Tips and Clues That May Save Your Life

- *Before and during rains watch for cracks in snow, ice, soil, or rock; bulges at the base of slopes; the appearance of holes or bare spots on hillsides; tilting trees; or increased muddiness of streams. Any sudden increase in runoff or debris is cause for concern.*
- *Listen for unusual rumbling sounds or noises that may indicate shifting soil, rock or breaking vegetation or structures.*
- *Stay alert to the amount of rain falling locally during intense rainstorms. Check for early flood warnings frequently.*
- *Debris flows can be triggered when rainfall exceeds ¼ inch per hour, especially when soil may be waterlogged.*
- *It takes time for bare slopes to recover from a wildfire. In the meantime, preparation for rapid evacuations should be made.*

Again, the two most important actions that should be taken by residents on rainy nights is to heed flood warnings and NOT to sleep in lower-floor bedrooms on the sides of houses that face steep slopes or drainages.

Where Can More Information Be Obtained?

For general information about debris flows and other kinds of landslides, contact the ***Colorado Geological Survey 303.866.2611*** *or visit* ***www.geosurvey.state.co.us.***

For an assessment of the debris flow risk to an individual property or homesite, obtain the services of a professional engineering geologist. For more information about the design and construction of debris basins, debris fences, deflection walls, or other protective works, consult a local or county engineer, local flood control agency, or the U.S. Department of Agriculture, Natural Resources Conservation Service.

REFERENCES

Barrows, A., and Smith, T. DMG Note 33, California Geological Survey.

Hollingsworth, R. and Kovacs, G.S., 1981, Soil slips and debris flows, prediction and protection: Bulletin of the Association of Engineering Geologists, v. 18, no. 1, p. 17-28. This paper provides information about deflection walls and similar structures.

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Post Wildfire Hazards:

Mudslides (Debris Flows) What You Need to Know

The two most important actions that should be taken by residents on rainy nights is to heed flood warnings and NOT to sleep in lower-floor bedrooms on the sides of houses that face steep slopes or drainages.

In the West, over 100 people have been killed by debris flows. Most deaths occurred when debris flows buried residents, sleeping in lower-floor bedrooms, adjacent to steep slopes or drainages.

Sudden debris flows gushing down rain-sodden slopes and gullies are widely recognized as a hazard to human life and property. Most debris flows are localized in small gullies, threatening only those buildings in their direct path. But the bare slopes left denuded by wildfires are especially susceptible to debris flows during and immediately after rainstorms. Debris flows often occur without warning in areas where they have never been seen before.

Those who live downslope of a burned area should be aware of this potential hazard. Following the fire and for years thereafter, burned areas are more susceptible to debris flows for about 5–10 years and sometimes longer.

What Are Debris Flows?

Debris flows (commonly called mud-slides, mud flows or debris avalanches) are shallow landslides, saturated with water, that travel rapidly downslope as muddy slurries. The flowing mud carries rocks, trees, and other debris as it pours down the slopes.

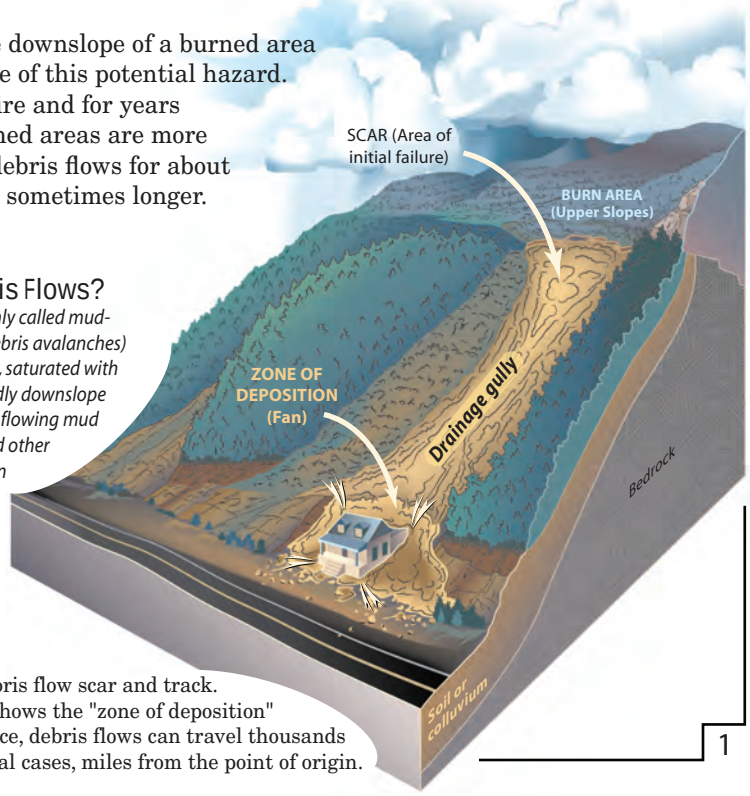

Figure 1.
Sketch of a typical debris flow scar and track. Although this figure shows the "zone of deposition" as quite near the source, debris flows can travel thousands of feet or, in exceptional cases, miles from the point of origin.

What Dangers Are Posed by Debris Flows?

Debris flows pose hazards that are often overlooked. Houses, roads and other structures in the path of debris flows can be severely damaged or demolished. People in these structures can be severely injured or killed.

When the ground is damaged from a wildfire, even relatively short high-intensity rainstorms may trigger debris flows. Debris flows may be generated when hillside soil, rock or landslide material becomes rapidly saturated with water and flows into a channel. Intense rainfall, rapid snowmelt, or high levels of ground water flowing through fractured bedrock can trigger such movement. Debris flows and floods also occur when rains on slopes cause extensive hillside erosion and channel scour.

What Causes Debris Flows?

The most common cause of debris flows is the combination of rainfall, steep slopes, and loose, bare soil. Most steep slopes have enough soil and loose rock for potential landslides and debris flows. Although "stable" when dry, such slopes can produce debris flows, often without warning. Broken water pipes or misdirected runoff concentrated by roads, roofs, or large paved areas may trigger, or help to trigger, debris flows. In Colorado, debris flows commonly occur during the summer following intense rainfall.

Where Do Debris Flows Occur?

They are common in mountainous areas, and occur in Colorado almost every year. Debris flows are known to start on slopes as low as 15 degrees, but the more dangerous, faster moving flows are more likely to develop on steeper slopes. About two-thirds of all debris flows start in hollows or troughs at the heads of small drainage courses. Typically, a debris flow bursts out of a hillside and flows quickly downslope, inundating anything in its path. Because the path of a debris flow is controlled by topography, just like flowing water, mud flows generally follow stream courses and spread out on alluvial fans (where streams exit steep areas onto a flatter plain).

Slopes burned by wildland fire are especially susceptible to debris flows because of the absence of vegetation and roots to bind the soil. Alluvial fans and areas directly downslope are especially subject to damage from debris flows.

Figure 2. Hayman post-fire debris flow. Depth of deposit is 4–10 feet.

What Can Be Done to Avoid or Reduce the Hazard Posed by Debris Flows?

To be safe, assume that all drainages in steep, hilly, or mountainous areas are capable of carrying debris flows, especially if loose, sandy soils are present in the watershed.

Avoid building sites at the bottoms and mouths of steep ravines and drainage courses. These areas are the most likely to be inundated by debris flows. The outer "banks" of bends along such ravines also should be avoided because swiftly flowing debris flows can "ride up" out of the bottom of the stream channel where it bends.

About Debris Flow Dangers

If these areas must be used, consult with a geotechnical engineer, a hydrologist, and an engineering geologist. In some cases, walls, or other structures can be built to deflect potential debris flow away from or around structures. To be effective, diversion walls must be properly designed, constructed, and regularly maintained.

Figure 3. Schematic of an A-shaped deflection wall serving as a splitting wedge to deflect debris and dangers. These and similar structures should be carefully engineered and constructed. Designs will vary from site to site. Sketch from the United Nations, 1996. ***Photo:*** *House that possibly could have been saved with a deflection wall.*

Mud Floods

People living directly downslope of mountainous wildfire areas should be aware that, in addition to debris flows, landslides, and rockfall; there is another, potential deadly hazard-- mud flooding at and near the mouths of channels that drain burned-over, ashy slopes. Studies have shown that, in the first year following a wildfire, the volume of sediment and water runoff in streams greatly increases. People living, working or traveling near such streams could be killed or injured by floods that incorporate enormous amounts of debris and mud washed off burned hillsides.

In l996, a large wildland fire nearly destroyed the small mountain community of Buffalo Creek, Colorado. Following the devastation, the community was rocked by a series of flash floods culminating in a severe deluge that claimed two lives and caused extensive infrastructure damage.