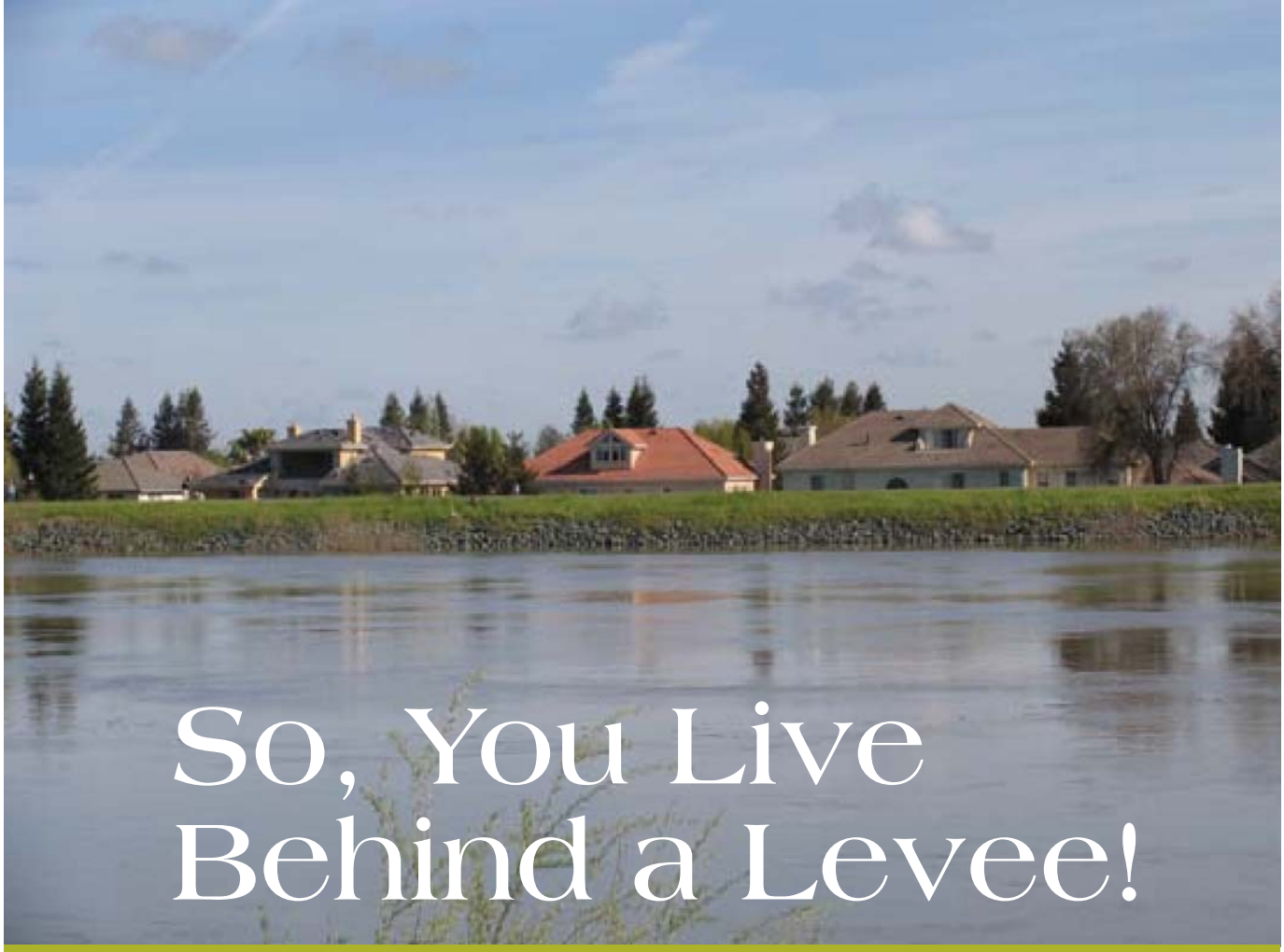


So, You Live Behind a Levee!

What you should know to protect your home and loved ones from floods

What to Do During a Flood Watch or Flood Warning

- ☐ **Listen to the radio or TV or check the Internet to see whether a flood watch or flood warning has been posted for your area. A flood *watch* means that flooding is possible. A flood *warning* indicates that flooding is expected or is occurring.**
- ☐ **Check for instructions from your local emergency management agency or other local officials via the radio, TV, or Internet.**
- ☐ **Locate your pre-assembled emergency kit and prepare other items to take with you in the event of an evacuation.**
- ☐ **Move valuable items from basements and ground-floor levels to higher areas.**
- ☐ **Turn off electricity at your breaker or fuse box and close your main gas valve. For fuel oil or propane tanks, turn off the fuel valve at the tank. Bring outdoor possessions inside or secure them adequately.**
- ☐ **Place sandbags anywhere water may enter your home.**
- ☐ **If instructed to do so, leave immediately. Avoid areas of high or moving water and downed power lines along your evacuation route.**
- ☐ **If floodwaters enter your home or business before you can leave safely, move to the highest level, including the roof. It may take hours or even days before help can arrive.**

For additional information about what to do during a flood, visit *www.fema.gov/hazard/flood/fl_during.shtm*.

Ask Yourself This:

Are My Home and Loved Ones Safe from Floods?

Most people know that levees are structures built near rivers and lakes to reduce the risk of flooding. But what does it mean to live behind a levee? How much protection does a levee really provide? What do you need to know to remain as safe as possible?

This booklet was created to help answer your questions about levees and their associated risk. Most importantly, it is intended to help you *act now* to better protect yourself against future flood threats.

Above: Flooded farmland in the San Francisco Bay-Delta region near Sacramento, California. California Department of Water Resources

Opposite: April 8, 1997 — Taking only what they can carry, residents begin evacuation of East Grand Forks, Minnesota. Dave Saville/ FEMA News

Front cover: Tim Mayhew/ Pashnit.com *(top);* FEMA *(bottom)*

Back cover: California Department of Water Resources

This booklet has been prepared in cooperation with the following organizations:

- **American Council of Engineering Companies**
- **American Society of Civil Engineers**
- **ASFE: The Best People on Earth**
- **Association of State Dam Safety Officials**
- **Association of State Floodplain Managers**
- **Dams Sector Coordinating Council**
- **National Association of Flood and Stormwater Management Agencies**
- **The Infrastructure Security Partnership**
- **United States Society on Dams**
- **U.S. Army Corps of Engineers**
- **U.S. Department of Homeland Security**
- **U.S. Federal Emergency Management Agency**

Four Essential Levee Facts

Flooding *will* happen.

All rivers, streams, and lakes will flood eventually. This means that all levees will be called upon to combat floodwaters at some point. Don't think flooding can happen to you? Think again.

No levee is flood-proof.

Levees *reduce* the risk of flooding. But no levee system can *eliminate* all flood risk. A levee is generally designed to control a certain amount of floodwater. If a larger flood occurs, floodwaters will flow over the levee. Flooding also can damage levees, allowing floodwaters to flow through an opening, or breach.

Risks associated with flooding vary.

If you live behind a levee, you are responsible for knowing the threat you face from flooding. Don't assume that someone else is watching out for you. Take responsibility.

Actions taken now will save lives and property.

There are many steps you can take, from purchasing flood insurance, to developing an evacuation plan, to flood-proofing your home, to reporting any problems that you see. The sooner you act, the better off you'll be when the next flood occurs. Be prepared.

FACT NUMBER

1 Flooding *will* happen.

March 28, 2009 — The River View neighborhood of Fargo, North Dakota, experiences flooding from the Red River. Patsy Lynch/ FEMA News

All rivers, streams, and lakes will flood eventually. There are no exceptions. Given enough time, any levee will eventually be overtopped or damaged by a flood that exceeds the levee's capacity.

How Flood Size Is Defined

A common practice to describe the size of a flood is by the "percent chance" that a flood will occur in a given year. Experts estimate the percent chance based, in part, on past storm data. They do this by charting the size of all known floods at a location and recording how often floods of a particular size occur. Experts then estimate the probability (or percent chance) that the floodwaters will reach or exceed a certain level at that location.

Smaller floods occur more often than larger floods. Therefore, smaller floods have a higher percent chance of reaching or exceeding a particular floodwater level in any given year.

A flood that has a 1-in-10 chance of occurring in a single year is also known as a 10%-annual-chance flood, or a 10-year flood. A 1%-annual-chance flood—sometimes referred to as a 100-year flood—is likely to happen less often. A "100-year flood" can happen more than once in 100 years. A 1%-annual-chance flood will have a higher floodwater level than a 10%-annual-chance flood. A significantly larger flood that is expected to occur once every 500 years—commonly known as a 500-year flood—has only a 0.2 percent chance of occurring in a given year.

What does this have to do with levees? The level of protection offered by a levee is typically described in terms of the flood size, or floodwater level, that the levee is capable of containing. For example, a levee designed to control a 1%-annual-chance flood is often referred to as a "100-year levee."

Levees are designed to have a particular size and shape to enable them to withstand the corresponding floodwater level. Do you know what size of flood your levee is designed to control?

Levee Lingo

Flood watch – a term that means flooding may occur. If you are in a flood watch area it is important to stay updated in case it becomes necessary to take action.

Flood warning – a term that means flooding is occurring or is imminent.

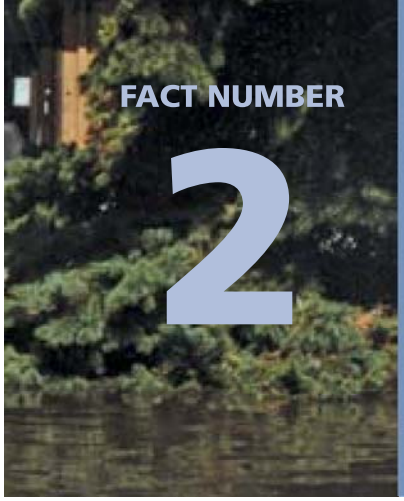
Floodplain – low-lying areas where water naturally overflows, often found along rivers and lakes.

National Flood Insurance Program (NFIP) – a federal program that offers flood insurance to property owners and renters in participating communities.

Runoff – rain water that cannot be absorbed into the ground because of already saturated soil conditions, steep grades, or impervious surfaces such as asphalt roads and concrete parking lots.

Storm surge – a build-up of water caused by high winds associated with hurricanes that creates a wave much above the normal sea level.

Watershed – an area of land that is drained by a river or stream and its tributaries.



FACT NUMBER

2

No levee is flood-proof.

Levees reduce the risk of flooding. But no levee system can eliminate all flood risk. There is always the chance that a flood will come along that exceeds the capacity of a levee, no matter how well it was built. Levees do not always perform as intended. In fact, levees sometimes fail even when a flood is small.

Where Levees Are Located

Many levees were originally built to protect farmland from flooding. As development has occurred these same levees now protect homes. The problem is that the consequences of a home's being flooded are a lot greater than those of a field's being flooded!

No one knows exactly how many miles of levees there are in the United States. However, there may be as many as 100,000 miles of levees. More than 85 percent are thought to be locally owned and the rest are overseen by the U.S. Army Corps of Engineers or other federal or state agencies.

FEMA has estimated that levees are located in roughly 22 percent of the nation's 3,147 counties. Although no one knows precisely how many people currently rely on levees for flood protection, 43 percent of the U.S. population lives in counties with levees.

Levees are located across the nation, but certain states—Arkansas, Louisiana, Missouri, Mississippi, and California—rely more extensively on levees than others.

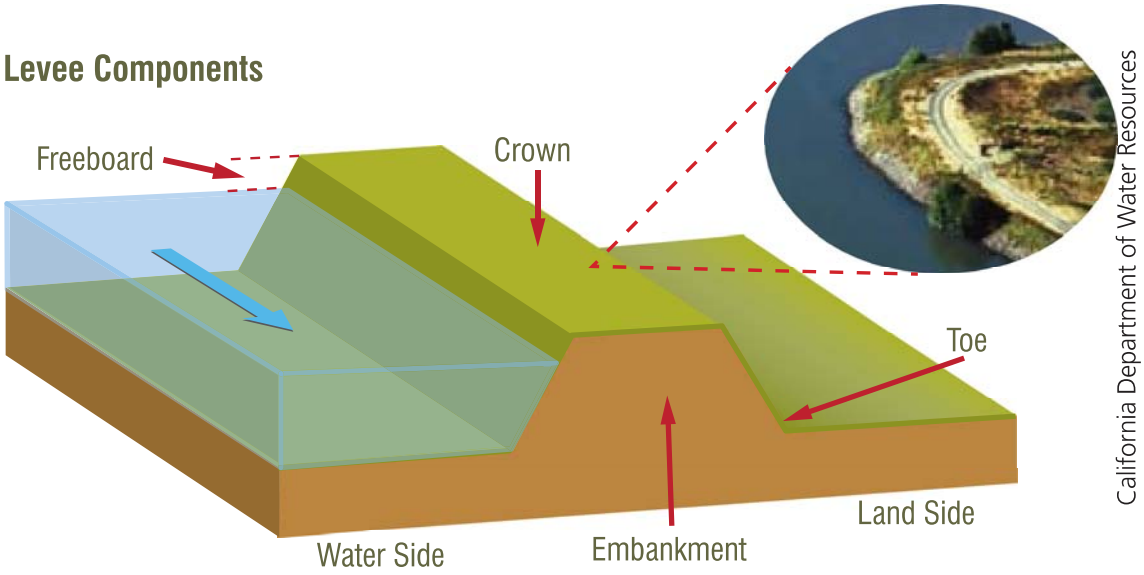
What Is a Levee?

The U.S. Federal Emergency Management Agency (FEMA) defines a levee as a"man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding." Levees are sometimes referred to as dikes.

As the name implies, earthen levees are made from earth, or soil. The soil used to construct a levee is compacted to make the levee as strong and stable as possible. To protect against erosion and scouring, levees can be covered with everything from grass and gravel to harder surfaces like stone (riprap), asphalt, or concrete.

A floodwall is a vertical wall that is built to do

Levee Components



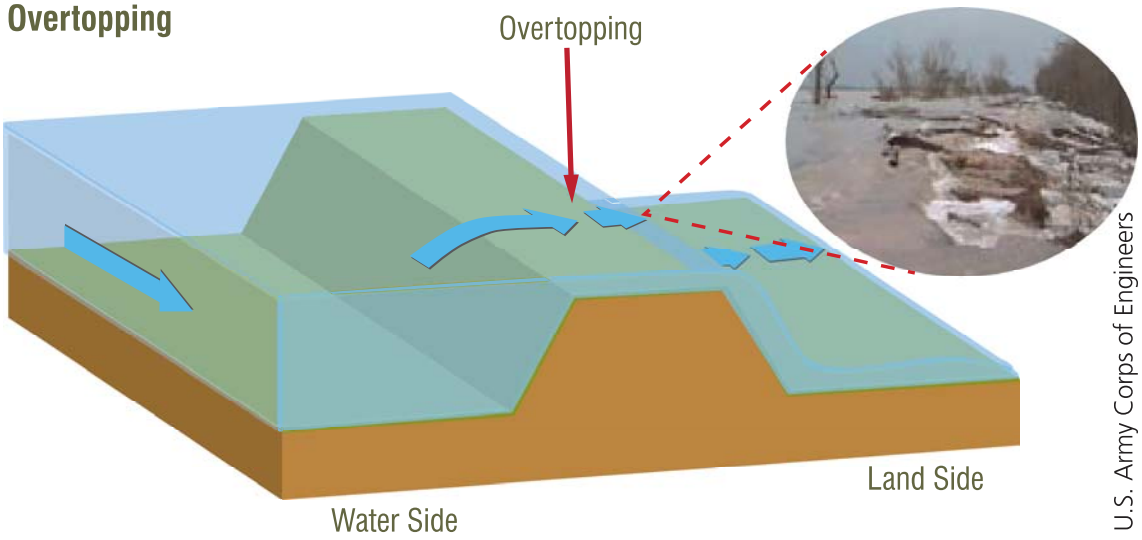
California Department of Water Resources

Dam – an engineered structure across a river that often stores water year round.

Dike – an earthen structure used to retain or divert waters from a tidal storm. "Dike" is used interchangeably with levee.

Embankment – a mound of earth raised to retain or divert water.

Floodwall – a wall, typically made of concrete or steel, that may be constructed in place of a levee or on a levee crown to increase the levee's height.



U.S. Army Corps of Engineers

For this reason, levees often include a series of culverts, canals, ditches, storm sewers, or pump stations, called "interior drainage" systems. These systems take water from the land side of a levee over to the water side.

Overtopping: When a Flood Is Too Big

Overtopping occurs when floodwaters exceed the height of a levee and flow over its crown. As the water passes over the top, it may erode the levee, worsening the flooding and potentially causing an opening, or breach, in the levee.

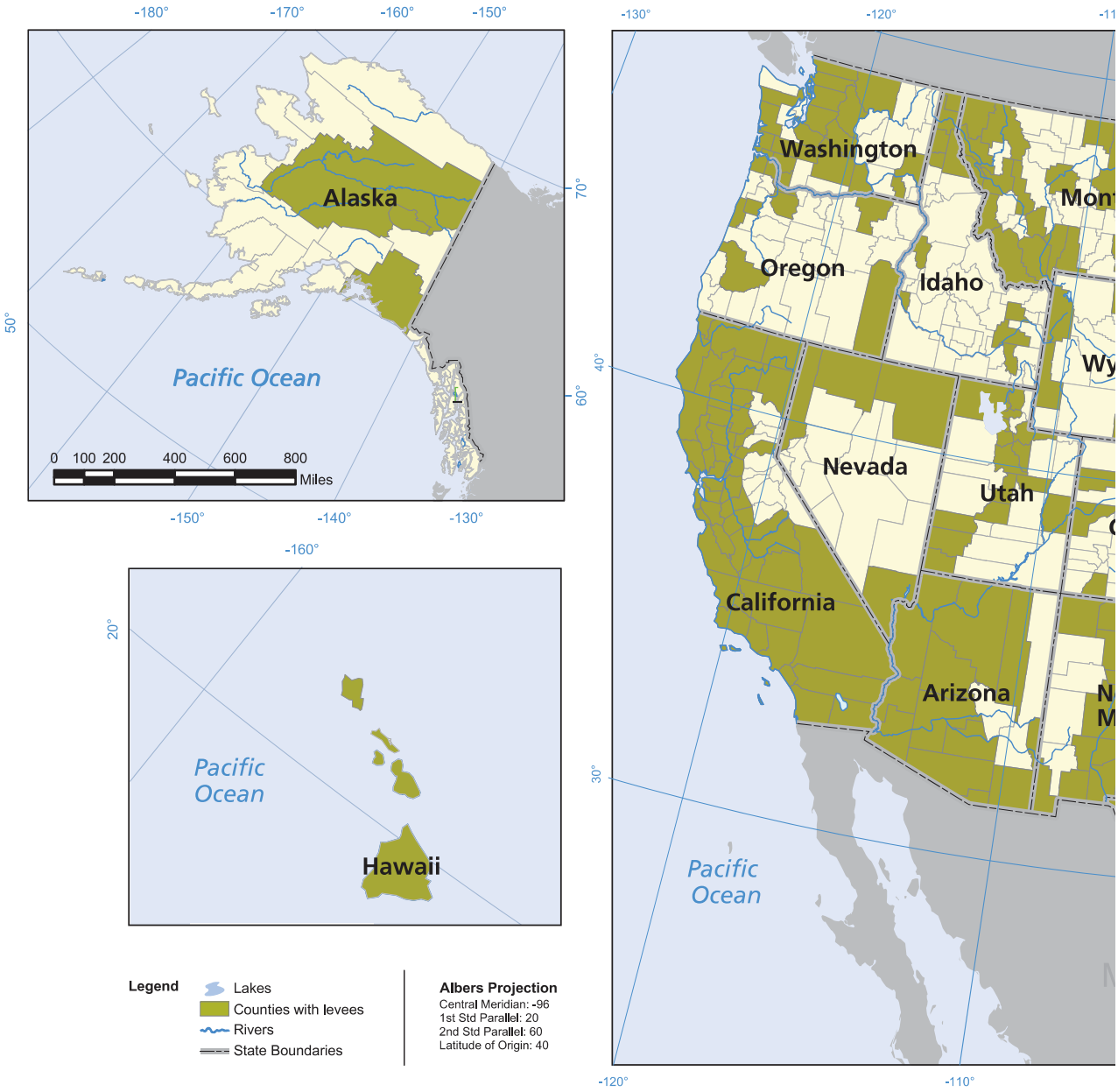
To prevent overtopping, communities sometimes place sandbags on top of levees to increase their height. These and other "flood-fighting" efforts can help prevent a disaster. However, they do not always succeed. Therefore, they should be viewed as last-ditch steps rather than a first line of defense.

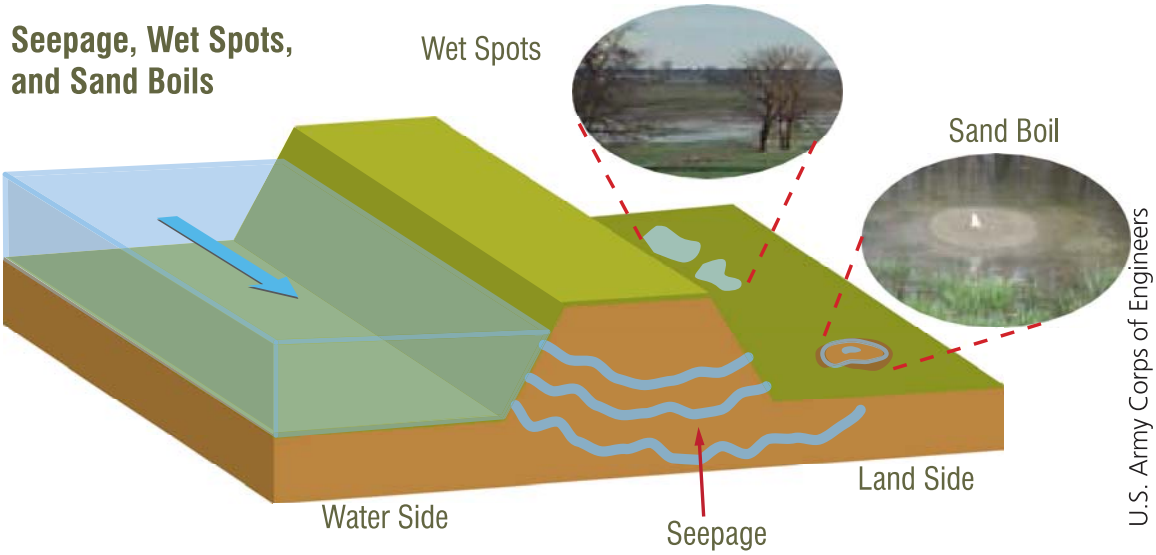
Levee Lingo

Breaching – an opening through which floodwaters may pass after part of a levee has given way. A breach may occur gradually or suddenly.

Overtopping – the flow of water over a levee or dam to low-lying areas.

United States Counties where levees are found





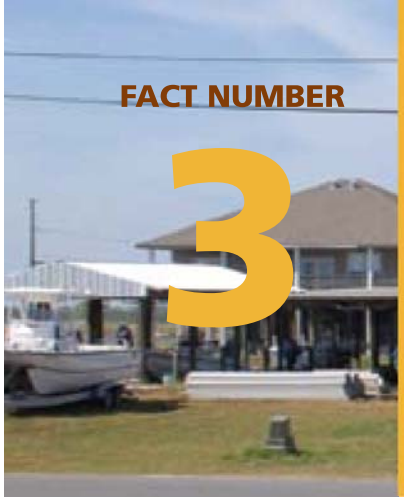
U.S. Army Corps of Engineers

Other Signs of Trouble

Levee inspectors are trained professionals who know what to look for when assessing the condition of a levee. But anyone living near a levee can watch for possible problems. You and your neighbors can play an important role in detecting levee problems and ensuring that they are addressed in a timely manner.

The following is a list of conditions that levee inspectors look for and why. If you see anything like this that you think needs to be addressed, don't hesitate to contact the levee owner or local government officials. If a levee failure has occurred or appears imminent, ***get away from the levee and call 911 immediately.***

- *Unwanted vegetation and debris.* Roots can allow seepage that weakens a levee. Vegetation and debris also make it harder to spot and address problems.
- *Unauthorized encroachments.* Improper structures and excavations can weaken a levee.
- *Slope stability.* Slides, slump, and cracks can indicate problems in need of attention.
- *Erosion.* Erosion is a sign of previous damage to a levee. If not addressed before the next flood, erosion can threaten levee stability.



FACT NUMBER

3 Risks associated with flooding vary.

If you live behind a levee you are responsible for knowing the threat you face from flooding.

How do you assess your level of safety living behind a levee? Unfortunately, there's no simple answer. Many factors must be considered. However, a better understanding of your risk will give you a better idea of what steps to take to reduce your risk.

Questions to Ask About Your Local Levees

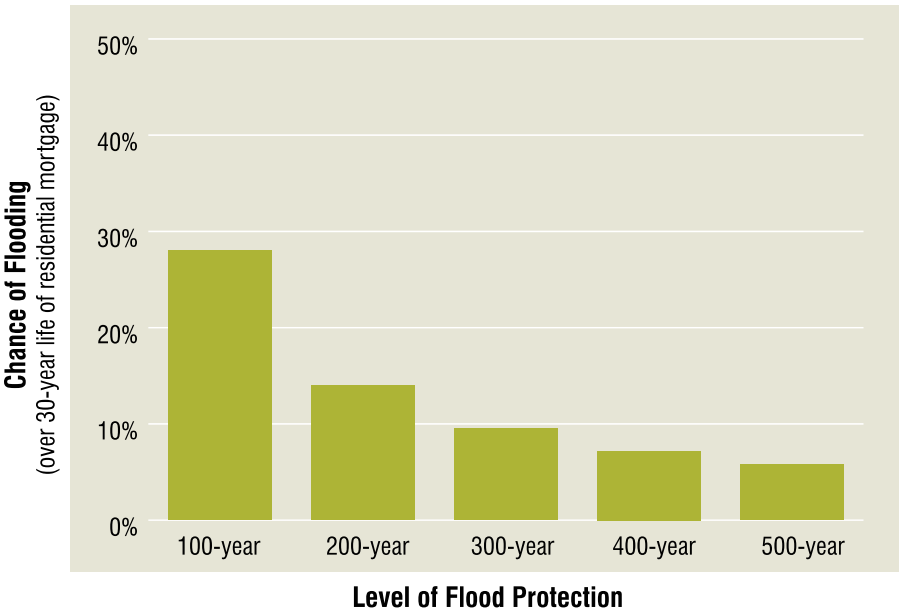
Become an informed citizen! Inquire about the following from levee owners or local government officials:

- ☐ Where are nearby levees located?
- ☐ What areas in my community are served by levees?
- ☐ What size of flood are the levees designed to control?
- ☐ What areas are most likely to flood if a levee is overtopped or breached?
- ☐ What is the condition of the levees?
- ☐ How well have the levees performed during previous floods?
- ☐ What plans are in place to ensure that any levee operations proceed smoothly during a flood?
- ☐ What is the elevation of my home relative to the potential flooding from a levee failure?
- ☐ How would my neighborhood and nearby areas likely be affected under different flood scenarios?
- ☐ How much time would I likely have to evacuate in the event of a disaster?
- ☐ What are my safe evacuation routes?

Levees and the Probability of Flooding

Overtopping *(as defined on page 10)* is one of the most common ways that flooding occurs behind a levee. Levees designed for larger floods are less likely to be overtopped than levees designed to protect against smaller floods. A levee designed to resist a 1%-annual-chance (100-year) flood is more likely to be overtopped than one designed to protect against a 0.2%-annual-chance (500-year) flood.

Flood Exposure Behind Levees for Various Levels of Flood Protection



Based on "Draft Recommendations for a National Levee Safety Program" as prepared by the National Committee on Levee Safety.

To help put this in perspective, imagine two homeowners living near different levees for 30 years, the span of a typical home mortgage. The first homeowner lives near a levee that is designed to withstand a 1%-annual-chance flood (100-year), while the second lives near a levee that is designed to withstand a 0.5%-annual-chance (200-year) flood.

Probability modeling reveals that the levee near the first homeowner has a 26 percent chance—or roughly a one-in-four likelihood—of being overtopped by a flood during a 30 year period. The levee near the second

Flood Risk Will Change Over Time

The hazards associated with flooding may change over time. Certain flooding threats are expected to grow in the future. Climate change is expected to increase the intensity of storms events. Larger storms could increase the risk of flooding along waterways. Climate change also could cause sea level to rise, posing a greater flood risk for coastal areas.

Conditions within a watershed can also change. For example, population may increase, adding to the number of people vulnerable to flooding. As areas become more developed with houses, roads, and parking lots, water runs off the land more quickly rather than being absorbed into the ground. As more runoff enters streams and rivers more quickly, the waterways become more flood-prone.

So How Safe Are You, Really?

The simple answer is no one knows for sure. Risk has not been calculated in most areas. It's important to put the dangers of flooding into perspective. Over the past 30 years, on average, flooding has resulted in more fatalities in the United States than any other weather-related cause *(see diagram, right)*.

How does the risk of flooding compare to the risk of fire? Certainly, fire poses a genuine threat. But a home located in a floodplain is five times more likely to suffer damage from flooding than from fire over the course of 30 years. Yet many homeowners do not insure themselves against flood damage unless they are required to do so.

FACT NUMBER

4 Actions now will save lives and property.

Everyone can help promote levee and flood safety. There are many actions you can take ahead of time.

How Communities Can Reduce Flood Risk

Flood risk can never be eliminated entirely. But just as you can take steps to reduce the risk of flooding to your home, your community can take actions to reduce its risk, too. In fact, communities should view levees as one part of a comprehensive approach to reducing flood risk, rather than the only line of defense.

Here are some steps communities can take to reduce their flood risk:

- ☐ Buy properties in flood-prone areas, remove existing structures, and convert the areas into parks or greenways that can accommodate flooding.
- ☐ Remodel or outfit buildings or raise them on stilts above floodwater levels.
- ☐ Urge homeowners to purchase flood insurance.
- ☐ Avoid building structures, planting trees, or leaving debris on a levee.
- ☐ Change zoning ordinances or building codes to limit development in floodplains.
- ☐ Develop or refine flood warning systems, emergency evacuation plans, and flood preparedness.
- ☐ Provide technical and/or financial assistance to property owners to protect against flooding.

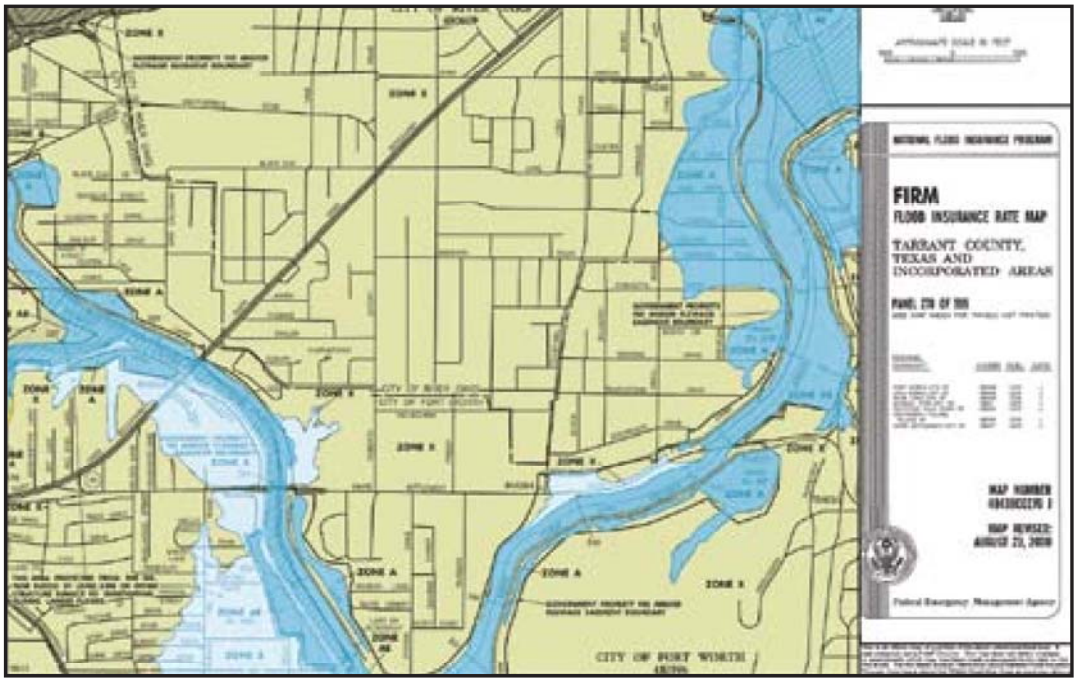
What About Flood Insurance?

The National Flood Insurance Program (NFIP) offers flood insurance, regardless of flood risk. Anyone living behind a levee should purchase a flood insurance policy. Don't wait until it's too late!

Flood damage typically is not covered by a standard homeowner's insurance policy. Federal disaster assistance—when available—usually comes in the form of a loan that must be paid back.

Under federal law, lenders must require borrowers whose property is located within designated high-risk flood areas to obtain flood insurance as a condition of receiving a mortgage that is federally backed, regulated, or insured. To assist lenders and borrowers, FEMA creates Flood Insurance Rate Maps *(see example map, below)* depicting the risk of flood threats for individual communities.

Typical Flood Insurance Rate Map



For more detailed information about the National Flood Insurance Program (NFIP), see www.floodsmart.gov. For a list of communities participating in the NFIP, see www.fema.gov/fema/csb.shtm.

What You Can Do in Advance

If you live in a flood-prone area, or behind a levee, don't delay. Take these steps today:

Prepare for a Flood

- ☐ Purchase flood insurance from the National Flood Insurance Program. For more information, see the "What About Flood Insurance?" section on page 24.
- ☐ Learn which local agency is responsible for notifying residents of flooding, so you'll know where to turn for relevant information in an emergency.
- ☐ Determine whether local agencies have a flood-warning system and an emergency response plan in place. Learn how this information will be broadcast (radio, television, Internet, etc.), so you'll know how to access it.
- ☐ Store insurance papers, deeds, and other important records in a safe-deposit box or other secure location.
- ☐ Prepare an emergency kit that includes at least one large flashlight, a battery-powered radio, spare batteries, candles, waterproof matches, and other items you'll likely need in the event of a power outage.
- ☐ Find out where you can get sandbags.

For additional information about what to do during a flood, visit ***www.fema.gov/hazard/flood/fl_during.shtm.***

Prepare Your Home

- ☐ Elevate your furnace, water heater, and electric panel if they are susceptible to flooding.
- ☐ Install "check valves" in sewer traps to prevent floodwater from backing up into drains.
- ☐ Seal basement walls with waterproofing compounds to avoid seepage.

The Truth About Levees

All rivers, streams, and lakes will eventually flood. The levees built to protect people from flooding are by no means fail-proof. Some levees are in good shape but many are not. People who live behind levees are vulnerable to flooding.

Can the problem be solved? Addressing the problems of inadequate levees will not be easy or inexpensive. Systematically upgrading our nation's levees will require considerable time, energy, and resources—and sustained leadership to see it through.

Rough estimates indicate that repairing and rehabilitating our levees will likely cost more than $100 billion. However, doing nothing ultimately will cost far more than it will cost to fix the problems. Consider that an additional $2-billion investment in the levees surrounding New Orleans before Hurricane Katrina could have greatly reduced the $200-billion-worth of property damage—not to mention the tragic and preventable loss of life.

As daunting as these figures sound, it's in our best interest to begin repairing levees sooner rather later. Such efforts will save lives and reduce flood damages. The costs of levee repair will only increase over time. Acting now will cost less than acting later.

DO YOU KNOW...

- What a levee failure would mean for you and your loved ones?
- What to do if flooding occurs?
- What you can do today to reduce your flood risk?

URGENT! What to do if water is rising quickly behind a levee: *Stay safe!* Listen to the TV or radio or check the Internet for instructions, and then follow them.

You Could Be at Risk of Flooding

A levee is a man-made structure designed and constructed to control the flow of water. The problem is that no levee can guarantee protection from flooding. There is always the chance that a levee will fail and flooding will occur.

ISBN 978-078441083-7

ASCE