling 15,237.[3] That represents an increase of more than 3,300 new high hazard potential dams since 2007. This increase is a result of new development below dams, which is dramatically increasing the consequences of failure and resulting in the reclassification of dams. This change in classification requires that significantly greater safety standards be met given the greater consequences of dam failure.

The number of dams determined to be unsafe or deficient has risen from 3,500 in 2005 to 4,095 in 2007.[3] Of that number, high hazard potential dams that are also classified as deficient has risen from 1,367 in 2005 to 1,819 in 2007.[3] The greatest indicator of the condition of the nation's dams can be seen in Table 1.1 that demonstrates the increase in the number of high hazard dams that need to be repaired compared to the number of completed repairs to high hazard dams, which remains flat.[3] The rate of dam repairs is

TABLE 1.1 ★ Number of Deficient Dams in United States by Repair Status

YEAR	# OF DEFICIENT DAMS	# OF HIGH HAZARD DEFICIENT DAMS	# OF HIGH HAZARD REPAIRED DAMS	# OF HIGH HAZARD DAMS NEEDING REPAIR
2001	1,348	488	124	364
2002	1,536	646	163	483
2003	2,004	648	120	528
2004	3,000	979	100	879
2005	3,271	1,367	138	1,229
2006	3,346	1,308	139	1,169
2007	4,095	1,826	83	1,743

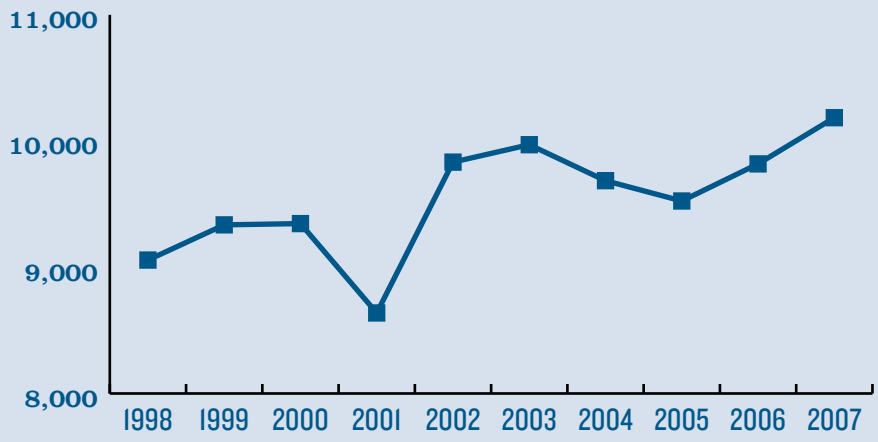
SOURCE Association of State Dam Safety Officials

not keeping pace with the increase in the number of high hazard dams that need rehabilitation. The gap between dams needing repair and those actually repaired is growing significantly.

Many dams are determined to be deficient as a result of aging, deterioration, and a lack of maintenance. Often dams are deemed unsafe or deficient as a result of increased scientific and engineering knowledge about large flood events and earthquakes, and the ability to predict a dam's structural response to such extreme events, which pose a significant safety threat. Many dams were constructed 30 or 40 years ago using the best science and engineering at the time. But as a result of the additional 40 years of historical records and greater abilities to predict increases in loads on dams and the dams'

Many state dam safety programs do not have sufficient resources, funding, or staff to conduct dam safety inspections, to take appropriate enforcement actions, or to ensure proper construction by reviewing plans and performing construction inspections.

FIGURE 1.1 ★ Number of High Hazard Dams in the United States



SOURCE Association of State Dam Safety Officials

responses to those events, more dams are being identified as unsafe or deficient.

The National Dam Safety Program (NDSP), which was established by the Water Resource Development Act of 1996, created a national dam safety program administered by the Federal Emergency Management Agency that is designed to provide incentive grants to states and training to encourage research.[12] While there have been successes and improvements as a result of the NDSP and stronger state programs, the safety and condition of the nation's dams have not improved overall. Successes have included modest increases in staffing, budgets, and dam safety inspections in some state programs. The number of Emergency Action Plans (EAPs)—essential plans used in the event of a failure to identify and notify people residing below a dam, and to coordinate their evacuation—has also increased.[9] However, the number of high hazard potential dams nationwide that have EAPs remains at a lackluster 50%. Even worse is the fact that many high hazard potential dams are unregulated and uninspected. Approximately 30% of the high hazard potential dams have not been inspected within the last five years (see Figure 1.1).

Federal agencies own or regulate a very small percentage of the 85,000 dams in the U.S. but they face significant challenges in terms of oversight.[8] As the country's dams age, downstream development increases, and better engineering methods are developed, more significant rehabilitation will be needed. Examples include the

RAISING THE GRADES
CASE STUDIES

U.S. NATURAL RESOURCES CONSERVATION SERVICE ★
Watershed Rehabilitation Program

The U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) has provided technical and funding assistance to local watershed sponsors to construct 11,000 project dams (primary purposes being flood control, water supply, and grade stabilization) since 1948—most of these dams were installed under the Watershed Protection and Flood Prevention Act (PL 83-566).[13] While these watershed project dams provide significant annual benefits, thousands of these dams need to be rehabilitated: 1,065 watershed dams have already exceeded their design life and by 2015 an additional 4,300 dams will have exceeded their design life; 1,000 dams need to be rehabilitated due to stricter dam safety standards as a result of downstream development greatly increasing the consequences of a dam failure.

The NRCS has implemented a very successful program to provide assessments, planning, designs, and construction funding to begin the enormous task of repairing watershed dams throughout the U.S. The success of the program has been a result of partnerships between the NRCS, local sponsors, and state dam safety officials—leadership and funding provided by Congress. The design and construction funding is cost-shared—65% is provided by the NRCS and 35% is provided through local participation. To date, 77 dams have been rehabilitated, an additional 55 have been authorized for construction, and another 31 are in the planning phase.

Congress has continued its leadership role by providing $100 million in the 2008 Farm Bill (mandatory funding) and has authorized $85 million to be appropriated for fiscal years 2008 through 2012 (discretionary funding) to support the Watershed Rehabilitation Program. Over the next four years (FY 2009–2012), the NRCS anticipates performing 400 dam assessments, processing 250 local sponsor requests for assistance, developing 200 rehabilitation plans, completing 170 designs, and rehabilitating 120 watershed dams.

$317 million rehabilitation of Wolf Creek Dam, which is owned by the USACE, and the major improvements to Folsom Dam, which were jointly undertaken by the USACE and the U.S. Bureau of Reclamation at an estimated cost of $1.5 billion through 2019.

In 2009, the Association of State Dam Safety Officials (ASDSO) estimated that the total cost to repair the nation's dams totaled $50 billion and the needed investment to repair high hazard potential dams totaled $16 billion. These estimates have increased significantly since ASDSO's 2003 report, when the needed investment for all dams was $36 billion and the needed investment for high hazard potential dams was $10.1 billion.[4]

The 2009 report noted an additional investment of $12 billion over 10 years will be needed to eliminate the existing backlog of 4,095 deficient dams. That means the number of high hazard potential dams repaired must be increased by 270 dams per year above the number now being repaired, at an additional annual cost of $850 million a year. To address the additional 2,276 deficient—but not high hazard—dams, an additional $335 million per year is required, totaling $3.4 billion over the next 10 years.[4]

While much progress in identifying the condition of the nation's dams has been made since the implementation of the NID, the 2008 failure of a dam retaining coal ash from a power plant in Tennessee points out significant gaps in the regulation of dams associated with the power and mining industry at both the federal and state levels. Many states do not have the authority to regulate mining dams, other states only regulate mining dams after the mining operation has stopped, and some states regulate mining dams through departments other than those that administer the dam safety program. At the federal level there are significant differences in regulatory standards between the coal mining industry and the metal/nonmetal industries regarding standards for design, inspection, and the requirements to provide EAPs for high hazard dams.

RESILIENCE

Dams are generally not very resilient because few have redundant structures, many have regional impacts, and only 50% of high hazard dams have EAPs.

The U.S. Department of Homeland Security, through the Office of Infrastructure Protection, has started addressing this important issue in collaboration with the dam safety and dam security communities, federal and state agencies, and the entire spectrum of owners and operators. Given the large number of dams and their broad range of resiliency levels, efforts are being made to develop a rational prioritization approach for coordinating protection programs and resiliency enhancements. Important physical and functional characteristics of dams—such as the consequence of failure and loss of critical benefits—are considered the basis for identifying which dams would have the most severe and long lasting impact if service was lost (drinking water, hydropower, flood damage reduction, inland

RAISING THE GRADES
CASE STUDIES

BEXAR COUNTY, TX ★ Martinez Creek Dam No. 5

When it was constructed in 1964, the Martinez Creek Dam was designed to protect agricultural lands. Since that time, development in the area has increased and the lake formed by the dam is an integral part of the city of Live Oak's park system. County officials applied to the NRCS Small Watershed Rehabilitation Program for grants to rehabilitate the dam since its hazard level had increased from low to high. Since the dam was raised and the spillway upgraded, engineers now expect the dam to last another 100 years. *Photo courtesy of the San Antonio River Authority.*

RINGWOOD, NJ ★ Skyline Lake Dam

Following several devastating flood events that resulted in more than 35 dam failures, the state of New Jersey developed funding programs for the rehabilitation of dams. Two state bond acts have provided the New Jersey Department of Environmental Protection, Bureau of Dam Safety and Flood Control, with $110 million to administer low interest loans for dam rehabilitation projects. Twenty-four dams, including 19 high hazard dams, have been completed so far; 29 more, including 10 high hazard dams, are under construction; and 45, including 11 high hazard dams, are in some stage of planning and design. Owners of the Skyline Lake Dam applied to this state program and received $900,000 to reconstruct the concrete spillway and stabilize the earth embankment to allow for overtopping during a storm. Overall, approximately $32.8 million has been disbursed from the program to date. *Photo courtesy of New Jersey Department of Environmental Protection, Office of Engineering and Construction.*

RAISING THE GRADES
CASE STUDIES

SANDOVAL COUNTY, NM ★ NRCS Rehabilitated Dam

Just outside of Albuquerque, New Mexico, the Piedra Liza Dam today protects seven times as many people as when it was built in the early 1950s. Analyses in the early 2000s showed deficiencies within the dam and should it fail, as many as 1,700 residents in the area and 43,000 commuters on Interstate 25 could be adversely affected. Sandoval County applied to the NRCS Small Watershed Rehabilitation Program for assistance in 2005 and by 2007 repairs had been completed. *Photo courtesy of the U.S. Natural Resources Conservation Service.*

navigation, etc.). By considering the impact on all sectors—public safety, local commerce, service suppliers, etc.—in the risk evaluation process, strategies that target increased resilience and improved security can be effectively identified.

CONCLUSION

Despite some successes, the overall condition of the nation's dams has not improved in recent years. This is evidenced by the rising numbers of dams—especially high hazard dams—that are deficient and in need of repair as well as by the limited number of dams that are actually repaired each year. In order to make significant improvements in the nation's dams—a matter of critical importance to public health, safety and welfare—Congress, the administration, state dam safety programs, and dam owners will have to develop an effective inspection, enforcement and funding strategy to reverse the trend of increasingly deteriorating dam infrastructure. ★

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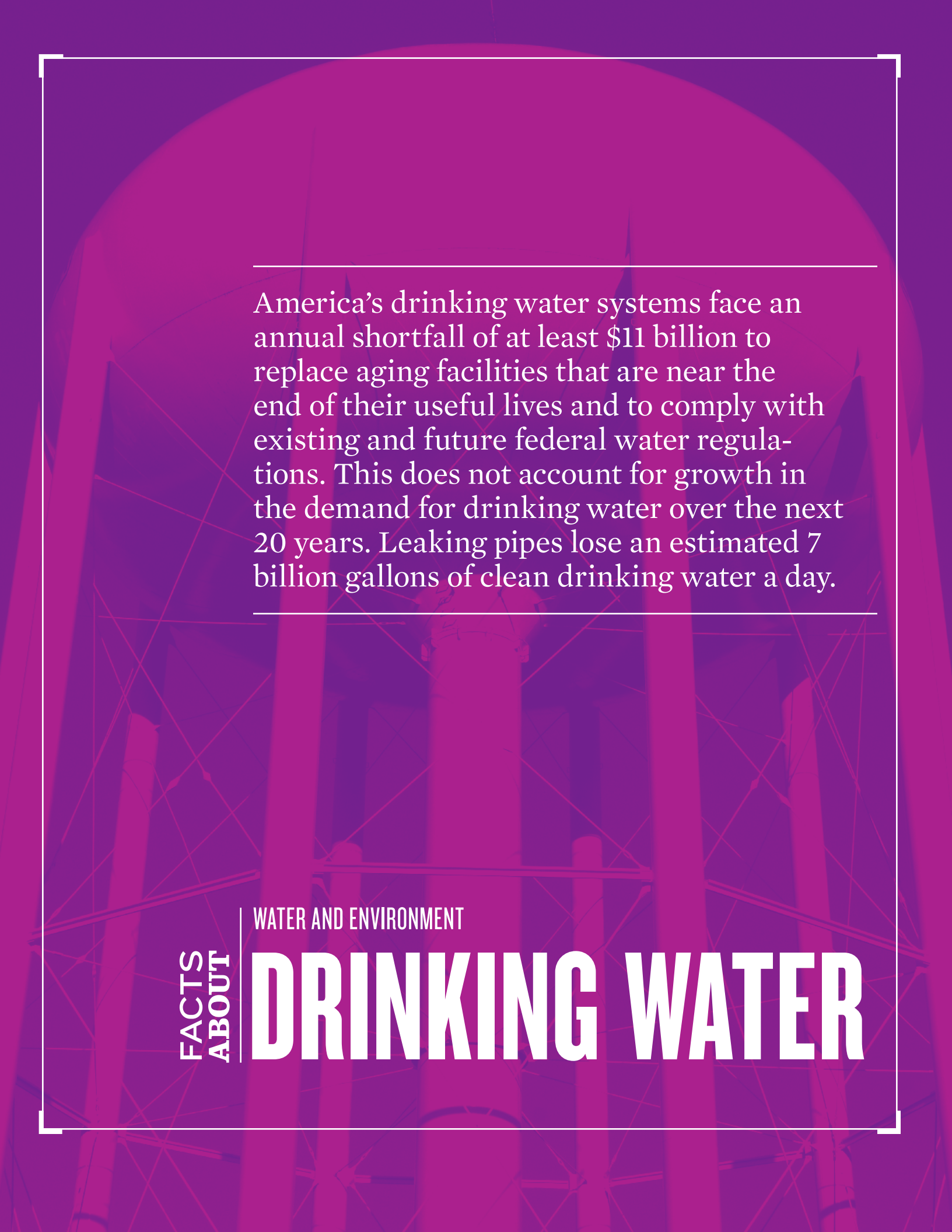


America's drinking water systems face an annual shortfall of at least $11 billion to replace aging facilities that are near the end of their useful lives and to comply with existing and future federal water regulations. This does not account for growth in the demand for drinking water over the next 20 years. Leaking pipes lose an estimated 7 billion gallons of clean drinking water a day.

WATER AND ENVIRONMENT

FACTS ABOUT DRINKING WATER

WATER AND ENVIRONMENT

DRINKING WATER

2009 GRADE **D-**

RAISING THE GRADES

SOLUTIONS

THAT WILL WORK **NOW**

A = Exceptional
B = Good
C = Mediocre
D = Poor
F = Failing

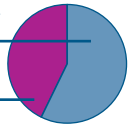
AMERICA'S INFRASTRUCTURE G.P.A. **D**

ESTIMATED 5-YEAR FUNDING REQUIREMENTS FOR **DRINKING WATER AND WASTEWATER**

Total investment needs
$255 BILLION

Estimated spending
$146.4 BILLION

Projected shortfall
$108.6 BILLION



★ **INCREASE** funding for water infrastructure system improvements and associated operations through a comprehensive federal program;

★ **CREATE** a Water Infrastructure Trust Fund to finance the national shortfall in funding of infrastructure systems under the Clean Water Act and the Safe Drinking Water Act, including storm-water management and other projects designed to improve the nation's water quality;

★ **EMPLOY** a range of financing mechanisms, such as appropriations from general treasury funds, issuance of revenue bonds and tax exempt financing at state and local levels, public-private partnerships, state infrastructure banks, and user fees on certain consumer products as well as innovative financing mechanisms, including broad-based environmental restoration taxes to address problems associated with water pollution, wastewater management and treatment, and storm-water management.

CONDITIONS

The nation's drinking-water systems face staggering public investment needs over the next 20 years. Although America spends billions on infrastructure each year, drinking water systems face an annual shortfall of at least $11 billion in funding needed to replace aging facilities that are near the end of their useful life and to comply with existing and future federal water regulations. The shortfall does not account for any growth in the demand for drinking water over the next 20 years.[2]

Of the nearly 53,000 community water systems, approximately 83% serve 3,300 or fewer people. These systems provide water to just 9% of the total U.S. population served by all community systems. In contrast, 8% of community water systems serve more than 10,000 people and provide water to 81% of the population served. Eighty-five percent (16,348) of nontransient, noncommunity water systems and 97% (83,351) of transient noncommunity water systems serve 500 or fewer people. These smaller systems face huge financial, technological, and managerial challenges in meeting a growing number of federal drinking-water regulations.

In 2002, the U.S. Environmental Protection Agency (EPA) issued The Clean Water and Drinking Water Infrastructure Gap Analysis, which identified potential funding gaps between projected needs and spending from 2000 through 2019. This analysis estimated a potential 20-year funding gap for drinking water capital expenditures as well as operations and maintenance, ranging from $45 billion to $263 billion, depending on spending levels. Capital needs alone were pegged at $161 billion.[2]

The Congressional Budget Office (CBO) concluded in 2003 that "current funding from all levels of government and current revenues generated from ratepayers will not be sufficient to meet the nation's future demand for water infrastructure." The CBO estimated the nation's needs for drinking water investments at between $10 billion and $20 billion over the next 20 years.[3]

In 1996, Congress enacted the drinking-water state revolving loan fund (SRF) program. The program authorizes the EPA to award annual capitalization grants to states. States then use their grants (plus a 20% state match) to provide loans and other assistance to public water systems. Communities repay loans into the fund, thus replenishing the fund and making resources available for projects in other communities. Eligible projects include installation and replacement of treatment facilities, distribution systems, and some storage facilities. Projects to replace aging infrastructure are eligible if they are needed to maintain compliance or to further public health protection goals.

Federal assistance has not kept pace with demand, however. Between FY 1997 and FY 2008, Congress appropriated approximately $9.5 billion for the SRF. This 11-year total is only slightly more than the annual capital investment gap for each of those years as calculated by the EPA in 2002.

RAISING THE GRADES
CASE STUDIES

ORANGE COUNTY, CA ★ Groundwater Replenishment System

The California Department of Water Resources predicts that by 2020, the entire state will experience water shortages equal to the needs of 4 to 12 million families of four for one year. To meet growing demand and reduce reliance on water imported from northern California and the Colorado River, the Orange County Water District developed the Groundwater Replenishment (GWR) System that takes highly treated sewer water and purifies it to levels that meet state and federal drinking water standards. GWR System water will be between 35% to 75% cheaper than water produced by seawater desalination and the purification process will consume about half the energy. *Photos courtesy of Orange County Water District.*

TABLE 2.1 ★ Design Life of Drinking Water Systems

COMPONENTS	YEARS OF DESIGN LIFE
Reservoirs and Dams	50–80
Treatment Plants—Concrete Structures	60–70
Treatment Plants—Mechanical and Electrical	15–25
Trunk Mains	65–95
Pumping Stations—Concrete Structures	60–70
Pumping Stations—Mechanical and Electrical	25
Distribution	60–95

SOURCE US EPA Clean Water and Drinking Water Infrastructure Gap Analysis Report, September 2002

TABLE 2.2 ★ Water Usage: 1950 and 2000

	1950	2000	PERCENT CHANGE
Population (Millions)	93.4	242	159%
Usage (Billions of Gallons per Day)	14	43	207%
Per Capita Usage (Gallons per Person per Day)	149	179	20%

SOURCE US EPA Clean Water and Drinking Water Infrastructure Gap Analysis Report, September 2002

RESILIENCE

Drinking water systems provide a critical public health function and are essential to life, economic development, and growth. Disruptions in service can hinder disaster response and recovery efforts, expose the public to water-borne contaminants, and cause damage to roadways, structures, and other infrastructure, endangering lives and resulting in billions of dollars in losses.

The nation's drinking-water systems are not highly resilient; present capabilities to prevent failure and properly maintain or reconstitute services are inadequate. Additionally, the lack of investment and the interdependence on the energy sector contribute to the lack of overall system resilience. These shortcomings are currently being addressed through the construction of dedicated emergency power generation at key drinking water utility facilities, increased connections with adjacent utilities for emergency supply, and the development of security and criticality criteria. Investment prioritization must take into consideration system vulnerabilities, interdependencies, improved efficiencies in water usage via market incentives, system robustness, redundancy, failure consequences, and ease and cost of recovery.

The question is not whether the federal government should take more responsibility for drinking water improvements but how it should take more responsibility.

RAISING THE GRADES
CASE STUDIES

LOUISVILLE, KY ★ American Recovery and Reinvestment Act Funding

The Louisville Water Company has proposed $11 million in projects that could be funded as part of the 2009 American Recovery and Reinvestment Act (P.L. 111-005). The projects would rehabilitate 75 miles of water main to extend the useful life of the system and reduce water main breaks. In addition, 9.5 miles of water main would be replaced to improve water quality, fire hydrant flow and reduce maintenance. Together, the projects would support 101 jobs.

PORT ANGELES, WA ★ Downtown Water Main Project

In 2008, the City of Port Angeles completed a project to replace the water mains and sidewalks in the downtown area. The replacement water mains bring the city's downtown area to a service level that meets current fire flow standards, reduces seismic risks and helps prevent water main failures due to age. The original water mains were installed in 1914. In conjunction with the water main replacement, many sidewalks were replaced with pavers that enhance the downtown appearance. Also, new conduit and wiring was installed for street and pedestrian lighting. *Photos courtesy of the City of Port Angeles.*

CONCLUSION

New solutions are needed for what amounts to nearly $1 trillion in critical drinking water and wastewater investments over the next two decades. Not meeting the investment needs of the next 20 years risks reversing public health, environmental, and economic gains of the past three decades.

Without a significantly enhanced federal role in providing assistance to drinking water infrastructure, critical investments will not occur. Possible solutions include grants, trust funds, loans and incentives for private investment. The question is not whether the federal government should take more responsibility for drinking water improvements but how it should take more responsibility.

The case for federal investment is compelling. Needs are large and unprecedented; in many locations, local sources cannot be expected to meet this challenge alone, and because waters are shared across local and state boundaries, the benefits of federal help will accrue to the entire nation. Clean and safe water is no less a national priority than are national defense, an adequate system of interstate highways, and a safe and efficient aviation system. These latter infrastructure programs enjoy sustainable, long-term federal grant programs; under current policy, water and wastewater infrastructure do not. ★

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Redevelopment of brownfields sites over the past five years generated an estimated 191,338 new jobs and $408 million annually in extra revenues for localities. In 2008, however, there were 188 U.S. cities with brownfields sites awaiting cleanup and redevelopment. Additionally, federal funding for "Superfund" cleanup of the nation's worst toxic waste sites has declined steadily, dropping to $1.08 billion in 2008, its lowest level since 1986.

WATER AND ENVIRONMENT

FACTS ABOUT

HAZARDOUS WASTE

WATER AND ENVIRONMENT

HAZARDOUS WASTE

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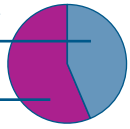
AMERICA'S INFRASTRUCTURE G.P.A. **D**

ESTIMATED 5-YEAR FUNDING REQUIREMENTS FOR **HAZARDOUS WASTE AND SOLID WASTE**

Total investment needs
$77 BILLION

Estimated spending
$33.6 BILLION

Projected shortfall
$43.4 BILLION



★ **REAUTHORIZE** federal Superfund taxes on chemicals, petroleum, and corporations or create another federal funding mechanism to revive the Hazardous Substance Superfund cleanup program and remove the cost of cleanup from the general fund;

★ **IMPLEMENT** legislation—incentive programs, for example—that considers environmental costs and encourages the reduction of hazardous waste at the source and the design of reuse programs;

★ **ENACT** the Brownfields Revitalization and Environmental Restoration Act to help localities redevelop brownfield sites;

★ **CONTINUE** to fund existing federal programs to finance the revitalization of America's brownfields;

★ **CREATE** a Brownfields Redevelopment Action Grant program within the Environmental Protection Agency to provide investment funds for local governments that would allow private investments to be leveraged in order to help preserve farmland and open spaces.

CONDITIONS

Superfund

Since Congress enacted the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA or Superfund) in December 1980, corrective action has been taken at thousands of contaminated sites across the country. However, nearly 30 years of federal attention to cleaning up contaminated sites has done little to reduce the problem. As of November 2008, 1,255 sites were listed on the National Priorities List (NPL), down only slightly from 1,273 sites in 2004, and another 9,957 sites were awaiting evaluation for possible listing.[3]

While the number of sites remains relatively constant, federal funding during the last 20 years has systematically decreased. When it was enacted, CERCLA established the Superfund Trust Fund, which was funded by a corporate environmental income tax and excise taxes on petroleum and specified chemicals. The trust fund received approximately $1.5 billion per year before the legislative authority authorized to collect the taxes expired on December 31, 1995. While there has been some interest in reinstating the taxes, there has been little legislative action. Superfund cleanup is currently funded through the ongoing appropriations process.[4]

Between fiscal years 1981 and 2005 Congress appropriated $29.3 billion to aid in the cleanup of hazardous waste sites under Superfund. Billions more were appropriated to clean up leaking underground storage tanks and brownfields sites. The states have also contributed billions to hazardous-waste cleanups. Even as the need has grown, annual congressional appropriations for Superfund have steadily declined in recent years after topping $2 billion in fiscal year 1998. The appropriation for both fiscal years 2007 and 2008 was $1.08 billion, the lowest level since fiscal year 1986.[2] Higher funding levels have been proposed in the last two years but have not been enacted because of incomplete congressional appropriations processes, which result in the same level of funding being carried on from the previous year.

The Environmental Protection Agency's (EPA) 2004 report *Cleaning up the Nation's Wastes Sites* estimated that as many as 350,000 contaminated sites will require cleanup during the next 25 years. Assuming that current regulations and practices remain the same, it could cost as much as $250 billion to clean up those sites.[5] No updated data have been released, but current cleanup costs could be much higher when inflation is taken into account.

Meanwhile, the pace of cleanups is slowing. For much of the 1990s the EPA averaged more than 70 construction-complete sites per year. However, since 2000 the number of newly completed sites has decreased dramatically. In fiscal year 2003 there were just 40 NPL sites deemed to be complete, and in 2007 and 2008 the EPA reported that only 24 and 30 sites were completed, respectively.[6]

RAISING THE GRADES
CASE STUDIES

AUSTIN, TX ★ Grove Landfill

In 2004, the Rhizome Collective received a $200,000 Brownfields Cleanup Grant from the EPA to remediate and restore the 9.8-acre Grove Landfill site. The site included a former landfill, which was open from 1967 to 1970 and then subjected to illegal dumping for approximately 15 years following its closure. Subsequent tests revealed the presence of harmful chemicals and other materials. Of Austin's 656,562 residents at the time, 39,105 lived in the area surrounding the Grove Landfill site. The collective implemented a green remediation strategy for the cleanup, which included salvaging wood scraps and concrete to be used for erosion control, chipping wood to create mulch for recreational trails, recycling 31.6 tons of metal, salvaging concrete to be used as fill for building infrastructure, and powering equipment with biofuel generators and photovoltaic panels. Following the cleanup, the site was turned into an environmental education park that promotes sustainable concepts.

Brownfields

Across the country, hundreds of thousands of former industrial and commercial sites potentially containing hazardous waste sit idle awaiting remediation. Most of these abandoned or underutilized facilities are in urban areas. Shifts in resources, industries, technical expertise, and wealth are the primary cause for environmental degradation and loss of economic viability. Remediated brownfield sites, however, can provide improvements in health and public safety, environmental benefits, and economic development.

According to a survey by the U.S. Conference of Mayors, there were 24,896 brownfield sites awaiting redevelopment in 2008 in 188 cities nationwide. In addition, more than 150 cities had successfully redeveloped 1,578 brownfield sites, return-

More than 150 cities had successfully redeveloped 1,578 brownfield sites, returning more than 10,000 acres to economic productivity in 2007. These actions resulted in $408 million in new municipal revenues in 62 cities and more than 191,338 jobs—a dramatic increase from $90 million and 83,000 jobs in 2004.

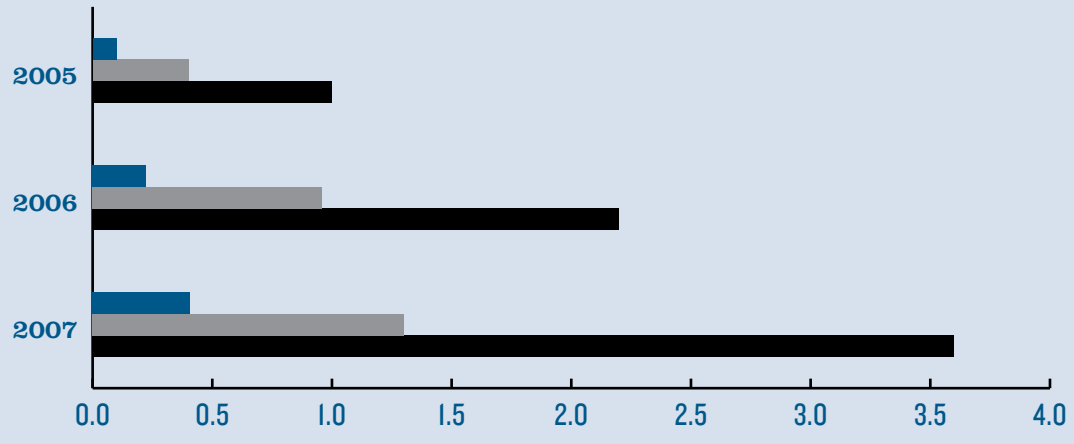
The pace of cleanups is slowing. For much of the 1990s the EPA averaged more than 70 construction-complete sites per year. However, since 2000 the number of newly completed sites has decreased dramatically.

ing more than 10,000 acres to economic productivity. These actions resulted in $408 million in new municipal revenues in 62 cities and more than 191,338 jobs—a dramatic increase from $90 million and 83,000 jobs in 2004.[1]

Of the 188 cities with idle brownfields, 148 reported that a total of 576,373 new jobs and as much as $1.9 billion annually could be generated if the sites were redeveloped.[1]

The country's mayors identified insufficient funding, environmental assessment, lack of money for demolition and liability concerns as the leading obstacles to redevelopment. Currently, 3,282 sites in 150 cities have been "mothballed"—designated by developers or owners as having no chance of redevelopment.[1]

FIGURE 3.1 ★ Tax Revenue from Brownfields Redevelopment in Billions of Dollars



The nation's mayors estimate that with additional funding for brownfields redevelopment, far more tax revenues could be realized.

SOURCE US Conference of Mayors, Recycling America's Land: 2008 Brownfields Redevelopment Report

RAISING THE GRADES
CASE STUDIES

SEQUIM BAY, WA ★ Sequim Bay Estuary Restoration

After a century of sitting at the hub of the area's timber industry, the Sequim Bay Estuary in northwest Washington State suffered from sediment pollution and habitat degradation. After receiving a Brownfields Cleanup Grant from the EPA and partnering with state, local, and private stakeholders, the Jamestown S'Klallam Tribe began restoring the estuary's natural features as part of its plan to clean up the entire Sequim Bay. The project removed 99 creosote pilings that were used to store timber waiting to be shipped out to sea as well as contaminated soil and solid waste, restoring an 82-acre area to its natural ecosystem. Since the cleanup's completion in 2005, the area is experiencing increased economic benefits from tourism and fishing.[7]
Photo courtesy of the Jamestown S'Klallam Tribe.

RAISING THE GRADES
CASE STUDIES

PROVIDENCE, RI ★ Brownfield Cleanup

Decades of industrial activity in a downtown area of Providence contaminated a seven-acre site with lead, arsenic, and other hazardous substances. In 2006, the nonprofit educational corporation Meeting Street secured a $200,000 Brownfields Cleanup Grant from the EPA, which paid for site remediation. The group also secured funding from government and private sources to build a new educational facility. The center, built to Leadership in Energy and Environmental Design (LEED) standards,

includes an elementary school and a middle school as well as special services for disabled and low-income students and other amenities available for community use.[7] *Photo courtesy of the U.S. Environmental Protection Agency.*

RESILIENCE

In order to be resilient, brownfield sites must be sustainable, ensuring that needs of both current and future generations are met. Future investments must address innovative technologies, security, and lifecycle maintenance of the sites. A resilience strategy that addresses both disposal and cleanup of existing sites can help improve public perception in accepting the creation and location of new waste disposal facilities.

CONCLUSION

Hazardous waste sites across the country hold enormous potential for economic growth and community redevelopment. However, we risk losing access to those benefits if funding is not increased and the pace of remediation is not accelerated. To restore these sites to a safe and usable condition, both public and private organizations must work together. ★

SOURCES

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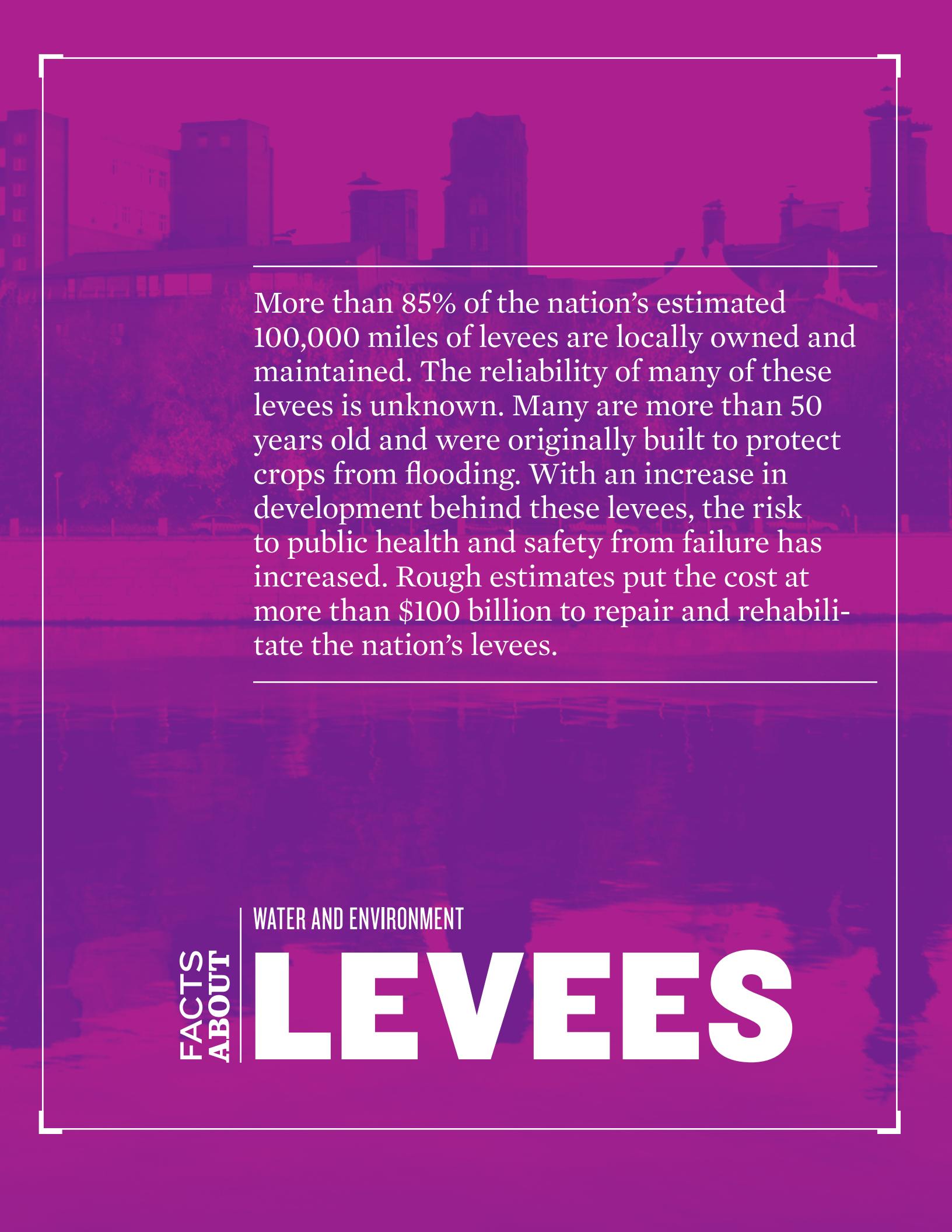

More than 85% of the nation's estimated 100,000 miles of levees are locally owned and maintained. The reliability of many of these levees is unknown. Many are more than 50 years old and were originally built to protect crops from flooding. With an increase in development behind these levees, the risk to public health and safety from failure has increased. Rough estimates put the cost at more than $100 billion to repair and rehabilitate the nation's levees.

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2009 GRADE **D-**

RAISING THE GRADES

SOLUTIONS

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A = Exceptional
B = Good
C = Mediocre
D = Poor
F = Failing

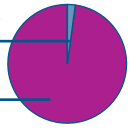
AMERICA'S INFRASTRUCTURE G.P.A. **D**

ESTIMATED 5-YEAR FUNDING REQUIREMENTS FOR **LEVEES**

Total investment needs
$50 BILLION

Estimated spending
$1.13 BILLION

Projected shortfall
$48.87 BILLION



★ **ADOPT** the following recommendations from the 2009 National Committee on Levee Safety:
ESTABLISH a National Levee Safety Commission;
COMPLETE the National Levee Inventory for both federal and nonfederal levees. The inventory must be regularly updated and maintained;
ADOPT a hazard potential classification system;
CREATE a strong education and outreach program to inform local leaders and residents about the level of protection they can expect from a nearby levee;[5]

★ **PHASE** in mandatory purchase of flood insurance with risk-based premiums for structures in areas protected by levees;

★ **INCREASE** funding at all levels of government to address structural and nonstructural solutions that reduce risk to people and property. Additionally, investments should be targeted to address life-cycle costs and research;

★ **REQUIRE** the development and exercising of emergency action plans for levee-protected areas;

★ **ENSURE** that operation and maintenance plans cover all elements of the system, recognizing that levees are part of complex systems that also include pumps, interior drainage systems, closures, penetrations, and transitions;

★ **ASSESS** levees using updated hydrology and hydraulic analyses that incorporate the impact of urbanization and climate change, particularly for coastal levees.

CONDITION

The state of the nation's levees has a significant impact on public safety. Levees are man-made barriers (embankment, floodwall, structure) along a water course constructed for the primary purpose of providing hurricane, storm and flood protection. Levees are often part of complex systems that include not only levees and floodwalls, but also pumps, interior drainage systems, closures, penetrations, and transitions. Many levees are integral to economic development in the protected community.

Federal levee systems currently provide a six-to-one return on flood damages prevented compared to initial building cost.[1] Despite this, baseline information has not been systematically gathered through inspections and post-flood performance observations and measurements to identify the most critical levee safety issues, quantify the true costs of levee safety, prioritize future funding, and provide data for risk-based assessments in an efficient or cost-effective manner.

There is no definitive record of how many levees there are in the U.S., nor is there an assessment of the current condition and performance of those levees. Recent surveys by the Association of State Dam Safety Officials and the Association of State Floodplain Managers found that only 10 states keep any listing of levees within their borders and only 23 states have an agency with some responsibility for levee safety. The Federal Emergency Management Agency (FEMA) estimates that levees are found in approximately 22% of the nation's 3,147 counties. Forty-three percent of the U.S. population lives in counties with levees.[4] Many of those levees were designed decades ago to protect agricultural and rural areas, not the homes and businesses that are now located behind them.[4]

In the aftermath of hurricanes Katrina and Rita in 2005, Congress passed the Water Resources Development Act (WRDA) of 2007. The Act required the establishment and maintenance of an inventory of all federal levees, as well as those non-federal levees for which information is voluntarily provided by state and local government agencies. The inventory is intended to be a comprehensive, geospatial database that is shared between the U.S. Army Corps of Engineers (USACE), FEMA, the Department of Homeland Security (DHS), and the states.

While the USACE has begun the inventory of all federal levees, to date few states or local agencies have provided any formal information, leaving the inventory far from complete. In addition, there is still much to be determined about the condition and performance of the nation's levees, both federal and nonfederal. As of February 2009, initial results from USACE's inventory show that while more than half of all federally inspected levees do not have any deficiencies, 177, or about 9%, are expected to fail in a flood event. The inventory data collection process is ongoing and these preliminary findings are expected to change as the process continues.[1, 6]

WRDA 2007 also created a committee to develop for the first time recom-

TABLE 4.1 ★ Damages from Flooding in Levee-Related Areas

LOCATION/YEAR	DAMAGES IN DOLLARS
Midwest 1993	$272,872,070
North Dakota/Minnesota 1997	$152,039,604
Hurricane Katrina 2005	$16,467,524,782
Midwest 2008	$583,596,400

SOURCE National Committee on Levee Safety

mendations for a national levee safety program. The National Committee on Levee Safety completed its work in January 2009 and the panel recommended that improvements in levee safety be addressed through comprehensive and consistent national leadership, new and sustained state levee safety programs, and an alignment of existing federal programs.[1]

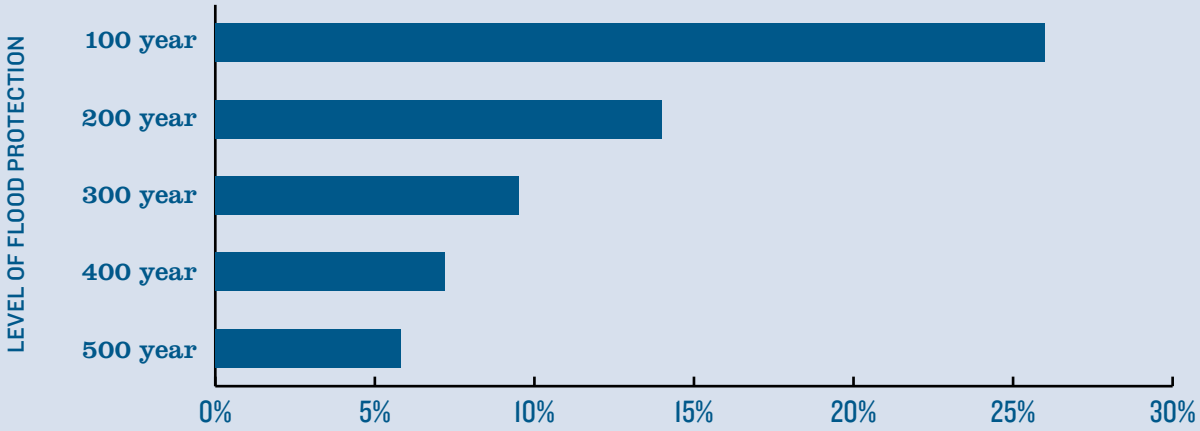
Often, the risk of living behind levees is not well-known, and the likelihood of flooding is misunderstood. For this reason, little focus is placed on measures that the public can take to mitigate their risks. Though the 1% annual chance flood event ("100-year flood") is believed by many to be an infrequent event, in reality there is at least a 26% chance that it will occur during the life of a 30-year mortgage. The likely impacts of climate change are expected to increase the intensity and frequency of coastal storms and thereby increase the chance of flooding.[5]

In 1968, Congress enacted the National Flood Insurance Program (NIFP). One of the primary purposes of the NFIP was to address the inability of the public to secure privately backed insurance for economic losses from flooding. The NFIP designated the 1% annual chance event ("100-year flood") as a special flood hazard area in which those holding federally backed mortgages would be required to purchase flood insurance.

Never intended to be a safety standard, the 1% annual chance event became the target design level for many levees because it allowed development to con-

There is no definitive record of how many levees there are in the U.S., nor is there an assessment of the current condition and performance of those levees.

FIGURE 4.1 ★ Likelihood of Levee Failure/Flooding Over a 30-Year Residential Mortgage



SOURCE National Committee on Levee Safety

tinue while providing relief from mandatory flood insurance purchase for homeowners living behind accredited levees. Allowing levees to simply meet the minimum requirements of the NFIP has created an unintentional—and potentially dangerous—flood insurance standard that is now used as a safety standard.

During the past 50 years there has been tremendous development on lands protected by levees. Coupled with the fact that many levees have not been well maintained, this burgeoning growth has put people and infrastructure at risk—the perceived safety provided by levees has inadvertently increased flood risks by attracting development to the floodplain. Continued population growth and economic development behind levees is considered by many to be the dominant factor in the national flood risk equation, outpacing the effects of increased chance of flood occurrence and the degradation of levee condition. Unfortunately, lands protected by levees have not always been developed in a manner that recognizes the benefits of the rivers and manages the risk of flooding.

Additionally, in the absence of a comprehensive levee inventory, there are many uncertainties regarding location, performance, and condition of levees. There has been a lack of formal government oversight, sufficient technical standards, and effective communication of the risks of living behind a levee, further placing people and property in danger of floods.

Finally, FEMA's Flood Map Modernization Program, which remaps floodplains using modern technologies, is resulting in a reexamination of levees throughout the United States to determine if they can still be accredited. Before accrediting a levee, FEMA is requiring many communities to certify that their levees meet the 1% criteria.

RAISING THE GRADES
CASE STUDIES

UNITED STATES ★ National Levee Safety Commission

After decades of ignoring the safety and condition of the nation's levees, the U.S. Congress in 2007 recognized the dangers that a lack of a federal levee safety program posed to the nation. As part of the Water Resources Development Act, the USACE was charged with developing guidelines for a program and released its report in January 2009. This, in conjunction with the national levee inventory, is an important first step to protecting lives and property behind the nation's levees.

CALIFORNIA ★ Investment in Levees

There are more levees in California than in any other state. The levee systems in California are fragile and subject to the risk of failure. Estimates put the cost of bringing the state's levees and flood control system up to good condition at $42.2 billion. In February 2006, Governor Arnold Schwarzenegger proclaimed a state of emergency for the California levee system to address the problems. Voters in the state agreed with the need for comprehensive repairs and modernization and approved a multibillion-dollar bond issue to begin the funding process in 2006. *Photo courtesy of the California Department of Water Resources, Division of Safety of Dams.*

RAISING THE GRADES
CASE STUDIES

MISSISSIPPI RIVER ★ Levee Protection

Since 1885, the USACE has been armoring more than 1,000 miles of levees on the Mississippi River to prevent scour and protect the population behind the levee. Over the years, the Corps has developed a process of plating the levees with concrete mats that prevent erosion. To date, about 95% of the levees under the New Orleans District jurisdiction, which reaches as far north as Cairo, Illinois, have been armored and the bulk of work performed today is maintenance on the work completed in the last century.[7] **BELOW:** USACE mat sinking unit, placing concrete revetment mattresses along the Mississippi in Poydras, Louisiana. *Photo courtesy of Angelle Bergeron, New Orleans Correspondent,* Engineering News-Record.

Flood insurance is one of the most effective ways to limit financial damages in the case of flooding and speed recovery of flood damaged communities. Currently, many people who live behind levees do not believe that they need flood insurance, believing that they are protected by a levee structure. Requiring the purchase of mandatory flood insurance is intended to increase the understanding that living behind even well-engineered levees has some risk. This may encourage communities to build levees to exceed the 1% annual-chance protection standard that has mistakenly become a target minimum.

RESILIENCE

Levees serve to protect the public and critical infrastructure and to prevent flooding. With increasing development behind existing levees, the risk to public health and safety from failure has increased. To address the current lack of resilience in the nation's levee system, DHS has included levees within the critical infrastructure protection program in an attempt to identify those levees that present the greatest risk to the nation. DHS has also funded research to increase the robustness of levees—for example, armoring the slopes to resist erosion should floodwaters exceed the design elevation—and technologies are currently under study to rapidly repair any breaches that may occur in a levee. To ensure system integrity, future investments must also focus on life-cycle maintenance, research, development of emergency action plans for levee-protected areas, and security.

CONCLUSION

Much is still unknown about the condition of the nation's tens of thousands of miles of levees. The residual risk to life and property behind such structures cannot be ignored. Due to their impact on life and safety issues, and the significant consequences of failure, as well as the financial burden of falling property values behind levees that are not safe and are being decertified, the nation must not delay addressing levee issues. ★

SOURCES

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In 2007, the U.S. produced 254 million tons of municipal solid waste. More than a third was recycled or recovered, representing a 7% increase since 2000. Per capita generation of waste has remained relatively constant over the last 20 years. Despite those successes, the increasing volume of electronic waste and lack of uniform regulations for disposal creates the potential for high levels of hazardous materials and heavy metals in the nation's landfills, posing a significant threat to public safety.

WATER AND ENVIRONMENT

FACTS ABOUT

SOLID WASTE

WATER AND ENVIRONMENT

SOLID WASTE

2009 GRADE

C+

RAISING THE GRADES

SOLUTIONS

THAT WILL WORK **NOW**

- ★ **IMPLEMENT** a holistic approach to waste management that reduces the volume of waste landfilled, increases the amount of materials recovered and recycled, and reduces the emissions of greenhouse gasses from landfills;
- ★ **ENCOURAGE** greater use of landfill gas to energy conversion to reduce greenhouse gas emissions and create new energy resources;
- ★ **OPPOSE** legislation that restricts the interstate movement of municipal solid wastes to new regional landfills that meet all federal requirements;
- ★ **PROMOTE** the use of alternative covers and the introduction of non-indigenous liquids and other operational changes to increase the effectiveness of solid-waste landfills;
- ★ **IMPLEMENT** source reduction policies that call for better design, packaging, and life span of commercial products;
- ★ **DEVELOP** national standards to promote proper, effective, and efficient collection and recycling of waste electronics.

A = Exceptional
B = Good
C = Mediocre
D = Poor
F = Failing

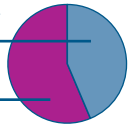
AMERICA'S INFRASTRUCTURE G.P.A. **D**

ESTIMATED 5-YEAR FUNDING REQUIREMENTS FOR **HAZARDOUS WASTE AND SOLID WASTE**

Total investment needs
$77 BILLION

Estimated spending
$33.6 BILLION

Projected shortfall
$43.4 BILLION



CONDITIONS

According to the U.S. Environmental Protection Agency (EPA), municipal solid waste (MSW), commonly known as trash or garbage, consists of everyday items from households and businesses that are deposited in landfills. Some landfills, however, do accept such non-MSW as construction by-products, wastewater sludge, or other hazardous materials.

Per capita solid waste generation in 2007 was 4.62 pounds per person per day, a slight decline from 4.65 pounds in 2000.[1] While per capita waste production has been fairly constant, MSW continues to increase with population growth. In 2007, the U.S. produced 254 million tons of municipal solid waste of all types—an increase from 239 million tons in 2000, according to the EPA. This included MSW that was generated by households, businesses, construction sites and other sources.[1]

In 1986, there were 7,683 municipal solid waste landfills in the U.S. In October 1991, the EPA adopted stringent new federal regulations for landfill design and operation to reduce groundwater contamination from hazardous materials disposed of in landfills. By 1992, the number of U.S. landfills had dropped to 5,345. By 1995, the EPA landfill census recorded only 3,581 facilities. In 2007, the agency counted 1,754 landfills—a decline of 79% within two decades.[1] According to the EPA, the nation's disposal capacity has remained relatively constant because new landfills are much larger than in the past. In 2006, the National Solid Wastes Management

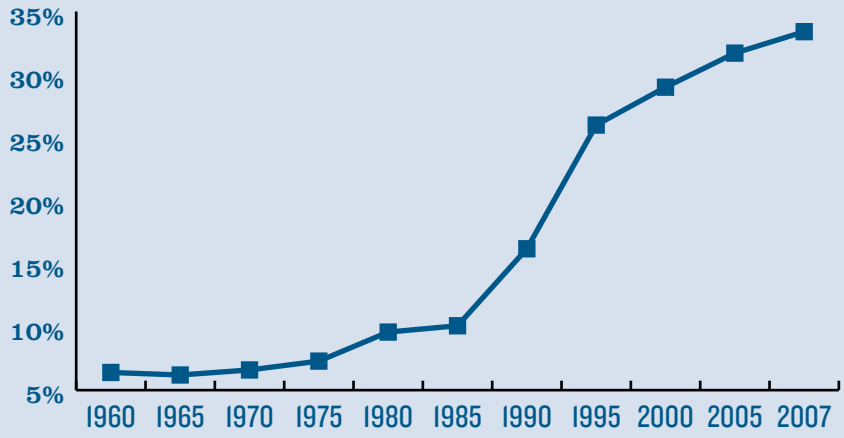
RAISING THE GRADES
CASE STUDIES

SAN FRANCISCO, CA ★ Food Scraps Diversion Program

San Francisco's food scrap diversion program—the first program of its kind in a large city—annually diverts more than 100,000 tons of primarily food scrap source-separated compostable material from the landfill for a variety of beneficial programs. The food scrap diversion program's commercial and agricultural uses include edible food redistribution, animal feed, on-site and centralized composting, conversion to energy, and grease to biodiesel.

Photo courtesy of Norcal Waste.

FIGURE 5.1 ★ Percent of Municipal Solid Waste that is Recycled: 1960–2007



SOURCE EPA Facts and Figures about Municipal Solid Waste, 2008

Association estimated that states have disposal capacity for another 20 years.[2]

Of the 254 million tons of solid waste generated in 2007, 85 million tons, or 33%, were recycled or composted compared to 30.1% in 2000; 32 million tons, or 13%, were burned in waste-to-energy (WTE) plants; and 137 million tons, or 54%, went into landfills compared to 55.3% in 2000.[1]

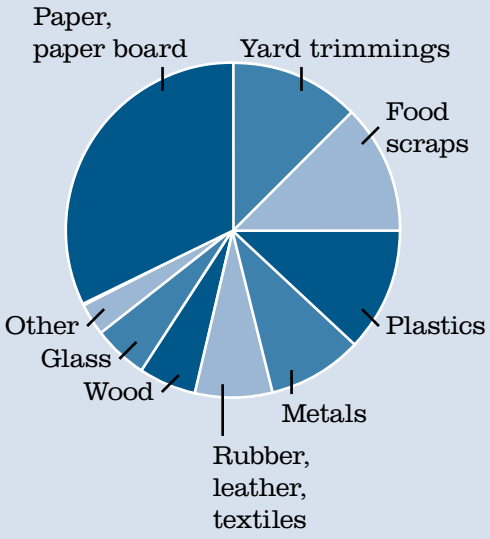
While the improvement in recycling rates is encouraging news, such issues as the improper disposal of electronic equipment and the emission of greenhouse gasses from landfills pose continued challenges.

The EPA estimates that in 2005 waste electrical and electronic equipment (WEEE) amounted to approximately two million tons, most of which was discarded in landfills. Only between 345,000 and 379,000 tons were recycled.[3] End-of-life electronics may contain such materials as lead that are hazardous to the environment when not handled and disposed of properly. No national standard on the recycling of WEEE exists, and uncoordinated state regulations can discourage consumers from recycling.[4]

In 2006, 23% of human-related methane gas emissions came from MSW landfills, making landfills the second largest producer of methane.[5] The methane gas emitted from landfills can be captured and transformed into usable energy. Despite this opportunity, at the end of 2007 only 457 landfill gas (LFG) energy projects

FIGURE 5.2 ★ Components of Municipal Solid Waste (254 million tons generated in 2007)

	% OF MSW
Paper, paper board	32.7
Yard trimmings	12.8
Food scraps	12.5
Plastics	12.1
Metals	9.2
Rubber, leather, textiles	7.6
Wood	5.8
Glass	5.3
Other	3.2



SOURCE EPA Facts and Figures About Municipal Solid Waste, 2008

were operational. These LFG programs produce approximately 11 billion kilowatt hours of electricity per year and deliver 236 million cubic feet per day of gas to direct-use applications. The EPA estimates that more than 500 additional sites are good candidates for energy conversion projects, but high start-up costs inhibit expansion of this process.[5]

RESILIENCE

Although landfills are dependent on energy and road infrastructure, as a system, solid waste disposal facilities remain resilient. However, the impacts of such landfill failures as air and groundwater pollution on surrounding neighborhoods are apparent but not well quantified, and the time required for restoration is often lengthy and costly. Additionally, landfills can play an important role during recovery operations, but without adequate disposal options cleanup and recovery efforts may be hindered.

Future investments must consider new technologies and behavioral changes focused on energy conversion, recycling, waste reduction, and increased efficiency.

RAISING THE GRADES
CASE STUDIES

ORANGE COUNTY, FL ★ Orange County Landfill

The Orange County Landfill, the third largest landfill in Florida, initiated design activities for a landfill gas-to-energy project in 1998. The electricity generated from the plant powers an estimated 13,000 homes and reduces methane emissions by nearly 31,000 tons per year at full capacity. Orange County stands to make $400,000 per year for rights to the landfill gas.[5]
Photos courtesy of Debra R. Reinhart, Ph.D., P.E., BCEE, F.ASCE.

Of the 254 million tons of solid waste generated in 2007, 85 million tons, or 33%, were recycled or composted compared to 30.1% in 2000; 32 million tons, or 13%, were burned in waste-to-energy (WTE) plants; and 137 million tons, or 54%, went into landfills compared to 55.3% in 2000.

CONCLUSION

Innovative technologies and recycling efforts have been successful in improving the safety, sustainability, and efficiency of the nation's waste disposal systems. The lack of long term strategies to deal with increased amounts of electronic waste and under-use of waste to energy practices, however, indicates the need for continued research and development of new policies and management practices. ★

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RAISING THE GRADES
CASE STUDIES

DETROIT, MI ★ Greater Detroit Resource Recovery Facility

Detroit's Resource Recovery Plant began operating in July 1989 and is currently one of the largest waste-to-energy facilities in the country in terms of capacity—the facility is permitted to process 4,000 tons of municipal solid waste per day. Everyday waste is processed into refuse-derived fuel (RDF), which is burned in stoker-fired boilers to yield steam for heating, cooling, and electricity. Approximately 3,300 tons of municipal solid waste is processed each day, yielding 3,100 tons of RDF. The facility produces 720,000 pounds of steam per hour, which is used to generate up to 68 megawatts of electricity. The resulting energy products are then sold to Detroit Edison Corporation.

Between July 1, 1989, and June 30, 1999, the facility processed 7,572,000 tons of municipal solid waste—enough waste to fill the interior of the Detroit Tigers' baseball stadium approximately 40 times. *Photos courtesy of the Greater Detroit Resource Recovery Authority.*

Aging systems discharge billions of gallons of untreated wastewater into U.S. surface waters each year. The Environmental Protection Agency estimates that the nation must invest $390 billion over the next 20 years to update or replace existing systems and build new ones to meet increasing demand.

WATER AND ENVIRONMENT

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WASTEWATER

WATER AND ENVIRONMENT

WASTEWATER

2009 GRADE **D-**

RAISING THE GRADES

SOLUTIONS

THAT WILL WORK **NOW**

- ★ **INCREASE** funding for water infrastructure system improvements and associated operations through a comprehensive program;
- ★ **CREATE** a Water Infrastructure Trust Fund to finance the national shortfall in funding of infrastructure systems under the Clean Water Act and the Safe Drinking Water Act, including stormwater management and other projects designed to improve the nation's water quality;
- ★ **RETAIN** traditional financing mechanisms, such as appropriations from general treasury funds, issuance of revenue bonds and tax exempt financing at state and local levels, public-private partnerships, state infrastructure banks, and user fees on certain consumer products;
- ★ **EXPAND** innovative financing mechanisms, including broad-based environmental restoration taxes.

A = Exceptional
B = Good
C = Mediocre
D = Poor
F = Failing

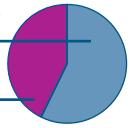
AMERICA'S INFRASTRUCTURE G.P.A. **D**

ESTIMATED 5-YEAR FUNDING REQUIREMENTS FOR **DRINKING WATER AND WASTEWATER**

Total investment needs
$255 BILLION

Estimated spending
$146.4 BILLION

Projected shortfall
$108.6 BILLION



CONDITIONS

Since 1972, Congress has directly invested more than $77 billion in the construction of publicly owned treatment works and their related facilities. State and local governments have spent billions more over the years. Total nonfederal spending on sewer and water between 1991 and 2005 was $841 billion. Nevertheless, the physical condition of many of the nation's 16,000 wastewater treatment systems is poor due to a lack of investment in plants, equipment, and other capital improvements over the years.

In 2008, the U.S. Environmental Protection Agency (EPA) reported that the total investment needs of America's publicly owned treatment works as of January 1, 2004, were $202.5 billion. This reflects an increase of $16.1 billion (8.6%) since the previous analysis was published in January 2004.[2]

In 2002, the Congressional Budget Office (CBO) estimated that for the years 2000 to 2019, annual costs for investment would need to be between $13 billion and $20.9 billion for wastewater systems.[4]

Many systems have reached the end of their useful design lives. Older systems are plagued by chronic overflows during major rainstorms and heavy snowmelt and are bringing about the discharge of raw sewage into U.S. surface waters. The EPA estimated in August 2004 that the volume of combined sewer overflows discharged nationwide is 850 billion gallons per year. Sanitary sewer overflows, caused by blocked or broken pipes, result in the release of as much as 10 billion gallons of raw sewage yearly, according to the EPA.[2]

Federal funding under the Clean Water Act State Revolving Loan Fund (SRF) program has remained flat for more than a decade. Federal assistance has not kept pace with the needs, yet virtually every authority agrees that funding needs remain very high. The U.S. must invest an additional $181 billion for all types of sewage treatment projects eligible for funding under the Act, according to the most recent needs survey estimate by the EPA and the states, completed in August 2003.[4]

In September 2002, the EPA released a detailed gap analysis, which assessed the difference between current spending for wastewater infrastructure and total funding needs. The EPA Gap Analysis estimated that over the next two decades the U.S. must spend nearly $390 billion to replace existing wastewater infrastructure systems and build new ones. The total includes money for some projects not currently eligible for federal funds, such as system replacement, which are not reflected in the EPA State Needs Survey.[5]

According to the Gap Analysis, if there is no increase in investment, there will be a roughly $6-billion gap between current annual capital expenditures for wastewater treatment ($13 billion annually) and projected spending needs. The study also estimated that if wastewater spending increases by only 3% per year, the gap would shrink by nearly 90% (to about $1 billion annually).

The CBO released its own gap analysis in 2002, in which it determined that the gap for wastewater ranges from $23 billion

RAISING THE GRADES
CASE STUDIES

SAN DIEGO, CA ★ North City Water Reclamation Plant

The City of San Diego imports approximately 90% of its water supply. To meet future water demands and decrease dependence on imported water, the city constructed the North City Water Reclamation Plant to provide reclaimed water for irrigation, landscaping and industrial use. This state-of-the-art facility can treat up to 30 million gallons of wastewater per day, and distribute the reclaimed water to customers through 79 miles of distribution pipelines. Reclaimed pipelines, sprinkler heads, meter boxes and other irrigation equipment

are color-coded purple to distinguish reclaimed water pipes from drinking water systems. The treatment facility is powered by methane piped from the Miramar Landfill and MBC digesters. *Photo courtesy of the City of San Diego.*

to $37 billion annually, depending on various financial and accounting variables.[4]

RESILIENCE

Construction, operation and maintenance, and reconstitution of service of wastewater infrastructure is expensive, and the monetary and societal costs incurred when this infrastructure fails are high. Aging, underdesigned, or inadequately maintained systems discharge billions of gallons of untreated wastewater into U.S. surface waters each year.

The nation's wastewater systems are not resilient in terms of current ability to properly fund and maintain, prevent failure, or reconstitute services. Additionally,

Sanitary sewer overflows, caused by blocked or broken pipes, result in the release of as much as 10 billion gallons of raw sewage yearly, according to the EPA.

the interdependence on the energy sector contributes to the lack of system resilience that is increasingly being addressed through the construction of dedicated emergency power generation at key wastewater utility facilities.

Future investments must focus on updating or replacing existing systems as well as building new ones to meet increasing demand; on improved operations processes, including ongoing oversight, evaluation, and asset management on a system wide basis; and watershed approaches to look more broadly at water resources in a coordinated systematic way.

CONCLUSION

If the nation fails to meet the investment needs of the next 20 years, it risks reversing public health, environmental, and economic gains of the past three decades.

The case for increased federal investment is compelling. Needs are large and unprecedented; in many locations, local sources cannot be expected to meet this challenge alone and, because waters are shared across local and state boundaries, the benefits of federal help will be disseminated throughout the nation. Clean and safe water is no less a national priority than are national defense, an adequate system of interstate highways, and a safe and efficient aviation system. Many other highly important infrastructure programs enjoy sustainable, long-term sources of federal backing, often through the use of dedicated trust funds; under current policy, water and wastewater infrastructure do not. ★

TABLE 6.1 ★ Design Life of Water Systems

COMPONENTS	YEARS OF DESIGN LIFE
Collections	80–100
Treatment Plants—Concrete Structures	50
Treatment Plants—Mechanical and Electrical	15–25
Force Mains	25
Pumping Stations—Concrete Structures	50
Pumping Stations—Mechanical and Electrical	15
Interceptors	90–100

SOURCE Clean Water and Drinking Water Infrastructure Gap Analysis Report, p. 11, EPA 816-R-02-020, September 2002

RAISING THE GRADES
CASE STUDIES

MARYSVILLE, WA ★ Pervious Paving

The City of Marysville, Washington, installed pervious paving stones instead of traditional asphalt at its Ash Avenue park-and-ride facility. Besides making the stop a much more attractive place to catch the bus, the paving stones allow stormwater to pass through and soak into the ground. The project also allowed for more parking spaces to be built because a stormwater pond was no longer needed. *Photo courtesy of Mutual Materials and UNI-GROUP U.S.A.*

RAISING THE GRADES
CASE STUDIES

WASHINGTON, D.C. ★ Sewer Separation Project

About a third of the District of Columbia is served by a single pipe that carries both wastewater and stormwater runoff. During dry weather, wastewater flows to the Blue Plains treatment plant. But during rain events, both the stormwater and wastewater from the Anacostia area flow in the same pipe, which is not big enough to handle the flows of very large storms. To prevent the combined water from backing up into homes and streets, the combined sewer system dumps the mixture into the Anacostia River. Though the untreated wastewater is diluted by stormwater, allowing this mixture to enter the river is no longer considered an acceptable solution.

To improve the health of the Anacostia River, the Washington Area Sewer Authority (WASA) is working with homeowners and businesses to separate their combined pipe into two separate pipes. DC WASA performs the separation at no charge to customers. *Photo courtesy of Washington Area Sewer Authority.*

SOURCES

1 U.S. Conference of Mayors, *Who Pays for the Water Pipes, Pumps and Treatment Works? —Local Government Expenditures on Sewer and Water (1991–2005)*, 2007, www.usmayors.org/urbanwater/07expenditures.pdf.

2 U.S. Environmental Protection Agency, *Clean Watersheds Needs Survey 2004 Report to Congress*, January 2008, www.epa.gov/owm/mtb/cwns/2004rtc/toc.htm.

3 U.S. Environmental Protection Agency, *Clean Watersheds Needs Survey 2000 Report to Congress*, January 2004, www.epa.gov/owm/mtb/cwns/2000rtc/toc.htm.

4 Congressional Budget Office, *Future Investment in Drinking Water and Wastewater Infrastructure*, May 2002, www.cbo.gov/ftpdocs/34xx/doc3472/Water.pdf.

5 U.S. Environmental Protection Agency, *The Clean Water and Drinking Water Infrastructure Gap Analysis*, September 2002, www.epa.gov/OWM/gapreport.pdf.

6 G. Tracy Mehan, Testimony before the Subcommittee on Water Resources and Environment, U.S. House Transportation and Infrastructure Committee, February 2009, http://transportation.house.gov/hearings/hearing.aspx.

RAISING THE GRADES
CASE STUDIES

UNITED STATES ★ Natural Infrastructure

In Philadelphia; Chicago; Portland, Oregon; and Milwaukee, water managers are trying to implement green infrastructure solutions or low-impact development practices. A number of these techniques are in use, including green roofs, rain barrels, rain gardens, vegetated curb extensions, porous pavement, urban reforestation, and even constructed or restored wetlands or wet meadows. The aim of these practices is to retain water on site, allowing for infiltration and evapotranspiration, thereby reducing runoff and allowing for removal of unwanted pollutants.[4]

Increasingly, communities are relying on the "natural infrastructure" as a least-cost approach to protecting surface water quality, which can generate multiple benefits such as habitat preservation, carbon sequestration, and aesthetics. Utilizing such green or natural infrastructure means less hard or gray infrastructure and reduced energy intensity, too. This trend is spreading with respect to wastewater and stormwater management in more and more utilities and communities across the country. This is especially true with respect to "urban wet weather" issues, which involve CSOs, stormwater runoff, and conventional point-source or end-of-the-pipe discharges. Increasingly, communities are meeting these challenges through a watershed approach which employs green or nonstructural approaches in tandem with traditional hard or gray infrastructure.

UNITED STATES ★ Water and Wastewater Agency Response Networks (WARN)

The WARN system created a network of water and wastewater utilities to respond to and recover from emergencies. The purpose of a WARN is to provide a response method for water and wastewater utilities that have sustained or anticipate damages from natural or human-caused incidents. WARN helps utilities communicate so they can provide and receive emergency aid and assistance in the form of personnel, equipment, materials, and other associated services as necessary from other water and wastewater utilities. The program began in early 2006 and by September 2008, 31 states were participating in WARN.