

# Landslides

**Learn if landslides, including debris flows, could occur in your area** by contacting local officials, your state geological survey or department of natural resources, or the geology department of a state university. Get information on specific locations that are vulnerable to landslides. Request a professional referral for a detailed landslide-vulnerability analysis of your property, and take corrective measures if necessary.

## **AWARENESS MESSAGES**

### **Why talk about landslides?**

Landslides are a serious geologic hazard that occurs in almost all 50 states. Every year in the United States, they cause significant damages and 25 to 50 deaths. Globally, landslides cause billions of dollars in damages and thousands of deaths and injuries each year.

Debris flows—“muddy” or “liquefied” landslides—are most destructive when they are caused by volcanic eruptions. A spectacular example of a massive debris flow resulted from the 1980 eruptions of Mount St. Helens in Washington State. Areas near the bases of many volcanoes in the Cascade Mountain Range of California, Oregon, and Washington are at risk from the same type of flows during future volcanic eruptions.

Wildfires can also lead to destructive debris flows. In July 1994, a severe wildfire swept Storm King Mountain in Colorado, denuding the slopes of vegetation. Heavy rains on the mountain in September resulted in numerous debris flows, one of which blocked Interstate 70 and threatened to dam the Colorado River.

### **What are landslides, and what causes them?**

The term “landslide” describes many types of downhill earth movements ranging from rapidly moving catastrophic rock avalanches and debris flows in mountainous regions to more slowly moving earth slides. Some landslides move slowly and cause damage gradually, whereas others move so rapidly that they can destroy property and take lives suddenly and unexpectedly. Gravity is generally the force driving landslide movement. Factors that trigger landslide movement include heavy rainfall, erosion, poor construction practices, freezing and thawing, earthquake shaking, and volcanic eruptions. Landslides are typically associated with periods of heavy rainfall or rapid snowmelt and tend to worsen the effects of flooding. Areas burned by forest and brush fires are particularly susceptible to landslides.

Debris flows—sometimes referred to as mudslides, mudflows, lahars, or debris avalanches—are common types of fast-moving landslides. These flows generally occur during periods of heavy rainfall or rapid snowmelt. They usually start on steep hillsides as shallow landslides that liquefy and accelerate to speeds that are typically about 10 miles (16 kilometers) per hour, but can exceed 35 miles (56 kilometers) per hour.

The consistencies of debris flows range from watery mud to thick, rocky mud that can carry such large items as boulders, trees, and cars. Debris flows from many different sources can combine in channels, and, when this happens, their destructive power can increase greatly as they flow downhill and through channels, growing in volume with the addition of water, sand, mud, boulders, trees, and other materials. When the flows reach flatter ground, the debris spreads over a broad area, sometimes accumulating in thick deposits that can wreak havoc in developed areas.

#### **How do landslides affect us?**

Landslides cause property damage, injury, and death and adversely affect a variety of resources. For example, water supplies, fisheries, sewage disposal systems, forests, dams, and roadways can be affected for years after a slide event.

The negative economic effects of landslides include the cost to repair structures, loss of property value, disruption of transportation routes, medical costs in the event of injury, and indirect costs, such as lost timber and fish stocks. Water availability, quantity, and quality can be affected by landslides. Geotechnical studies and engineering projects to assess and stabilize potentially dangerous sites can be costly.

#### **How can I protect myself from landslide?**

Landslides generally happen where they have occurred in the past, and in identifiable hazard locations. Areas that are prone to landslides include existing old landslides, the bases of steep slopes, the bases of drainage channels, and developed hillsides where leach-field septic systems are used.

Areas that are typically considered safe from landslides include areas that have not moved in the past; relatively flat areas away from sudden changes in slope; and areas at the top of or along ridges, but set back from the edge of slopes.

People can reduce their personal risk by learning about potential local landslide hazards and taking steps to reduce those hazards.

Landslides are usually isolated events occurring without public warning. If you live in a landslide-prone area, be alert, particularly during periods of heavy rainfall or snowmelt or after a wildfire. If you see signs of a landslide or suspect a landslide may occur, you yourself must make the decision to evacuate.

#### **What is the best source of information in a landslide situation?**

The best source of information in a landslide situation is a local radio or television station.

## **ACTION MESSAGES**

### **Be Prepared for a Landslide**

### **Protect Yourself**

#### **CORE ACTION MESSAGES**

- **Determine your risk.**
- **Prepare members of your household.**
- **Consult an expert and correct potential problems.**
- **Be alert to changes and patterns in the land.**

For general preparedness, every household should create and practice a Family Disaster Plan and assemble and maintain a Disaster Supplies Kit. In addition, every household at risk from landslides should take landslide-specific precautions and plan for and practice what to do if a landslide occurs.

If you are at risk from landslides, you should:

- **Develop an evacuation plan.** If your home could be damaged in a landslide, you should know where to go if you have to leave. Making plans at the last minute can be upsetting, create confusion, and waste precious time. Contact local authorities to learn about the emergency response and evacuation plans for your area and develop your own emergency plans for your family and business.
- **Familiarize yourself with the land around you.** Knowing the land can help you assess your risk.
- **Watch the patterns of storm water drainage on slopes near your home** and especially the places where runoff water converges, increasing flow over soil-covered slopes. Watch the hillsides around your home for any signs of land movement, such as small landslides or debris flows, or progressively tilting trees. Noticing small changes could alert you to an increased threat of a landslide.
- **Discuss landslides and debris flows with members of your household.** Everyone should know what to do to stay safe if one occurs.
- **Be aware that, generally, landslide insurance is not available;** however, in some cases, debris flow damage may be covered by flood insurance policies from the National Flood Insurance Program (NFIP) ([www.fema.gov/nfip](http://www.fema.gov/nfip)).

## What to Do During Severe Storms, Which Can Trigger Landslides

### CORE ACTION MESSAGES

- Monitor local news.
- Consider evacuating.
- Look and listen for signs of landslide.

**During a severe storm, if you are in an area susceptible to landslides, you should:**

- **Stay alert and awake.** Many landslide fatalities occur when people are sleeping.
- **Listen to local stations on a portable, battery-powered radio or television or to NOAA Weather Radio** for warnings of heavy rainfall. Be aware that short bursts of heavy rain may be particularly dangerous, especially after longer periods of heavy rain and damp weather.
- **Consider leaving if it is safe to do so.** Remember that driving during a severe storm can be hazardous. If you remain at home, move to a second story if possible. Staying out of the path of a landslide or debris flow can save your life.
- **Listen for any unusual sounds that might indicate moving debris, such as trees cracking or boulders knocking together.** A trickle of flowing or falling mud or debris may precede a large landslide. Moving debris can flow quickly and sometimes without warning.
- **If you are near a stream or channel, be alert for any sudden increase or decrease in water flow and for a change from clear to muddy water.** Such changes may indicate landslide activity upstream, so be prepared to move quickly. Act quickly. Save yourself, not your belongings.
- **Be especially alert when driving.** Embankments along roadsides are particularly susceptible to landslides. Watch the road for collapsed pavement, mud, fallen rocks, and other indications of a possible debris flow.
- **Bring your companion animals indoors and maintain direct control of them.** Be sure that your pet disaster kit is ready to go, along with your family disaster kit, should you need to evacuate.
- **Consider a precautionary evacuation of large or numerous animals.** If you think an evacuation might be advised or ordered and if you have large, unusual, or numerous animals, start evacuating them as soon as you are aware of impending danger. If you are using a horse or other trailer to evacuate your animals, move early rather than wait until it may be too late to maneuver a trailer through slow traffic. Road hazards may make this too dangerous for you and for them.
- **If you are ordered to or decide to evacuate, take your animals with you.** If it is not safe for you, it is not safe for your animals.

## What to Do if You Suspect Imminent Landslide Danger

### CORE ACTION MESSAGES

- **Contact local officials.**
- **Inform your neighbors.**
- **Get out.**

**If you learn or suspect that a landslide is occurring or about to occur in your area, you should:**

- **Contact your local fire, police, or public works department.** Local officials are the people best able to assess the potential danger.
- **Inform affected neighbors.** Your neighbors may not be aware of the potential hazard. Advising them of a threat may help save lives. Help neighbors who may need assistance to evacuate.
- **Leave.** Getting out of the path of a landslide or debris flow is your best protection. Take your pets with you when you leave, provided you can do so without endangering yourself.

## What to Do During a Landslide

### CORE ACTION MESSAGE

- **Get out of the landslide's path.**

**If a landslide occurs, you should:**

- **Quickly move out of the path of the landslide.** Moving away from the path to a stable area will reduce your risk.

## What to Do After a Landslide

### CORE ACTION MESSAGES

- Stay away from the slide area.
- Help others.
- Report hazards.

### After a landslide, you should:

- **Stay away from the slide area.** There may be danger of additional slides.
- **Check for injured and trapped persons and animals near the slide, without entering the slide area.** Direct rescuers to their locations.
- **Help people who require special assistance**—infants, elderly people, those without transportation, large families who may need additional help in an emergency situation, people with disabilities, and the people who care for them.
- **Listen to local stations on a portable, battery-powered radio or television** for the latest emergency information.
- **Watch for flooding,** which may occur after a landslide or debris flow. Floods sometimes follow landslides and debris flows.
- **Look for and report broken utility lines to appropriate authorities.** Reporting potential hazards will get the utilities turned off as quickly as possible, preventing further hazard and injury.
- **Check your home's foundation, chimney, and surrounding land for damage.**
- **Replant damaged ground as soon as possible** because erosion caused by loss of ground cover can lead to flash flooding.

## Media and Community Education Ideas

- If your area is prone to landslides, ask your local newspaper or radio or television station to:
  - Do a series on the dangers of landslides and debris flows.
  - Do a story featuring interviews with local officials about land use management, zoning regulations, and building codes for landslide safety.
  - Highlight the importance of staying alert to land and rainfall conditions.
  - Run public service ads about how to protect lives and property in a landslide.
  - Report on what city and county governments are doing to reduce the possibility of landslides.

Help the reporters to localize the information by providing them with the local emergency telephone number for the fire, police, and emergency medical services departments (usually 9-1-1) and emergency numbers for the local utilities and hospitals. Also provide the business telephone numbers for the local emergency management office, local American Red Cross chapter, and state geological survey or department of natural resources.

- Work with officials of the local fire, police, and emergency medical services departments; utilities; hospitals; emergency management office; and American Red Cross chapter to prepare and disseminate guidelines for people with mobility impairments about what to do if they have to evacuate.
- Support your local government in efforts to develop and enforce land use and building ordinances that regulate construction in areas susceptible to landslides and debris flows. Buildings should be located away from steep slopes, streams and rivers, intermittent-stream channels, and the mouths of mountain channels.

## Facts and Fiction

**Fiction:** Landslides are caused by the earth collapsing into a hole or a void.

**Facts:** Landslides exhibit vertical and horizontal movement down a slope, and most are triggered by heavy rain and snowmelt, earthquake shaking, volcanic eruptions, and gravity.

**Fiction:** Landslides are caused by human activities such as logging, road construction, and farming on steep slopes.

**Facts:** Although human activities may cause landslides on unstable slopes, most landslides are caused by natural forces or events, such as heavy rain and snowmelt, earthquake shaking, volcanic eruptions, and gravity.

**Fiction:** Landslides occur only on the West Coast.

**Facts:** California and the Pacific Northwest experience numerous landslides; however, landslides also occur in most states and territories in the United States. The Appalachian Mountain region on the East Coast, Puerto Rico, and Hawaii are highly susceptible to landslides.