LANDSLIDE HAZARDS IN UTAH

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UTAH DNR GEOLOGICAL SURVEY

Landslides: Serious and Common Geologic Hazards

According to the U.S. Geological Survey, landslides are a serious geologic hazard common to almost every state in our country. Nationwide, estimated losses from damaging landslides exceed $2 billion annually. Annual losses from landslide damage in Utah vary, but are often in the millions of dollars; documented losses in 2001 exceeded $3 million and estimated losses in 2005 exceeded $10 million.

Types of Landslides

The term “landslide” refers to a downslope movement of rock, soil, and/or organic debris under the influence of gravity. Specific types of landslides are classified by the material involved and type of movement. Material in a landslide can be rock, soil, organic debris or a combination of these materials, and movement types include fall, topple, slide, and flow. Typical landslides in Utah include slides, rock falls, debris flows, and earth flows.

In Utah, many landslides move slowly, but some move quickly with devastating results. Debris flows, which are a type of landslide having very high water content, can travel at speeds greater than 30 to 50 miles per hour.

Causes of Landslides

Landslides can be naturally occurring or human-caused. Landslides often result from a rise in groundwater levels caused by increased precipitation, rapid snowmelt, or by human causes such as landscape irrigation or leakage from water-conveyance structures (reservoirs, ponds, pipelines). Modification of a slope that results in over-

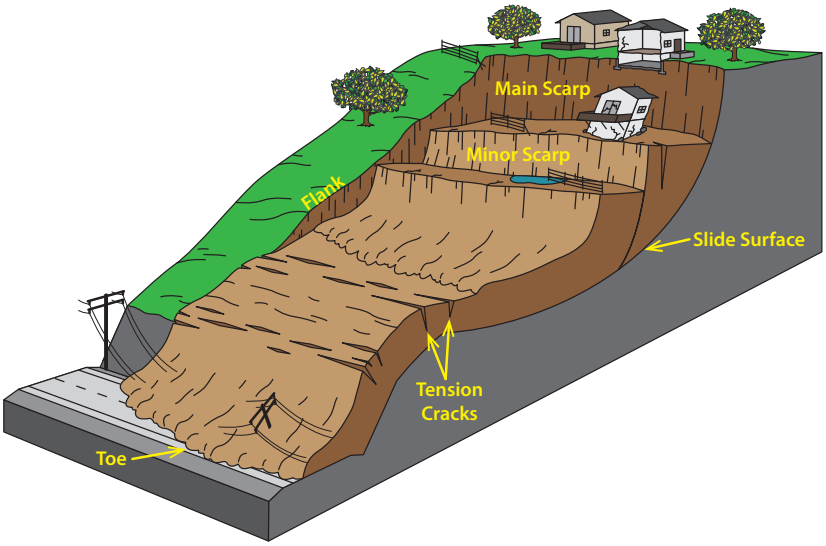
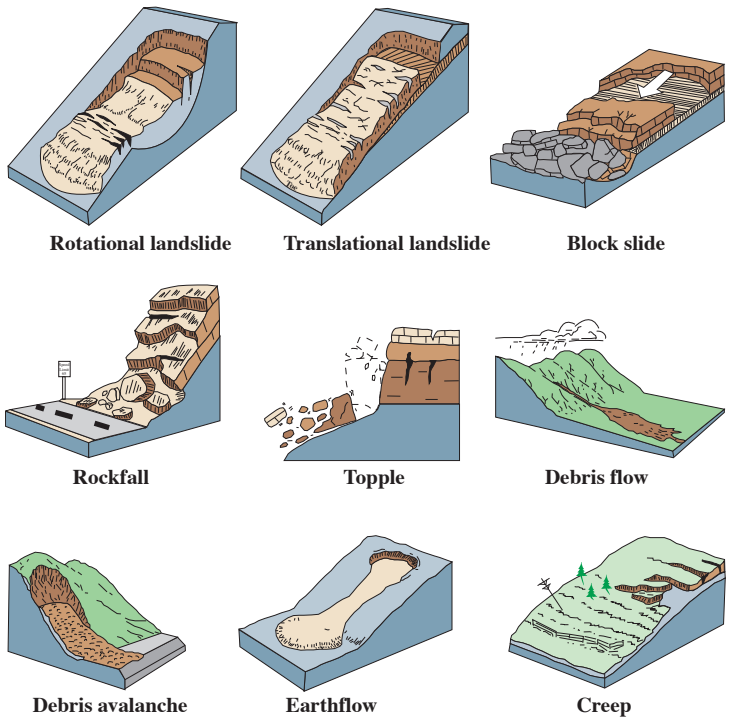


Diagram of an idealized landslide showing commonly used nomenclature for its parts.



Major types of landslides and their physical characteristics (from U.S. Geological Survey Fact Sheet 2004-3072 [http://pubs.usgs.gov/fs/2004/3072/fs-2004-3072.html]).

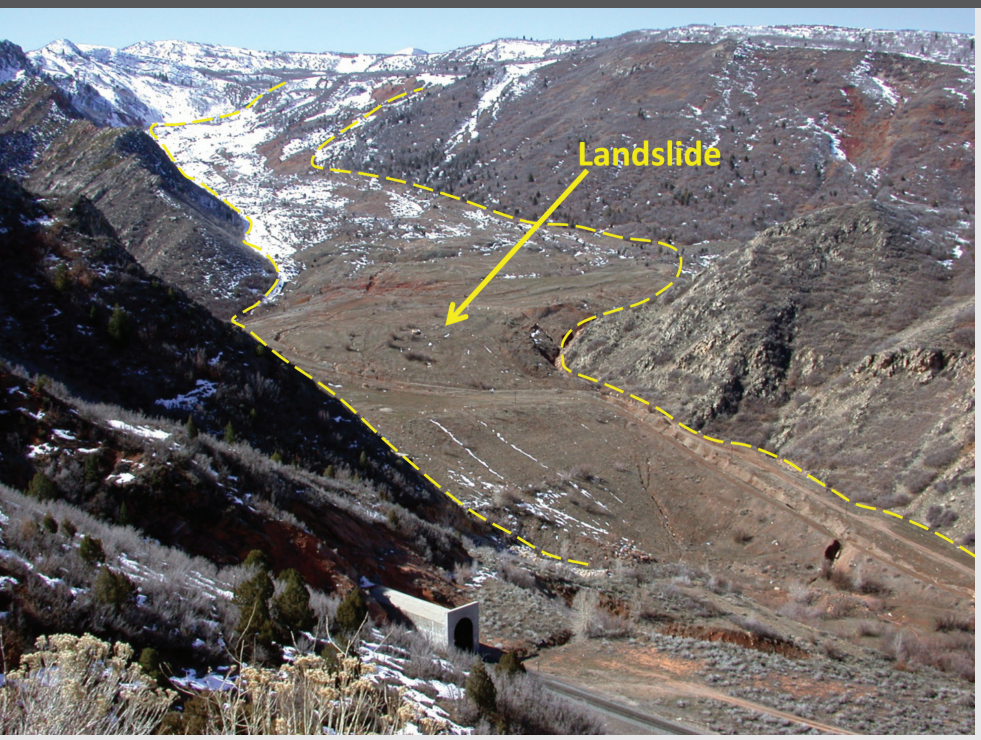
steepening of the slope, either by removal of material from the lower part of the slope or addition of material near its crest, can also trigger landslides. Development-related slope modification can include loading by construction of buildings or fills, or removal of material during grading for building pads or roadways.

Landslide Distribution

The distribution of landslides in Utah is dependent on geology, topography, and climate. Landslides are most numerous in a zone stretching from the northern Wasatch Front and back valleys southwestward to the St. George area. This zone contains weak rock types, steep slopes, and the highest annual precipitation in the state.

An intense rainfall-triggered debris flow that began in an area burned by a wildfire flowed through part of Santaquin in Utah County in 2002. The debris flow quickly inundated this Santaquin subdivision, leaving behind the dark, muddy deposits seen in this photo. (Photo credit: Dale Deiter, U.S. Forest Service)

Thistle Landslide—World-Class Landslide in Utah



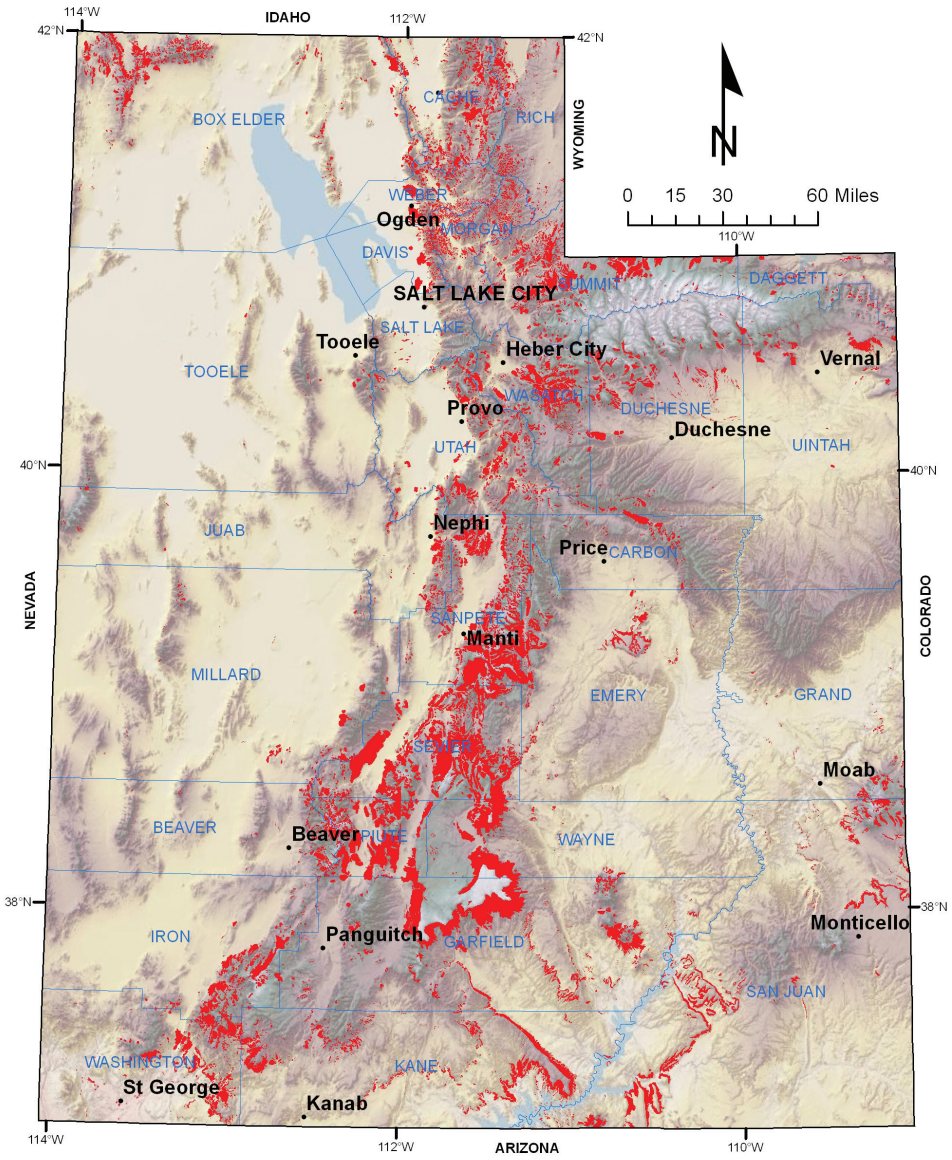
View of the Thistle landslide, Utah County. The railroad tunnel at bottom center of photograph was built as part of mitigation measures after landsliding in 1983 buried the original railroad grade. (Photo taken in 2005.)

In 1983, near the town of Thistle in Utah County, a landslide occurred when unseasonably warm weather caused rapid snowmelt, saturating a slope, and triggering a landslide that resulted in the greatest economic loss from any landslide in the history of the United States. The landslide destroyed U.S. Highway 89 and the adjacent Denver and Rio Grande Western railroad tracks. It also dammed the Spanish Fork River, causing inundation of the small town of Thistle. After the resulting lake was drained and sediment was shown to have partially buried the town, Thistle was abandoned. The Thistle landslide resulted in Utah's first U.S. Presidential Disaster. The economic loss associated with the Thistle landslide was several hundred million dollars (in 1984 dollars), which included the costs of rerouting the highway and railroad and draining the lake.

Landslide Warning Signs

Early recognition of landslide movement can be critical in attempts to avoid and/or minimize damage to property and structures. The following signs may indicate landslide movement:

- New cracks or unusual bulges in the ground, street pavements, or sidewalks.
- Soil moving away from foundations and other rigid objects.
- Decks and patios tilting and/or moving relative to the main house.
- Tilting or cracking of walls, concrete floors, and foundations.
- Sticking doors and windows, and visible open spaces and/or cracks, indicating jambs and frames out of plumb.
- Leaning telephone poles, trees, retaining walls, or fences.
- Sunken or down-dropped sidewalks and pavements.
- Springs, seeps, or saturated ground in areas that have not typically been wet before.
- Rapid increase in stream flow, possibly accompanied by increased turbidity (cloudy water).
- Sudden decrease in stream flow, though rain is still falling or just recently stopped.

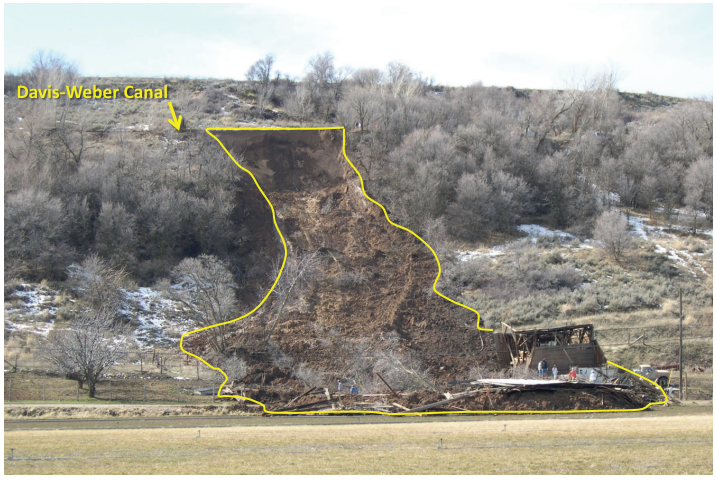


A 2010 generalized landslide map of Utah with more than 22,000 mapped landslides shown in red (Utah Geological Survey compilation).

Reducing Risk from Landslides

As the population base of Utah continues to expand into areas that are susceptible to landsliding, damage and economic costs of this natural geologic process increase. Recognition of landslide risk prior to development and implementation of appropriate land-use planning and landslide mitigation measures are the most effective means to reduce their hazards. Many hillslopes are prone to landsliding, particularly where development has taken place on existing landslides or where grading has modified a slope and reduced its stability. In Utah, nearly all recent landslides have occurred as reactivations of pre-existing landslides. Therefore, historical landslides, prehistoric landslides, and steep slopes prone to landsliding must be thoroughly investigated prior to development activities. When considering development on a hillslope or adjacent area property, owners should consult with local planning and building officials, nearby property owners, and geotechnical consultants

The 2005 landslide above a residential subdivision in Springdale, Washington County. The landslide developed in loose deposits that had accumulated at the base of the steep east wall of Zion Canyon.



The 2005 landslide below the Davis-Weber Canal in South Weber, Davis County, that demolished a barn and covered part of State Route 60 (landslide outlined in yellow). The landslide occurred in one of the steeper parts of the slope composed of prehistoric landslide deposits that had been historically active.

knowledgeable about previous landslides and local landslide susceptibility before building in these areas. Before and during development activities, recognition of potential landslide activity and implementation of required engineered mitigation measures necessary to improve the stabilization of slopes can reduce landslide risk.

The Utah Geological Survey (UGS) recommends site-specific geotechnical investigations and hazard assessments for all new development. These assessments must be performed by Utah licensed Professional Geologists (specializing in engineering geology) and Professional Engineers (specializing in geotechnical engineering). If landslide hazards are present, the professionals should disclose the hazards and provide appropriate recommendations for grading, groundwater control, project design, and construction that will reduce the hazards.

Additional Landslide Resources

The UGS (http://geology.utah.gov/ghp) provides a variety of information on geologic hazards in Utah. Additionally, the online page for Geologic-Hazard Resources for Consultants and Design Professionals (http://geology.utah.gov/ghp/consultants) includes information on recommended report guidelines, UGS geologic-hazard maps and reports, geologic maps, groundwater reports, historical aerial photography, and other sources of useful information.

To find out more about landslides in general or those near you contact:

The home office of the Utah Geological Survey at 1594 West North Temple, P.O. Box 146100, Salt Lake City, UT 84114-6100, phone 801-537-3400, http://geology.utah.gov. The Southern Regional Office of the UGS is at 88 East Fiddler Canyon Road, Ste. C, Cedar City, UT 84721, phone 435-865-9034. Also contact your city, county, or regional planning departments, or “geologists, geotechnical engineers” in the phone book.

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