

PLANNING FOR DAM SAFETY:

*Systemic and Regulatory
Challenges*

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Abstract

Hazard Mitigation Plans, Emergency Action Plans, and Floodplain Management Plans are all prerequisites for accessing most dam safety grants administered under FEMA's National Dam Safety State Assistance and High Hazard Potential Dams programs. The U.S. boasts over 92,000 dams, with an average age estimated at 64 years, compared to a life expectancy of 50 years. The American Society of Civil Engineers gives the nation's dams a D-plus grade; current cost estimates are over \$157B to bring the nation's dams up to today's standards.

The State of Texas alone has close to 7,255 deficient dams; the actual number may be significantly higher. Of these dams, 1,491 are classified as High Hazard Potential Dams, meaning that any failure or breach would result in a significant loss of life or property downstream. Texas only regulates 1,500 of all dams in the State; the vast majority are under the jurisdiction of private owners or local municipalities.

An Emergency Action Plan (EAP) identifies potential emergency conditions at a dam and specifies preplanned actions to be followed to help prevent loss of life and minimize property damage. In 2022, FEMA updated its Hazard Mitigation Planning guide to require that a state's Hazard Mitigation Plan (HMP) address risks posed by high-hazard potential dams (HHPDs) to access FEMA funding for dam rehabilitation. In addition, FEMA requires that Floodplain Management Plans (FMPs) be updated on the completion of a dam repair, rehabilitation, or repair project.

The paper examines whether all the Planning regulations pose an unreasonable burden on the State and dam owners, place contradictory requirements, and serve as a counterincentive to national dam safety, thereby ensuring critical infrastructure is kept in good repair.

Keywords: dams, dam safety, water, critical infrastructure, planning, policy, regulatory

Table of Contents

Introduction	1
A Report Card On The Nation's Dams	1
The Problem: Current Requirements For Accessing Federal Dam Grants	5
Discussion: Eligible Activities For The National Dam Safety Program	9
Hazard Mitigation Plans.....	12
Emergency Operation Plans and Emergency Action Plans	14
Floodplain Management Plans	16
Operation and Maintenance Plans	17
Discussion: The Situation In Texas As Compared To Other States	18
Recommendations For The Future.....	21
Conclusion	23
References	24
Author Biography	27

Introduction

The US Army Corps of Engineers' National Inventory of Dams lists 92,429 dams in its national database. The Corps estimates the average age of dams in the U.S. at 64 years. Only about 5 percent of dams are federally regulated, 70 percent are state-regulated, leaving many dams without federal or state regulations. However, the 92,000+ dams may be a severe undercount. The NID only includes dams that are a minimum of six feet high and impound a reservoir of at least 50 acre-feet.¹ The Environmental and Energy Study Institute (EESI) and American Rivers, two leading advocacy groups, held a hearing in Washington, D.C. in the Summer of 2024.² Extensively discussed at the hearing titled "Dams in Every District" was an updated inventory of dams compiled by the National Aquatic Connectivity Collaborative (NACC) that estimates the true number of dams in the U.S. at over 558,000.³

A Report Card On The Nation's Dams

Many factors contribute to the life expectancy of dams. Still, it is generally believed that 50 to 100 years is a good rule of thumb, with many mechanical components of dams, such as gates and motors, needing to be replaced every 30 to 50 years.⁴ According to the American Society of Civil Engineers (ASCE), by 2030, seven out of ten dams in the U.S. will be over 50 years old.⁵ In short, many of the dams in the U.S. are past their useful life or in an increasing state of disrepair.

The ASCE, which releases a scorecard every four years of the State of the Nation's Infrastructure, is even more damning in its assessment of the condition of U.S.

¹ "National Inventory of Dams," <https://nid.sec.usace.army.mil/#/about-the-nid/mission> Accessed May 31, 2025

² "Dams in Every District: Challenges, Opportunities, and What's Ahead | Briefing | EESI," accessed December 8, 2025, <https://www.eesi.org/briefings/view/050124dams>.

³ "National Aquatic Barrier Inventory | National Aquatic Connectivity Collaborative," accessed December 8, 2025, <https://aquaticbarriers.org/inventory/>.

⁴ Cms Admin, "Life-Span of Storage Dams," *International Water Power*, March 3, 2010, <https://www.waterpowermagazine.com/analysis/life-span-of-storage-dams/>.

⁵ "Dams," *ASCE's 2021 Infrastructure Report Card* |, January 17, 2017, <https://2021.infrastructurereportcard.org/cat-item/dams-infrastructure/>.

dams. Its 2025 report ranks the nation's infrastructure at grade C, but dams receive a grade D-plus.⁶ The reasons for the poor grade are varied; however, a large part of the issue comes down to funding. Since the 2021 quadrennial report, the State of Infrastructure sees a small improvement from a C-minus to C in part due to increased funding available under the Infrastructure Investment and Jobs Act (IIJA) of 2021, which dedicated \$1.2 trillion to infrastructure.⁷ IIJA authorized approximately \$3 billion to advance dam safety, though Congress subsequently reprogrammed \$364 million of that allocation for unrelated purposes.⁸ Federal dam safety programs likewise continue to receive annual appropriations below their authorized levels, reflecting a persistent gap between statutory intent and fiscal reality.

The National Dam Safety Program (NDSP) provides states with modest annual funding of \$13.9 million to strengthen dam safety programs, while the High Hazard Potential Dam Rehabilitation Grant Program (HHPD) offers \$60 million annually for repairing the most at-risk dams. In 2021, the Infrastructure Investment and Jobs Act (IIJA) delivered a one-time \$800 million boost to these efforts, alongside \$75 million for the U.S. Army Corps of Engineers' Water Infrastructure Financing Program (CWIFP) to support non-federal projects through low-interest loans, and \$118 million for the Department of Agriculture's Small Watershed Program, which otherwise receives about \$10 million annually for dam rehabilitation.

While IIJA resources, reinforced by other Congressional actions, provided an important infusion for rehabilitation and risk reduction, these measures remain insufficient to address the scale of national need. Without a stronger and more consistent policy commitment—anchored in increased annual appropriations for inspection, monitoring, planning, and critical repairs—the backlog of deferred maintenance will expand, the cost of restoring dams to a state of good repair will escalate, and downstream communities will face heightened exposure to catastrophic failure. Sustained investment is therefore

⁶ “2025 Infrastructure Report Card,” *ASCE's 2025 Infrastructure Report Card* |, December 20, 2024, <https://infrastructurereportcard.org/>.

⁷ Peter A. [D-OR-4 Rep. DeFazio, “H.R.3684 - 117th Congress (2021-2022): Infrastructure Investment and Jobs Act,” legislation, November 15, 2021, 2021-06-04, <https://www.congress.gov/bill/117th-congress/house-bill/3684>.

⁸ “IIJA Dam Safety Pages 11-2021.Pdf,” n.d., accessed January 17, 2026, <https://asds-impexium.informz.net/ASDSO-impexium/data/images/IIJA%20Dam%20Safety%20Pages%2011-2021.pdf>.

essential to align federal funding practices with legislative mandates and to safeguard public safety.

Nearly half of the 18 infrastructure sectors that ASCE tracks resulted in improved scores, as did dams that saw an improvement from D to D-plus. A D-grade indicates infrastructure that “is in fair to poor condition and mostly below standard, with many elements approaching the end of their service life. A large portion of the system exhibits significant deterioration. Condition and capacity are of serious concern with strong risk of failure.”⁹

Dams in the United States are categorized according to their hazard potential, defined as the level of risk posed to downstream communities should a failure occur. As of August 2024, more than 16,700 dams fall into the high hazard potential category, meaning that a breach would likely result in loss of life and extensive property damage, and nearly a third of all dams are either high or significant hazard potential.¹⁰ Importantly, hazard classification reflects the consequences of failure rather than the structural condition of the dam itself. Current assessments indicate that roughly 15%—over 2,500—of these high-hazard potential dams are in poor or unsatisfactory condition.¹¹ While hazard potential is often influenced by downstream development, condition ratings are shaped by factors such as the age of the infrastructure, advances in engineering inspection techniques, severe weather events, and the impacts of climate change. Since 2012, the number of high-hazard potential dams has risen by 20%, underscoring the growing urgency for sustained investment in dam safety and risk mitigation.

One of the findings of the 2025 ASCE scorecard is that aging infrastructure systems are increasingly vulnerable to natural disasters and extreme weather events. Climate-related hazards have become increasingly pervasive, extending into regions once considered relatively insulated from such events. Flooding now occurs with greater

10 Executive-Summary-2025-Natl-IRC-WEB.Pdf,” n.d., accessed December 10, 2025, <https://infrastructurereportcard.org/wp-content/uploads/2025/03/Executive-Summary-2025-Natl-IRC-WEB.pdf>.

¹⁰ “FEMA National Dam Safety Program Overview Fact Sheet,” n.d., accessed January 17, 2026, https://www.fema.gov/sites/default/files/documents/fema_nsdp-overview-fact-sheet.pdf.

¹¹ “Dams,” *ASCE’s 2025 Infrastructure Report Card* |, January 17, 2017, <https://infrastructurereportcard.org/cat-item/dams-infrastructure/>.

frequency and severity, hurricanes generate intensified wind loads, and wildfires advance with heightened irregularity and unpredictability. Although federal and state investments have improved the state of infrastructure, a sustained level of funding is still required.

In March 2025, the Association of State Dam Safety Officials (ASDSO) updated its cost for rehabilitating the nation’s dams. According to the report, “ASDSO estimates the cost to rehabilitate the nation’s non-federal dams at \$157.5 billion, with \$34.1 billion of that amount needed just for the most critical dams. Costs will continue to rise as maintenance, repair, and rehabilitation work is deferred.”¹² The costs of dam rehabilitation are not only substantial but continue to rise sharply. According to the study, this escalation stems from multiple factors, including increased prices for construction materials and labor, as well as the expanded scope of engineering studies and analyses. ASDSO further identified funding and permitting constraints as major contributors to delays in project completion. As maintenance, repair, and rehabilitation are deferred, the financial burden will only grow, compounding risks to public safety and infrastructure resilience.

Since 2018, increasingly intense rainfall events—exacerbated by climate change— have contributed to roughly 30 dam failures or near failures across the Midwest. In June 2024, Minnesota’s Rapidan Dam experienced a western abutment failure following several days of extreme precipitation. The flood, equivalent to a once-in-a-century event, destroyed a power station and eroded part of the riverbank. Constructed in 1910, the dam had undergone multiple repairs since 2002, yet was rated in poor condition in 2023. An engineering report in 2021 projected repair costs exceeding \$15 million, in addition to more than \$6 million already spent since 2002. FEMA’s road-map for recovery, titled “Program Delivery Process Steps,” lists seven phases, each involving multiple parties and potentially taking several years to complete.¹³ Vermont illustrates similar vulnerabilities. With an average dam age of 89 years, many of the state’s structures predate modern engineering codes and were not designed to withstand the heavier, more frequent rainfall associated with a changing climate. In July 2023, a 48-hour storm dropped up to nine

¹² “SCOPE OF WORK,” n.d., accessed January 17, 2026, <https://damsafety-prod.s3.amazonaws.com/s3fspublic/files/2025%20ASDSO%20Costs%20of%20Dam%20Rehab%20Report.pdf>.
¹³ “Future of the Rapidan Dam | Blue Earth County, MN - Official Website,” accessed January 17, 2026, <https://www.blueearthcountymn.gov/1588/Future-of-the-Rapidan-Dam>.

inches of rain across parts of the state, producing historic flooding that severely strained aging dams. Inspections of 400 dams revealed that 57 were overtopped, 50 sustained notable damage, and five failed.¹⁴

These cases highlight how climate-driven extreme weather is accelerating risks for aging dam infrastructure nationwide. Although climate-induced flash floods are of concern in parts of Texas, the situation with dams in Texas is examined in greater detail in subsequent sections. Without sustained investment in modernization, inspection, and hazard mitigation measures, the combination of outdated design and intensifying precipitation will continue to magnify the threat of catastrophic dam failures and downstream community impacts.

The Problem: Current Requirements For Accessing Federal Dam Grants

Hazard mitigation is defined as “any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards.”¹⁵ Mitigation planning enables state, local, tribal, and territorial governments to identify natural hazards affecting them, identify actions and activities to reduce losses from those hazards, and establish a coordinated process to implement the plan using a wide range of resources.¹⁶

The National Dam Safety Program (NDSP) was established by Congress in the Water Resources Development Act of 1996 (Public Law 104-303) to protect lives, property, and the environment by strengthening dam safety nationwide through a coordinated partnership among FEMA, states, federal agencies, and dam owners. It provides grants, technical guidance, training, and research to help states improve inspections, emergency planning, risk communication, and rehabilitation, while promoting

¹⁴ Michael Casey and Associated Press, “Vermont Floods Raise Concerns about Future of State’s Hundreds of Aging Dams,” Vermont Public, July 13, 2024, <https://www.vermontpublic.org/local-news/2024-07-13/vermontfloods-raise-concerns-about-future-of-states-hundreds-of-ageing-dams>

¹⁵ 44 Code of Federal Regulations (CFR) § 201.2 Definitions.

¹⁶ 44 CFR § 201.1(b) Purpose.

consistent safety standards and modern engineering practices. By aligning state programs with national best practices, the NDSP reduces the risk of dam failures and enhances community resilience against aging infrastructure and climate-driven extreme weather. For both the National Dam Safety Program (NDSP) (33 U.S. Code § 467f - National dam safety program) and the High Hazard Potential Dam (HHPD) Program (33 U.S. Code § 467f-2 - Rehabilitation of high hazard potential dams), Congress sets clear requirements for States to access Federal Dam programs and grants.

Under the NDSP, states are expected to establish and maintain dam safety programs that align with federal guidelines by ensuring they have the legal authority, staffing, and technical capacity to conduct inspections, enforce safety standards, and require emergency action plans for high-hazard dams. States must also collect and report data to the National Inventory of Dams, adopt risk-based approaches to prioritize rehabilitation, and engage in public awareness and preparedness activities. In return, they are eligible for federal assistance grants and technical support, but continued participation requires demonstrating that their programs meet minimum standards for oversight, enforcement, and coordination with federal partners to safeguard downstream communities.

To participate in FEMA's High Hazard Potential Dam (HHPD) Rehabilitation Grant Program, states must maintain an approved dam safety program that meets minimum federal standards, including legal authority to regulate dams, adequate staffing and technical expertise to conduct inspections, and requirements for Emergency Action Plans (EAPs) for all high-hazard potential dams. States must also collect and report data to the National Inventory of Dams, adopt risk-based approaches to prioritize rehabilitation projects, and demonstrate the capacity to oversee and enforce safety measures. Only states with programs that meet these criteria are eligible to receive federal grant funding to support the rehabilitation of non-federal, high-hazard potential dams, ensuring that resources are directed to jurisdictions with the infrastructure and oversight needed to safeguard downstream communities.

As of the writing of this paper, the State of Alabama is the only State in the Union that does not have a State Dam Safety program and hence is ineligible for federal dam safety or HHPD program assistance. Forty-nine States and the territory of Puerto Rico do. In 2023, Alabama enacted legislation (SB 284, 2023) establishing a voluntary opt-in dam safety program that enables inspection and monitoring of both state-owned and privately owned dams.¹⁷ These measures advance the state toward qualifying for NDSP State Assistance Grants. Alabama is not there yet, but its legislation is a step in the right direction.

There are no federally mandated guidelines for dam safety: each state sets and adopts its own standards. In September 2022, ASDSO, in partnership with FEMA, released its Model State Dam Safety Manual.¹⁸ For states, the Model provides a blueprint for building effective, sustainable dam safety programs by outlining core components such as legal authorities, inspections, risk evaluation, emergency planning, enforcement, and program administration. It encourages states to adopt progressive safety standards, modern engineering practices, and risk-based approaches while strengthening communication with dam owners, emergency managers, and the public. Although not mandatory, the model serves as guidance for legislators and program managers to align state efforts with national best practices, improve resilience against aging infrastructure and climate-driven hazards, and close gaps in funding, permitting, and oversight.

In December 2023, FEMA also updated its Federal Guidelines for Dam Safety.¹⁹ The Guidelines establish a national framework that sets consistent expectations for dam design, construction, operation, and emergency planning. For states, these guidelines serve as a benchmark to align their own dam safety programs with federal standards, ensuring that inspections, risk assessments, and rehabilitation practices meet a uniform level of rigor. They emphasize risk-informed decision making, emergency action planning, and coordination across agencies, which helps states strengthen their regulatory oversight and improve preparedness for dam incidents.

¹⁷ Alabama SB 284 | 2023 | Regular Session | SB 284 | LD 282236, accessed January 19, 2024, <https://legis.alabama.gov/legislation/details/2023/1/282236>.

¹⁸ Kirstin A Janocha, *Model State Dam Safety Program Manual*, n.d.

¹⁹ *Federal Guidelines for Dam Safety*, n.d.

In practice, the guidelines mean that states are encouraged to adopt federal best practices, integrate modern engineering standards, and incorporate risk management approaches into their dam safety programs. They also highlight the importance of emergency action plans, stakeholder engagement, and consistent monitoring to reduce risks to downstream communities. While not legally binding, the guidelines influence state policy by shaping funding priorities, permitting processes, and program development, ultimately helping states build resilience against aging infrastructure and climate-driven extreme weather events.

According to ASDSO, many state dam safety programs are limited in their dam safety regulatory capabilities due to a lack of state statutory authorities and funding, both of which are needed to reduce dam safety risks for public safety. States regulate 70 percent of US dams. Federal agencies regulate or own five percent of US dams. Approximately 65 percent of dams are privately owned. The rest are unregulated. Even more alarmingly, many dams are owned by quasi-governmental utilities or have unknown ownership.²⁰ Rehabilitation is essential as dams grow older, engineering standards advance, downstream populations and land use expand, and climate change poses greater threats. Yet many dam owners—particularly those in the private sector—struggle to secure the funding required for these costly projects. When maintenance is deferred, the risk of catastrophic failure increases significantly.

According to ASDSO's study, the five states with the highest number of deficient dams are:

- Texas, 7,255
- Kansas, 6,417
- Mississippi, 6,059
- Georgia, 5,498
- Missouri, 5,335

(As noted earlier, the state of Alabama does not have a State Dam Safety program, and numbers exclude roughly 2,200 dams in Alabama.)

²⁰ "SCOPE OF WORK."

The cost to rehabilitate all 7,255 dams in Texas is estimated at \$13.61 billion, and the cost to rehabilitate 1,491 HHPD dams in Texas is \$3.76 billion. Although Texas has the second-highest number of HHPD dams in the Nation (North Carolina, with 1,520, is first), Texas leads in the total estimated costs. All these numbers dwarf the federal funding available, even if one were to include the one-time dam rehabilitation funding available under IIJA. Texas shows a dam infrastructure grade of D-Plus, comparable to the rest of the nation.²¹

Discussion: Eligible Activities For The National Dam Safety Program

FEMA's National Dam Safety Program (NDSP) State Assistance Grants provide annual funding to help states strengthen their dam safety programs. These grants support core activities such as inspections, permitting, enforcement, emergency planning, data collection for the National Inventory of Dams, training, and public outreach. The goal is to build state capacity so regulators can effectively oversee dams, reduce risks, and improve public safety.

State dam safety assistance disadvantages smaller states and communities by often favoring larger, high-hazard dams, leaving many smaller, potentially numerous, and aging dams unregulated or underfunded, while also requiring significant local matching funds and technical capacity that smaller entities lack, creating unequal protection and burden, especially in states with fewer large dams but many smaller, problematic ones. Smaller states and local communities often have fewer personnel, less technical expertise, and smaller budgets to conduct inspections, develop emergency plans, and implement costly repairs, making it hard to compete for limited funds.

The High Hazard Potential Dam (HHPD) Rehabilitation Grant Program funds the repair, rehabilitation, or removal of non-federal, high-hazard potential dams whose failure

²¹ "Texas Infrastructure Report Card | ASCE," *ASCE's 2025 Infrastructure Report Card* |, March 1, 2025, <https://infrastructurereportcard.org/state-item/texas/>.

could cause loss of life. To be eligible, local governments must have jurisdiction over the dam and maintain a FEMA-approved local mitigation plan that includes all dam-related risks. The program prioritizes projects that address the most serious threats to downstream communities and requires long-term commitments to operation, maintenance, and emergency planning after rehabilitation.

Under the HHPD, the three core eligible activities are often summarized as the “3 Rs”: Repair, Rehabilitate, and Remove.

Repair	Addressing deficiencies or damage to ensure dams remain structurally sound and safe for continued use.
Rehabilitate	Modernizing or upgrading dams to meet current engineering standards, improve resilience, and extend their service life.
Remove	Decommissioning and dismantling unsafe or obsolete dams to eliminate risks and restore natural river systems.

Together, these activities provide states and dam owners with pathways to reduce hazards, improve safety, and adapt infrastructure to changing environmental and community needs.

FEMA follows the dam conditions as listed in the NID.²² Under this system, dams are rated according to:

- **Satisfactory:** No existing or potential safety deficiencies; considered safe for normal operations.
- **Fair:** No *current* issues during normal use, but rare events could create a deficiency, or deficiencies exist but don't pose an immediate threat.
- **Poor:** A known deficiency exists under normal operating conditions, and repairs or remedial action are needed.

²² “Condition Assessment as Used in the National Inventory of Dams | FEMA.Gov,” December 9, 2024, <https://www.fema.gov/about/glossary/condition-assessment-used-national-inventory-dams>.

- **Unsatisfactory:** A serious deficiency requires immediate or emergency action to prevent failure. Ratings Matter for several reasons:
- **Risk Assessment:** Ratings help identify high-risk dams, especially those with "High Hazard" potential (failure likely to cause loss of life).¹¹
- **Aging Infrastructure:** Many U.S. dams are aging, and a significant percentage, particularly high-hazard ones, fall into "Poor" or "Unsatisfactory" categories.
- **Public Safety:** These assessments guide owners and regulators in prioritizing maintenance, leading to increased inspections, documentation reviews, and potentially costly repairs to prevent failures and incidents.

Typically, under its HHPD grant program, FEMA has only funded dams that were rated Poor or Unsatisfactory, although FEMA has widened its aperture lately to include Fair dams on a case-by-case basis, which may have high-risk consequences.²³

For approved activities to take place and for funding, the Federal Government imposes an additional set of requirements. Besides the commonplace requirements that applicants will adhere to Federal grant requirements, follow Federal procurement guidelines, satisfy NEPA and environmental laws, there are requirements unique and specific to dams. Besides including information in the NID and maintaining a State Dam Safety program, applicants are required to create and maintain:

- Hazard Mitigation Plans
- Emergency Operations and Emergency Action Plans
- Floodplain Management Plans
- Operations and Maintenance Plans

Each of these can act as a potential barrier to States successfully completing a

²³ "Dam & Project Eligibility | FEMA.Gov," May 12, 2025, <https://www.fema.gov/grants/mitigation/learn/dam-safety/rehabilitation-high-hazard-potential-dams/eligibility>.

federally funded dam project.

Hazard Mitigation Plans

The FEMA Hazard Mitigation Planning Guide was released on April 19, 2022, and it included provisions to address dam hazards in planning documents. It has since been superseded by FP 302-094-2, State Mitigation Planning Policy Guide, Version 2.0, effective May 19, 2025.²⁴ FEMA policy FP-306-112-1, in effect since August 19, 2013, makes it explicitly clear that “FEMA will not obligate funds unless a State, Tribal, or Local Government meets the requirements outlined in accordance with Title 44 Code of Federal Regulations (CFR) Part 201 of having a FEMA-approved Mitigation Plan.”²⁵

Mitigation planning serves as the cornerstone for directing risk reduction investments statewide. These strategic investments enhance community resilience against future natural hazard events. Through the state mitigation planning process, partners collaborate to shape a risk reduction strategy that leverages diverse public and private resources. State mitigation plans underscore a cross-sector commitment—including infrastructure and economic development—to reducing natural hazard risks for communities throughout the state.

Local governments must involve the state dam safety agency and/or dam owners when developing their hazard mitigation plans, since these partners hold essential data for understanding and reducing dam-related risks in the planning area. The Guide details all HHPD requirements for an approved local mitigation plan—including planning process, risk assessment, and other elements—which can be integrated throughout the plan rather than placed in a standalone section. For multi-jurisdictional plans, the requirements should be met for every participating jurisdiction, including special districts.

To satisfy requirements for HHPD grants, the mitigation plan must describe how the locality coordinated with dam owners and/or the state dam safety agency and must

²⁴ *State Mitigation Planning Policy Guide*, 2025.

²⁵ “Mitigation-Administration-Policy.Pdf,” n.d., accessed June 16, 2025, <https://www.fema.gov/sites/default/files/2020-07/mitigation-administration-policy.pdf>.

document the information shared by these partners. This may include data on populations at risk, potential impacts to institutions and critical infrastructure, inundation maps, EAPs, floodplain management information, and outputs from the dam breach modeling tool. FEMA's HHPD Guidance spells out four criteria that must be met to satisfy planning requirements²⁶:

HHPD 1 Does the plan describe the incorporation of existing plans, studies, reports, and technical information for eligible high-hazard potential dams?

HHPD 2 Does the plan address all dam risk from eligible high-hazard potential dams in the risk assessment?

HHPD 3 Does the plan include mitigation goals to reduce long-term vulnerabilities from high-hazard potential dams that pose an unacceptable risk to the public?

HHPD 4 Does the plan prioritize mitigation actions to reduce vulnerabilities eligible high hazard potential dams?

HHPD planning requirements, such as the planning process and risk assessment, must be integrated into the relevant sections of the mitigation plan and must be met for every jurisdiction in a multi-jurisdictional plan. To satisfy requirement of HHPD1, the plan must show evidence of coordination with dam owners or the state agency and include shared information such as population-at-risk data, impacts to critical infrastructure, inundation maps, EAPs, floodplain management information, and outputs from dam breach modeling tools

Up-to-date Hazard Mitigation Plans affect more than just communities with dams in Texas. A 2024 report found that “of 254 counties in the state, 103 counties lack plans approved by the Federal Emergency Management Agency. Most of these are rural, with fewer than 50,000 residents, a Texas Tribune analysis of federal data found. A total of 3.5 million Texans — or about 12% of the state’s population — live in a county without a plan.”²⁷ However, well-intentioned Hazard Mitigation Plans may be, the cost to update

²⁶ Michael M Grimm, *Rehabilitation of High Hazard Potential Dams*, n.d.

²⁷ Jess Huff Nicholson-Messmer Elijah, “More than 100 Texas Counties Lack Plans to Curb Damage from Natural Disasters,” *The Texas Tribune*, June 27, 2024, <https://www.texastribune.org/2024/06/27/texas-hazard-mitigation->

these, which could be upward of \$100,000 even for small communities, is beyond the capacity of most communities and individual dam owners.

Emergency Operation Plans and Emergency Action Plans

FEMA differentiates between two core planning documents for managing dam-related risks: the Emergency Action Plan (EAP) and the Emergency Operations Plan (EOP). The EAP is developed and maintained by the dam owner and focuses on conditions at the structure itself. It identifies potential emergency indicators, outlines notification procedures, includes inundation maps to show areas at risk, and details the actions the owner must take to address developing issues. EAPs require regular review and periodic exercises to ensure they remain accurate and actionable.

The EOP, by contrast, is created and managed by local, state, or tribal emergency management authorities and addresses the broader community response to hazards, including dam incidents. Rather than structural interventions, it covers evacuation routes, public warning systems, sheltering, and resource coordination. Information from the dam owner's EAP—especially inundation mapping—is typically incorporated into the jurisdiction's EOP as a Dam Incident Annex, ensuring that community-level planning aligns with dam-specific risk information.

FEMA spells out the detailed requirements for EAPs in its Federal Guidelines for Dam Safety Emergency Action Planning for Dams, FEMA 64, July 2013. An Emergency Action Plan (EAP) is a structured document that outlines how dam owners and emergency officials will identify emerging problems, take immediate actions to reduce risks, and coordinate an effective response to protect lives and property. It details the owner's steps to address issues at the dam, joint response procedures with emergency management agencies, early warning and notification protocols, inundation maps showing areas and populations at risk, and clearly defined roles and responsibilities for everyone involved in managing a dam-related incident or emergency.

plans/.

A dam safety incident refers to a situation in which a sudden, uncontrolled release of water—or an unusually large controlled release—occurs or is likely to occur from an impounding structure. Such releases can result from structural damage, failure, flood conditions, or any circumstance that compromises the dam’s safe operation. Depending on the severity and context, the outflow may or may not pose risks to people, property downstream, or the continued functioning of the dam. From this perspective, the creation and maintenance of an Emergency Action Plan is vital to the health, safety, and well-being of a community.

Developing an EAP requires close collaboration with all agencies, jurisdictions, and organizations that would be affected by a dam incident or that hold legal responsibilities for warning, evacuation, and post-incident actions. The plan must clearly outline roles and responsibilities, and working directly with emergency management authorities ensures alignment on how warnings will be issued and how evacuations will be carried out. This coordination strengthens confidence in the plan and creates space to address key operational issues such as notification order, backup personnel, alternative communication methods, and procedures for nights, weekends, and holidays.

It is equally important to coordinate with upstream and downstream dam owners to align operational strategies for flood and dam-related emergency management. For dams that provide essential community services—such as drinking water or power—recovery planning should be developed jointly with local emergency management officials. The loss of such a facility could significantly hinder community or regional recovery, making continuity-of-operations planning for critical infrastructure an essential part of preparedness.

However, creation and maintenance of plans is only part of the story – an EAP to be effective also needs to be periodically exercised. Regular exercises are essential to keep everyone familiar with their roles and responsibilities in carrying out the EAP. Without periodic practice, personnel may lose proficiency in the procedures the plan requires. The EAP should outline a proposed schedule for exercises and describe the structure of the exercise program, along with plans for evaluating performance and updating the EAP based on lessons learned. Texas, for instance, has EAPs for all its High

Hazard Potential Dams; however, only 20% were exercised in the past five years. FEMA recommends that after an EAP has been developed, it must be exercised so it does not become outdated and ineffective.²⁸

Raising public understanding of dam-related risks and promoting safe practices around dams is a central objective of state dam safety programs and the National Dam Safety Program. Dam owners and operators must be familiar with state laws and regulations, their associated responsibilities and liabilities, and the proper procedures for operating, maintaining, and inspecting their structures. Likewise, local emergency managers, first responders, and downstream residents and businesses need a clear grasp of the risks they face and the plans in place for responding to an emergency. State programs address these needs through direct engagement—such as meetings and training sessions with dam owners, workshops for local officials, and public outreach materials. In Texas, this includes regular workshops and meetings with dam owners and engineers to strengthen awareness and preparedness.

Floodplain Management Plans

Floodplain management involves an ongoing series of decisions about how floodplain lands and waters should be used. These plans aim to identify and carry out measures that lessen or prevent the negative effects of future flooding in the project area by accounting for all flood risks—including the residual risks linked to the dam. According to FEMA’s Rehabilitation of High Hazard Potential Dams Grant Program Guidance, June 2020 FP 104-008-7, “HHPD floodplain management plan requirements differ from typical floodplain management plans. The purpose of the HHPD floodplain management plan is to specifically address the impacts of the dam for which an HHDP grant has been awarded. HHPD floodplain management plans may be dam-specific and focus on the area impacted by the dam that is undergoing rehabilitation or removal.”²⁹

In principle, creating or updating an existing Floodplain Management Plan makes

²⁸ “Texas 2024,” n.d., accessed January 18, 2026, <https://damsafety-live.s3.eu-north-1.amazonaws.com/s3fspublic/files/Texas%202024%20.pdf>.

²⁹ Grimm, *Rehabilitation of High Hazard Potential Dams*.

sense, especially for dam removal projects where the nature of the floodplain is altered. However, the complex requirements to coordinate among State regulators, floodplain managers, local authorities, and dam owners, all while keeping the public informed is often beyond the capabilities and capacity of applicants. As these requirements apply to all construction projects, even the smallest repair utilizing HHPD grant funding triggers complex floodplain management requirements. Updated Hydrologic and Hydraulic Plans are required for the impacted area of the dam projects and include both upstream and downstream impacts. As this area may include municipalities and counties over which a dam owner has no jurisdiction, the requirement to strictly adhere to updated floodplain management plans acts as a hindrance rather than promotes safe dam management practices. It is little surprise that since the inception of the HHPD grant program in 2019, not a single project has been fully closed.³⁰ Acknowledging the difficulties that dam owners, smaller states, and communities face in meeting floodplain management requirements, in August 2024, FEMA released a simplified floodplain management fact sheet that included a decision tree, which includes situations in which an updated floodplain management plan may not be required.³¹

Operation and Maintenance Plans

Dam Operation and Maintenance plans outline clear procedures for routine, high-flow, and low-flow operations; establish schedules for inspections and preventive upkeep of spillways, embankments, outlet works, and vegetation; and require ongoing monitoring of water levels, flows, and seepage. They also incorporate emergency protocols through the EAP and mandate comprehensive recordkeeping, including system descriptions, drawings, asset inventories, and assigned responsibilities—to support safe operations, extend the structure’s service life, and safeguard downstream communities.

As per the latest version of FEMA’s HHPD Guidance, to receive funding through the HHPD grant program, applicants must commit to providing long-term operation and

³⁰ “High Hazard Potential Dams Grant Awards | FEMA.Gov,” June 2, 2025, <https://www.fema.gov/grants/mitigation/learn/dam-safety/rehabilitation-high-hazard-potential-dams/awards>.

³¹ *Rehabilitation of High Hazard Potential Dam Floodplain Management Plan Fact Sheet*, n.d.

maintenance (O&M) for the rehabilitated dam. O&M plans outline the procedures and instructions needed to ensure safe operation, routine monitoring, and timely maintenance—activities that help prevent deterioration and extend the dam’s functional life. Grant eligibility requires subrecipients to demonstrate their ability and intent to carry out O&M for at least 50 years after rehabilitation is completed (or for the full expected life of the dam, if longer) and to confirm that the dam owner has established and will implement an O&M plan for the duration of the dam’s service life.

In addition to an Operations and Maintenance Plan, FEMA also requires an O&M Financial Plan that “demonstrates the subrecipient will have adequate funding resources for O&M activities to be carried out over a 50-year period following completion of the rehabilitation project.” The financial plan must also be accompanied by assurances from all parties that the dam owner has adequate resources available for 50 years, but states and owners face difficulties like a lack of funding, managing complex regulations, liability concerns, and finding qualified personnel, leading to deferred maintenance and increased risks.

Discussion: The Situation In Texas As Compared To Other States

As mentioned earlier, the cost to rehabilitate all 7,255 deficient dams in Texas is estimated at \$13.61 billion, and the cost to rehabilitate 1,491 Texas’ HHPD dams is \$3.76 billion. Although Texas has the second-highest number of HHPD dams in the Nation, Texas leads in the total estimated costs.³² The federal funding available is several orders of magnitude smaller than the national requirement.

The 2025 ASCE scorecard shows a gradual improvement in its Dam Scores from 2004, when it received a D-minus, and is currently in line with the national grade for dams of D-plus. The ASCE Texas Section emphasizes that raising the state’s infrastructure grade requires consistent, sustained investment to ensure safety, reliability, and resilience

³² “SCOPE OF WORK.”

while preparing for future demands driven by economic and population growth. Their report highlights eight key metrics—spanning health, safety, environment, resources, and the economy—that reveal pressing deficiencies across Texas’s infrastructure systems. To reverse negative trends, elected officials are urged to act decisively, bringing infrastructure up to satisfactory performance standards and safeguarding communities.

ASDSO’s Dam Safety Report for 2024 documents that Texas oversees more than 7,000 dams, including over 1,200 classified as high-hazard potential, meaning failure could cause loss of life.³³ Many dams are aging, inspection coverage remains incomplete, and transparency has historically been limited due to state confidentiality laws, though recent reporting has improved. With rapid population growth and increasing climate risks, the program highlights urgent needs for consistent inspections, stronger regulatory enforcement, and sustained funding to rehabilitate or remove unsafe dams and protect downstream communities.

Infrastructure investment is framed as the backbone of Texas’s economy, enabling mobility, commerce, clean water access, waste management, and safe environments. The Section calls for dedicated funding across all categories, including revenues directed to their proper sources, expanded use of grants, low-interest loans, and public-private partnerships, and adoption of utility fees with regular rate reviews. They also recommend new funding streams, such as stormwater drainage utility fees and investment in advanced technologies like artificial intelligence to improve efficiency and safety. Together, these measures are intended to secure long-term resilience and economic vitality for Texas.

In Texas, the Dam Safety Program falls under the jurisdiction of the Texas Commission on Environmental Quality, and it monitors and regulates both private and public dams in Texas.³⁴ In addition, several individual river authorities have jurisdiction over their own dams. The program periodically inspects dams that pose a high or significant hazard and makes recommendations and reports to dam owners to help them

³³ “Texas 2024.”

³⁴ Tex. Comm. Environ. Qual., “Dam Safety Program.”

maintain safe facilities.

However, the Dam Safety program in Texas (along with New Jersey) has one significant shortcoming. Currently, if an individual wants to look up the condition and hazard rating of a dam that they live in, they can simply do so by consulting an online database of dams – the National Inventory of Dams (NID), created and maintained by the US Army Corps of Engineers since 1975 and freely available to all.³⁵ For much of its existence, the Corps declined to release condition assessments of dams, citing post 9/11 security concerns. Since 2021, however, for greater transparency, the Corps started including condition and risk data in the NID. However, several Federal agencies and some State agencies did not share this information publicly. Texas was one such state.

Besides their condition classification as satisfactory, fair, poor, or unsatisfactory, dams are classified as low to high risk based on the consequences their breach or failure may cause to life and property. Texas has long reported the existence of its thousands of dams to the NID, but until recently withheld key safety details such as hazard classifications and condition ratings, citing state laws that treat technical infrastructure data as confidential for security reasons. Because NID participation is largely voluntary, Texas used these exemptions to limit transparency, leaving many dams—particularly significant hazard dams—without inspection updates or national reporting.

Even as other states expanded disclosure, Texas continued to restrict information, with reports in 2022 noting withheld names and conditions of high-hazard dams. A significant change was that FEMA excluded Texas from its list of eligible applicants for its HHPD grant program. A total of \$585 million made available under IIJA funding for HHPD may have played some role in Texas making its dam data available in the NID. Under the current rules governed by Texas Administrative Code Title 30, Part 1, Chapter 299: Dams and Reservoirs, the executive director shall maintain an inventory of dams that includes information on a variety of factors that include the condition of the dam and its hazard classification.³⁶ Despite some omissions, the NID still lists more than 7,400 dams in

³⁵ “National Inventory of Dams,” accessed January 18, 2026, <https://nid.sec.usace.army.mil/nid/#/>.

³⁶ “Home - Rules & Meetings,” accessed January 18, 2026,

[https://texas-sos.appianportalsgov.com/rules-andmeetings?\\$locale=en_US&interface=VIEW_TAC_SUMMARY&queryAsDate=01%2F18%2F2026&recordId=210235](https://texas-sos.appianportalsgov.com/rules-andmeetings?$locale=en_US&interface=VIEW_TAC_SUMMARY&queryAsDate=01%2F18%2F2026&recordId=210235).

Texas, though the lack of complete data has raised concerns about oversight and public safety. Texas also exempts certain significant-hazard dams from inspection, a practice not common in most states, leaving gaps in oversight. Based on ASDSO's Texas 2024 Dam Safety Program report, the State compares less favorably to many other states in several key areas.

By contrast, many other states have moved toward greater transparency, mandatory inspections for high-hazard dams, and stronger alignment with federal guidelines. Texas's large dam inventory, combined with rapid population growth downstream, makes these gaps more consequential. While recent changes have improved reporting, Texas still lags states that consistently provide complete data to the NID and enforce more comprehensive inspection regimes. In short, Texas's dam safety program is substantial in scale but weaker in transparency and regulatory rigor compared to national peers.

Recommendations For The Future

Sound policies and regulations provide the framework for safe, efficient, and resilient infrastructure by setting clear standards that ensure projects are technically robust, socially and environmentally responsible, and adaptable to future needs. Well-crafted policies not only foster design innovation but also enable public-private partnerships that accelerate project delivery and resource allocation. For Texas, this means advancing equity in underserved regions, updating outdated or risky regulations, adopting safe development rules to reduce hazard exposure, streamlining permitting for transparency and timeliness, and creating new state programs—such as a Levee Safety Program—to strengthen management of existing assets.

Standards are essential to ensuring the safety, efficiency, and resilience of critical infrastructure systems, and must evolve alongside advances in technology, materials, and design methodologies. Modernizing standards across all counties supports economic

growth, fosters innovation, and reduces vulnerabilities. This includes embedding resilience into design and maintenance to address climate impacts such as sea level rise, extreme heat, drought, and heavier rainfall, and adopting technological advancements to strengthen long-term infrastructure resilience.

Effective asset management and planning require a comprehensive understanding of existing infrastructure to guide investment, resource allocation, and risk mitigation. By assessing condition and performance, owners can prioritize funding based on need and impact, while proactive management extends asset life and improves service delivery. Recommendations include developing GIS-based asset repositories, implementing strategic funding partnerships, using non-destructive evaluation methods, requiring regular inspections of high-hazard assets, and mandating emergency response plans to strengthen resilience. Together, these measures support a safe, reliable, and efficient infrastructure system that underpins Texas's long-term prosperity and economic growth.

Finally, although this paper focuses on dams, another critical part of water infrastructure is levees, which are integral to water management. According to ASCE, twenty-three million Americans live and work behind a levee. The nation's levees guard against flood risk to critical infrastructure systems and protect \$2 trillion worth of property, seven million buildings, and five million acres of farmland. The National Levee Database contains over 24,000 miles across the US, although this is an underestimate, and the true number may be closer to 100,000 miles.³⁷

Like the National Dam Safety Program, in 2007 (amended in 2014), Congress authorized the National Levee Safety Program.³⁸ Similar to the NDSP, the NLSP legislation, codified in 33 U.S.C Chapter 46, envisions that USACE and FEMA collaborate on the design and development of a National Levee Safety Program. However, FEMA has not received any direct appropriation for the specific grant programs outlined in the 2007/2014 Acts. FEMA and USACE launched the program in 2021 to develop national

³⁷ "Levees," *ASCE's 2025 Infrastructure Report Card* |, January 17, 2017, <https://infrastructurereportcard.org/cat-item/levees-infrastructure/>.

³⁸ James L. [D-MN-8 Rep. Oberstar, "H.R.1495 - 110th Congress (2007-2008): Water Resources Development Act of 2007," legislation, November 9, 2007, 2007-03-13, <https://www.congress.gov/bill/110th-congress/housebill/1495>.

guidelines and improve management, but since then, the program has faced significant funding shortages. In 2021, only \$5 million was provided for the National Levee Safety Program, despite an authorized amount of \$79 million per year.³⁹

Conclusion

The risk facing the nation's dam infrastructure is increasing as the average age of dams increases, maintenance is deferred, and the funding required to address the deficiencies continues to increase.

From the **Federal** side develop a balanced, forward-looking approach to dam safety and resilience: improving data sharing, and engaging the public throughout the process; strengthening local land-use planning to better account for how dams shape surrounding communities; modernizing probable maximum precipitation estimation methods in line with the 2024 National Academies recommendations; completing the National Low-Head Dam Inventory by 2030; ensuring all high-hazard potential dams have Emergency Action Plans and are exercised by 2030; and fully funding federal dam safety and rehabilitation programs so states can effectively manage risks and address their most vulnerable structures. Increased federal funding and less onerous rules to access the funding are big factors in achieving greater dam safety.

The local match requirement of 35% for federal grants remains a big hurdle for **States** to access Repair, Rehabilitation and Removal projects under the HHPD. Likewise, requirements to match State dam safety budgets to access Dam Safety State Assistance grants, as we have noted earlier, advantage bigger and wealthier States and dam-owners over smaller ones. While these rules are set by Congress, States are not powerless when it comes to proposing and implementing change.

³⁹ "Levees-2021.Pdf," n.d., accessed January 19, 2026, <https://2021.infrastructurereportcard.org/wpcontent/uploads/2017/01/Levees-2021.pdf>.

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Kayed Lakhia, until his retirement in 2025, was the National Director of Dam Safety at FEMA. Previously, he was the Director of FEMA's Hazard Mitigation Assistance program and managed a national portfolio of over \$10B in disaster and non-disaster grants. His leadership saw the creation of FEMA's new BRIC-Building Resilient Infrastructure and Communities grant program. He has also acted as FEMA's Deputy Assistant Administrator for Recovery.

Before his Federal Service, Mr. Lakhia was a principal at a global engineering firm. He holds a Master of Science degree from MIT and a Master's in Homeland Security from the Naval Postgraduate School. He has also completed post-graduate studies at Harvard's National Preparedness Leadership Institute and the University of Virginia's Darden School of Business. He is a Registered Architect, a Certified Floodplain Manager, and a LEED Accredited Professional. Mr. Lakhia is an OPM-certified member of the Senior Executive Service (SES).

The opinions expressed in this paper are those of a private citizen and not the official position of the U.S. Federal Government.

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