

## Levees and the National Flood Insurance Program: Improving Policies and Practices

**This report examines how FEMA’s National Flood Insurance Program assesses, mitigates, and insures against flood risk behind levees, and how the program communicates that risk to the public. FEMA needs an updated approach to analyze and manage flood risk to give public officials and individual property owners a more precise idea of the risks they face, the report finds. Because no levee completely eliminates flood risk, more effective communication is needed to increase awareness and encourage communities behind levees to use multiple methods to manage flood risk.**

In recent years extreme storms and hurricanes have caused increasingly disastrous flooding along U.S. rivers and coastlines, with much of the damage occurring when levees failed or were overtopped by water. The Federal Emergency Management Agency (FEMA) asked the National Research Council to examine the manner in which levees are addressed in the National Flood Insurance Program—a cornerstone in the nation’s strategy to help communities prepare for floods—and to provide advice to improve this element of the program.

Currently, a key part of the program is the requirement that property owners with a federally backed mortgage located within a Special Flood Hazard Area—also known as the “1 percent annual chance” floodplain—are mandated to buy flood insurance. Properties protected by an accredited levee system, however, are not mapped into the Special Flood



Hazard Area and are exempt from the insurance requirement. To gain accreditation, a community must submit evidence to FEMA that its levee system has been designed and constructed to protect against a “1 percent annual chance” flood.

In 2003, however, as FEMA began a 5-year plan to modernize its flood maps, it became apparent that some of the accredited levees did not meet the “1 percent annual chance” standard. A non-accredited levee is considered by FEMA in its analyses to be the same as no levee at all; this meant that communities protected by levees that do not meet the standard would be considered “without levees,” mapped into the Special Flood Hazard Area, and its property owners required to buy flood insurance.

At the urging of Congress, the FEMA Administrator instructed the agency’s staff to replace its “without levee” approach with methods that would be technically sound, credible, and cost-effective, and that would provide results that more precisely reflect the

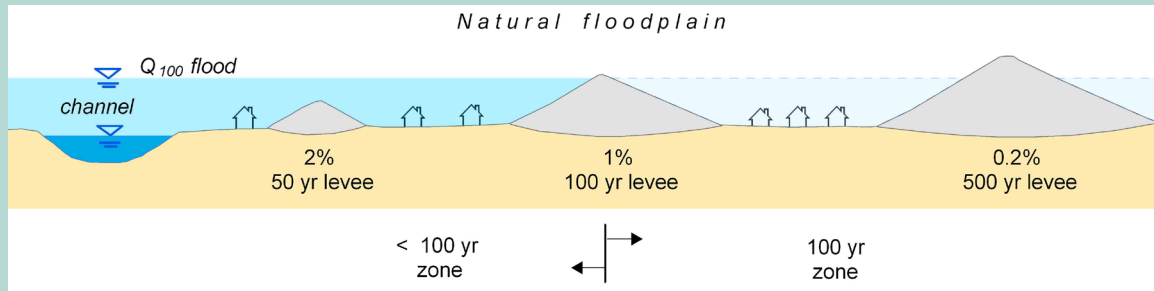
### ***Box 1. What is a Levee?***

A levee is a manmade structure, usually an earthen embankment, that is constructed to contain, control or divert the flow of water in order to provide protection from floods. Levees are generally designed to control water up to a given elevation and, unlike dams, they do not typically have spillways to reduce structural damage if water levels overtop the structure. A levee system is a system, constructed to reduce flood damage, consisting of one or more levee and related structures that are constructed and operated in accordance with sound engineering principles.

### Box 2. One Percent Annual Chance Flood

“1 percent annual chance flood,” “base flood,” and “100-year flood” are common terms used to describe a water elevation level that has a 1 in 100 chance of being exceeded in any year. Flood designations are based on statistical averages, not on the number of years between big floods.

Floodplains and levees are also classified in the same way; the “100-year” or “1 percent annual chance” floodplain has a 1-in-100 chance of being flooded in any year. A “100-year levee” provides reasonable assurance that the levee will provide protection from such a flood. A property located in the 1 percent annual chance floodplain has a 26 percent chance of being flooded at least once during the lifetime of a 30-year mortgage payoff period.



**Figure 1** Illustration of the one percent annual chance flood ( $Q_{100}$ ) and the impact on a natural floodplain with various levee heights.

flood risk in areas behind levees. Accordingly, FEMA staff proposed a new approach, the Levee Analysis and Mapping Procedure (LAMP).

### Flood Risk Management and a Modern Risk Analysis

Flood risk management continuously assesses flood risk (the likelihood of flooding and its adverse consequences) and takes steps to reduce it. A key component of this approach is flood risk analysis, which analyzes the flood hazard and the levee system; a community must have an accurate understanding of the risks it faces in order to manage them.

In its current analysis to evaluate flood risk behind levees, the National Flood Insurance Program considers whether the area is protected by an accredited levee—one designed to protect against a “1 percent annual chance” flood. If the levee is accredited, the area is treated as if it were outside of the 100-year floodplain. If the levee does not meet the regulatory standard, the evaluation gives no credit, in setting insurance rates, for any protection these levees may provide. The evaluation also does not give any extra credit to levees that far exceed the standard. Nor does the current analysis describe or communicate the residual risk that remains for properties that are protected by an accredited levee; even accredited levees can be breached or overtopped.

FEMA should move to a more modern flood risk analysis that can provide a clearer, more detailed picture of risk in areas both without levees and behind them. Such an approach would use the best available

science and modern computational and mapping methods to produce precise, state-of-the-art risk estimates, offering a more nuanced and detailed picture of flood risk across the landscape. It would also provide a better idea of how an area’s flood risk management system, which often includes multiple levees, floodwalls, and other structures, will perform as a whole.

A modern risk analysis assesses the risk that exists throughout the floodplain in geographically specific terms, so that risk will no longer be determined, mitigated, and communicated based on whether an area is protected by a 1 percent levee, but on the nature of its risk. Because levees cannot completely eliminate the risk of flooding, it would let communities know about the residual risk they face—information not provided by current analyses.

Although the LAMP approach FEMA proposes is a reasonable first cut at dealing with the potential contributions of levees that do not meet FEMA standards, implementation of LAMP would divert effort away from a move to a modern risk-based approach. FEMA should move directly to a more modern analysis for dealing with areas behind levees and not implement the LAMP approach. Interim steps to deal with non-accredited levees are proposed in the report.

In addition to giving communities and property owners a clearer picture of the risk they face, a modern risk analysis would:

- **Enable FEMA to improve the way it sets insurance rates.** The NFIP determines flood risk and premiums through a balance of factors including

the extent and type of flood hazard, the type of structure and its base flood elevation, and the location of its contents (first floor, second floor, etc.). The program then assigns properties to a “zone” and prices premiums accordingly. However, the risk of water inundation can differ from property to property even within the same area of flood zone. A modern analysis would let FEMA set insurance rates for property owners in ways that more appropriately reflect individual risk gradations throughout zones and behind levees.

- **Potentially expand the number of people who buy flood insurance.** Currently, for communities participating in the National Flood Insurance Program, owners of properties located in the Special Flood Hazard Area holding a federally backed mortgage are required to buy flood insurance. However, data on compliance with this policy indicate that the mandatory flood insurance purchase requirement is ineffective in achieving widespread policy purchase. By offering property owners more-precise information on the risks they face, as well as pricing that more accurately reflects it, it is possible that using a modern risk analysis may prompt additional purchases of policies.

Although flood insurance is an effective way for property owners behind levees to deal with risk, at this time there is no sound reason to extend the mandatory purchase requirement to areas behind levees, where the flood risk for many properties is unknown and where the challenges of risk communication are great. Once the risk-based approach has been put in place and matures, FEMA should study whether the mandatory purchase requirement is necessary throughout flood hazard areas and behind levees.



## Managing Flood Risk

All locations within a floodplain face some risk; although levees can reduce risk, they cannot eliminate it. An effective flood risk management strategy identifies and implements measures, tailored to each community, that reduce overall risk. Measures to reduce risk include structural approaches such as levees, floodwalls, and pumps; nonstructural approaches, such as elevating, floodproofing, or relocating buildings, using early warning systems and building codes, and transferring risk through insurance, can also be important. There is a clear need for a comprehensive, tailored approach to flood risk management behind levees that is:

- designed and implemented at the local level,
- involves federal and state agencies, communities, and households,
- takes into account possible future conditions, and
- relies on an effective portfolio of structural measures, non-structural measures, and insurance to reduce the risk to those behind levees.

Communities’ strategies should consider the full range of foreseeable flood scenarios, including the failure or overtopping of levees.

## Communicating Flood Risk

Part of formulating flood risk management strategies is developing ways to communicate with the public about flood risk. However, efforts to communicate information about flood risk face many challenges. For example, the meaning of the “100-year” flood plain is often misunderstood. Moreover, even if people are aware of risk, they do not always act to reduce it. People often assume that flood control structures such as levees are always effective and that they personally do not need to take additional actions to mitigate risk.

To be effective, risk communication efforts:

- are delivered at the local level
- are tailored to individual households, communities, and other stakeholders
- are delivered from a credible and trusted source
- are long-term
- have consistent, clear, and non-conflicting content
- encourage and motivate some behavior
- account for values of target audiences or communities
- use various modes of communication
- provide repeat messaging

FEMA and other federal, state and local organization who communicate flood risk should incorporate these risk communication principles in their strategies. A single federal message that uses consistent terminology, transparent data, and open discussion about flood risk is critical to informing the affected communities who, in turn, communicate and manage risk at the local level. FEMA should assume a leadership role in providing direction for research, development, and release of flood risk communication products and maps.

### **A National Levee Inventory**

An important step in developing flood risk management strategies is to know the location, ownership, and condition of the nation's levees, along with what assets and lives they are protecting—information that is currently unclear. Some levees are monitored by FEMA for insurance purposes, while others are monitored by the U.S. Army Corps of Engineers for flood risk management purposes and each agency currently has a complementary, but separate database for keeping this information. A comprehensive inventory of the nation's levees needs to be completed.

### **Shared Responsibility in Moving to Flood Risk Management**

Several federal agencies—including FEMA and the U.S. Army Corps of Engineers (USACE)—help

manage the nation's flood risk. State and local governments also have responsibilities, such as controlling land use and communicating about flood risk, that are critical to managing risk. Greater coordination and cooperation among federal agencies, state and local entities, and the public at large would improve the effectiveness and efficiency of the National Flood Insurance Program, as well as the nation's approach to managing levees and floodplains. The Federal Interagency Floodplain Management Task Force, an existing group that represents agencies involved in floodplain management efforts within the federal government, is a useful vehicle to promote the need for better definition of the shared responsibilities for floodplain management among all the parties.

Currently, efforts to share and coordinate responsibility for levee-related flood risk activities across the federal, state, and local levels are as not as robust as they could be. A preliminary analysis indicates that about 3,400 miles of levees or approximately two-thirds of NFIP levee miles are part of the programs of both FEMA and USACE. FEMA and USACE should jointly develop a common, risk-based approach to levee assessment in a timely manner and apply this approach to all levees assessed by the two agencies. This would include a joint methodology, procedure, and where feasible, the sharing of models and other risk analysis tools.

**Read or purchase this report and locate information on related reports at**  
<http://dels.nas.edu/wstb>

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The National Academies appointed the above committee of experts to address the specific task requested by the U.S. Department of Energy. The members volunteered their time for this activity; their report is peer-reviewed and the final product signed off by both the committee members and the National Academies. This report brief was prepared by the National Research Council based on the committee's report.



For more information, contact the Water Sciences and Technology Board at (202) 334-3422 or visit <http://dels.nas.edu/wstb>. Copies of *Levees and the National Flood Insurance Program: Improving Policies and Practices* are available for purchase from the National Academies Press, 500 Fifth Street, NW, Washington, D.C. 20001; (800) 624-6242; or as free PDFs at [www.nap.edu](http://www.nap.edu).

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