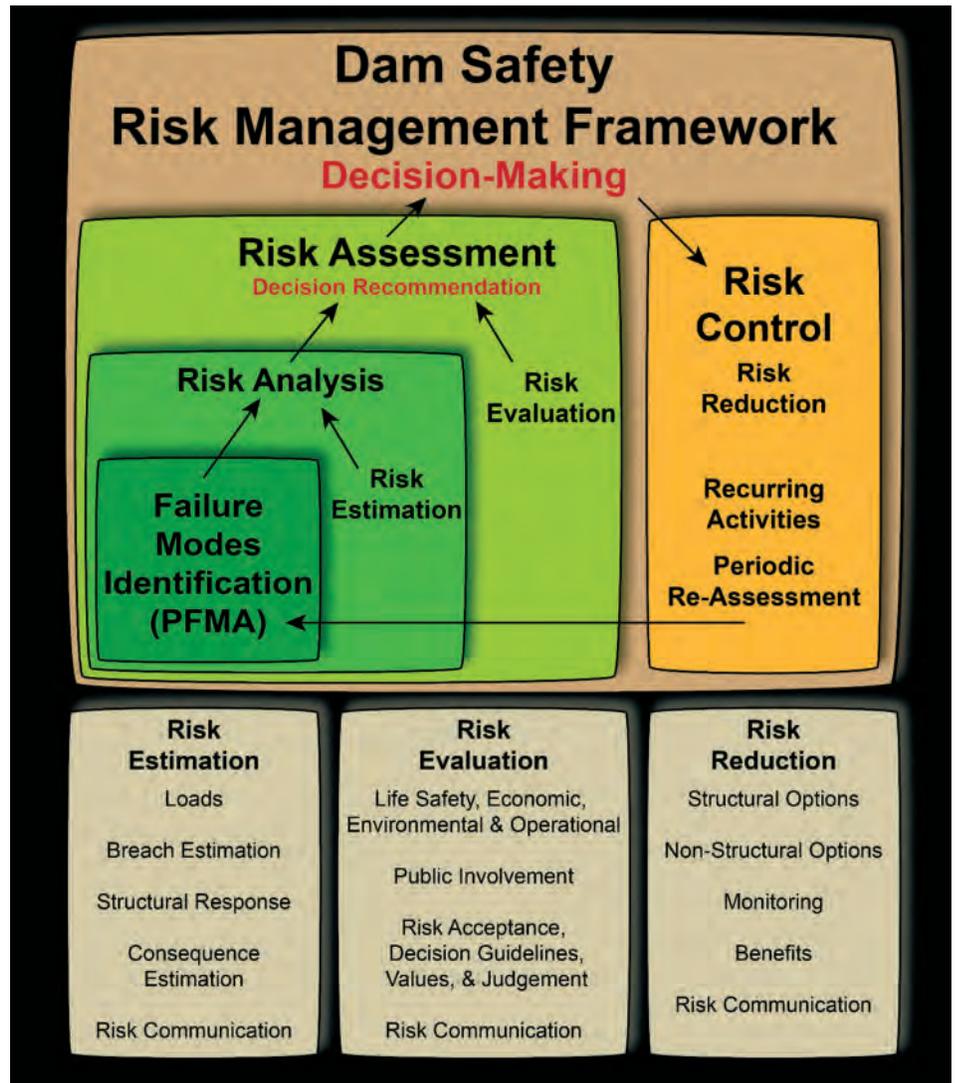


WRDA process. The Corps of Engineers conducts studies of potential projects, including benefit-cost analysis and engineering and environmental evaluations. Completed reports are reviewed by the Office of Management and Budget (OMB), which conducts its own benefit-cost assessment. Subject to approval by OMB, project proposals are forwarded to Congress for possible WRDA authorization.

According to the American Society of Civil Engineers' (ASCE) 2017 *Infrastructure Report Card*, which is published every four years, infrastructure in the U.S. has received a grade of D+. The report card estimates that the U.S. needs to spend some \$4.5 trillion by 2025 to improve the state of the country's roads, bridges, dams, airports, schools and more.

Risk Informed Management of USACE Portfolio

In 2006, USACE adopted a risk informed framework for managing its dam and levee portfolio. The risk management framework for dams has been developed in policy *Engineer Regulation 1111-2-1156*, and similar policy is being developed for levees. Risk assessments within the dam and levee safety program provide a systematic, evidence-based approach for estimating and describing the likelihood and consequences of existing and future risk associated with the dams and levees. The risk assessments consider what can go wrong, the consequences if it happens and how likely it is to happen.

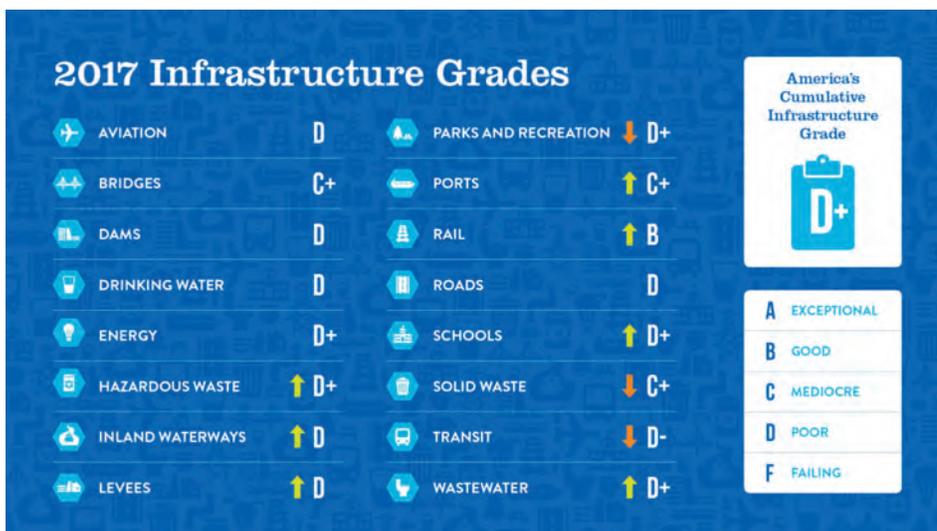


USACE dam safety risk management framework

The USACE dam inventory includes some of the largest earth and concrete dams in the U.S. USACE has completed screening level assessments of the dam portfolio, which identified that about 50

percent of the inventory had actionable dam safety issues. Since 2009, detailed evaluations have been completed on about 75 percent of the inventory, and it is estimated that the cost to rehabilitate the highest risk structures is approximately \$20 billion.

ASCE 2017 Infrastructure Report Card



Fundamental to the risk informed process is the development of Tolerable Risk Guidelines (TRGs), which address tolerable individual and societal risk. The Individual Risk (IR) Threshold is established as 1/10,000. If the total probability of failure is less than 1/10,000, individual risk could be considered to be tolerable — probability of failure is used as a proxy for individual risk as IR is always lower than probability of failure. Risks could still be tolerable if risks exceed 1/10,000 if evacuation considerations would reduce individual risk. The Societal Risk Threshold was established as 1/1,000.

Relevant statistics of the USACE dam inventory	
Embankment dams	86 percent
Concrete dams	7 percent
Combination dams	7 percent
Median height	93 ft (28.4 m)
Mean height	112 ft (34.1 m)
Average age	60 yrs
High hazard dams	77 percent
Total storage capacity	331 million acre-ft (40.8 million hectare-m)



Dworshack Dam, Idaho – One of the largest concrete dams in the U.S.



Fort Peck Dam, Montana – One of the largest embankment dams in the U.S.

If the total annualized life loss is less than 1/1,000, societal risk should be tolerable. All of the federal agencies that own, operate or regulate dams developed and adopted the *Federal Guidelines for Dam Safety Risk Management* – FEMA P-1025/January 2015.

The levee portfolio consists of 2,200 levee systems. Over 1,200 levee sponsors operate and maintain approximately 2,000 of these levee systems, spanning about 70 percent of the length of the entire portfolio. The remaining 200 levee systems are operated and maintained by USACE. USACE has currently completed levee risk characterizations for about 75 percent of the portfolio. This effort has provided a more comprehensive understanding than previously known: where the levees are (inventory), their

condition (inspection), and the flood risk associated with each levee (risk assessment).

The most common risk driver is overtopping, which impacts 40 percent of the levee portfolio. Seepage through or beneath the levee is the second most common risk driver impacting about 20 percent of the portfolio. The estimated cost to address risk in the

USACE levee portfolio is anticipated to cost about \$20 billion.

A f-N plot is used to graphically delineate the probability of failure versus the average number of fatalities (loss of life) of all dams and levees in the USACE portfolio. Over half of the dams and about 25 percent of the levees in the USACE portfolio will likely require modification to meet Tolerable Risk Guidelines (TRGs) for probability of failure and life safety.

Navigation Portfolio

Many of the USACE's 250 locks and dams on the 27 inland river systems have exceeded their economic design life of 50 years. Pertinent facts of the USACE navigation system are summarized as follows:

- 99.6 percent of U.S. overseas trade volume moves through coastal channels maintained by USACE.
- The U.S. marine transportation industry supports about \$2 trillion in commerce.

FEMA Federal Guidelines



Federal Guidelines for Dam Safety Risk Management

FEMA P-1025/January 2015



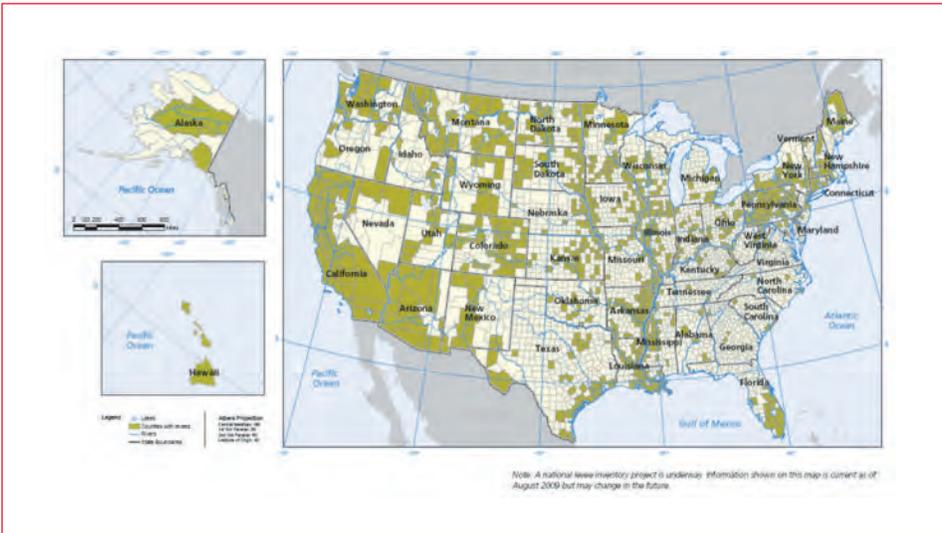
- More than 60 percent of farm exports move on inland waterways to downstream ports.
- Nearly 80 million tons of grain move by barge annually.
- One barge can carry as much freight as 15 rail cars or 60 trucks, and reduce traffic congestion and air pollution.
- Average age of our navigation locks is over 60 years.
- Federal funding has remained flat in nominal terms and declined in real terms.

To address this significant infrastructure issue, USACE has adopted an Asset Management Infrastructure Strategy to assess, identify and prioritize maintenance resources on critical components. In addition, research efforts are focused on:

- Enhancing the ability to assess the condition of assets to better inform maintenance management and prioritization.
- Reducing repair costs by detecting problems before failures occur and by better predicting remaining service life.
- Developing new and innovative low-cost repair solutions with greater durability.
- Improving designs for project safety, efficiency and reliability.

Future Actions

One of the top priorities of the current presidential administration is to rebuild and modernize the nation's infrastructure. The administration's goal is to seek and secure long-term reforms on how infrastructure projects are regulated, funded, delivered and maintained. By streamlining project delivery and removing barriers, the administration hopes to incentivize and expedite the delivery of our nation's infrastructure. The president has proposed a \$200 billion federal commitment to stimulate at least \$1.5 trillion in new infrastructure investment. While much of the public and congressional interest regarding the administration's Infrastructure Initiative has been focused on the legislative



Counties in the U.S. that have levees

principles, the administration is also addressing infrastructure delivery through a range of policy and regulatory changes.

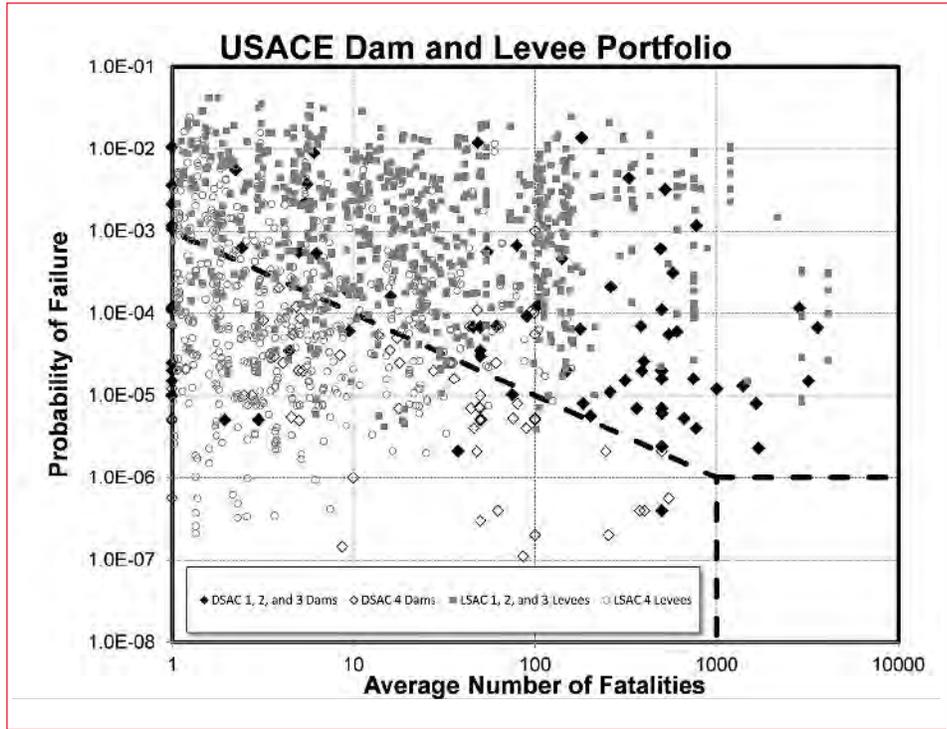
The primary focus of USACE, as related to the Infrastructure Initiative, is on five areas that would directly involve civil works missions:

- Water Resources – remove barriers and create innovative delivery models
- Inland Waterways – promote opportunities for nonfederal investments
- Incentives – incentivize nonfederal investments through grants
- Water Infrastructure Finance and Innovation Act (WIFIA) – incentivize nonfederal investments through low-cost federal loans
- Permitting – streamline permitting processes

The infrastructure legislative principles, as part of the Infrastructure Initiative, support the administration’s goal to seek and secure long-term reforms on how infrastructure projects are regulated, funded, delivered and maintained. The principles are not legislation but are intended to form the basis for a comprehensive infrastructure bill.

USACE is committed to working with federal, state and local agencies to implement efficiencies in existing permitting and environmental review processes. Permitting efficiencies are intended to enhance the delivery of timely decisions while maintaining environmental

USACE dam and levee safety portfolio represented in a f-N plot (probability of failure versus loss of life)



protections provided by law. The intent of the administration’s One Agency, One Decision proposal is to reduce the environmental review and permitting process to no more than a two-year timeframe to accelerate infrastructure delivery.

USACE also recognizes the importance of stakeholder engagement and support in the effort to implement change and improve the nation’s water resources infrastructure. USACE plans to gain stakeholder feedback on advancing infrastructure initiatives and to get ideas on how to remove impediments that prevent successful implementation of projects.

USACE fully supports innovative approaches and changes that will result in improvements in the delivery of our Nation’s infrastructure needs. The Infrastructure Initiative is an opportunity for USACE to apply new financing approaches and streamline business processes that will enable needed change to meet current and future needs of the nation.

David B. Paul, P.E., is special assistant for dam safety at the U.S. Army Corps of Engineers in Washington, D.C., and is currently the Dam Safety Officer for the Mosul Dam Task Force. He has over 41 years of experience as a national specialist on critical infrastructure design, dam design, levee design, construction engineering, engineering risk assessments, and dam and levee safety modifications performed as part of USACE Dam Safety management activities. Paul is a DFI trustee, and is serving on the United States Society of Dams (USSD) Committees on Construction and Embankment Dams and represents USSD on the ICOLD Embankment Dams committee.