

# LANDSLIDING IN WESTERN PENNSYLVANIA

*Civilization exists by geological consent, subject to change without notice.*  
Will Durant

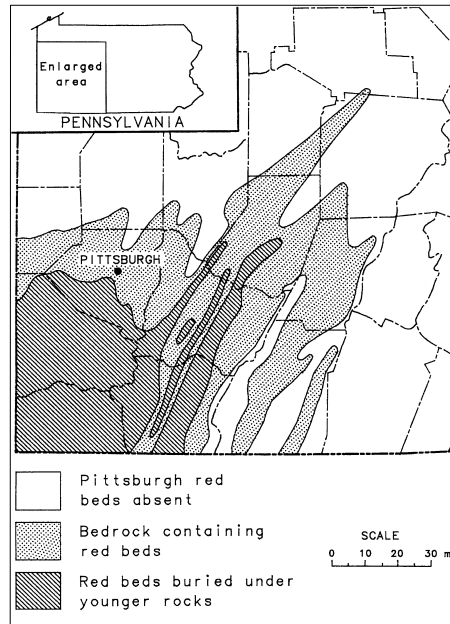
Although the earth is a relatively hospitable place to live, we take our chances every day with numerous hazards, both man-made and natural. Speeding cars, wobbling stepladders, open manholes, falling safes, and violent crime make up only one side of the coin. On the other side we find diseases, stampeding elephants, earthquakes, great white sharks, volcanoes, violent storms, raging fires, floods – and landslides.

The word **landslide** is a very generic term for any downhill movement of earth materials – rocks, soils, or artificial fills – resulting from slope failure. The movement can be fast or slow and the slope where the movement occurs can be anything from a gentle rise to a vertical cliff. The sliding material can be soaking wet or dry as a bone. Under these conditions, the strength of the slope material is exceeded, gravity takes over, and the material flows, slides, or falls.

## CONDITIONS FOR LANDSLIDING

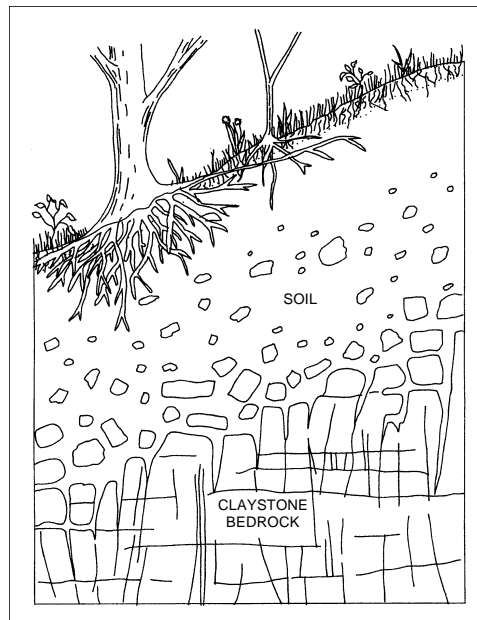
Two natural conditions occurring in western Pennsylvania are most responsible for landslide problems throughout the area. First, in many places the bedrock consists mainly of shales and claystones. This generally means little to the average person who considers rock to be a nuisance at best, particularly in one's garden or yard. The softer the offending rock the easier it is to remove. Unfortunately, if the rock is too soft it commonly deteriorates into a mass of clay that becomes sticky and slippery when it gets wet. The primary culprit in western Pennsylvania, though by no means the only one, is a thick, 40- to 60-foot rock layer called the **Pittsburgh red beds**. This is a series of mostly reddish, greenish, and grayish claystones and shales that tend to weather deeply where they occur on hillsides throughout large portions of western Pennsylvania (Figure 1). One such hillside along Route 28 in Pittsburgh had to be cut back about 50 feet before the highway department could find solid bedrock. The rock rapidly falls apart in water and tends to lose strength with each seasonal freeze-thaw and wet-dry cycle. Water that collects in the rock has little chance to drain and subsequently helps make the slope unstable from the inside out.

Soils formed on shales and claystones typically range from 5 to 15 feet thick, but they can be much thicker. They grade downward into partially decomposed rock, and eventually into solid bedrock (Figure 2). Soils on hillsides are generally thinner than on hilltops. Such soils normally are stiff but very prone to downhill movement, and under the influence of gravity they can creep down even the gentlest slopes. This movement normally is imperceptibly slow. During the spring, however, the soil often be-



**Figure 1.** Location of rocks containing Pittsburgh red beds in western Pennsylvania.

comes very wet from thawing snow and spring rains and the creeping can accelerate into a full-blown landslide. Except near streams, major slides in soils of this type rarely occur under



**Figure 2.** Cross section of a typical hillside showing bedrock and soil.

natural conditions.

The second naturally occurring condition responsible for landslides is western Pennsylvania's landscape, which is dominated by steep hills and valleys. This part of the state has many picturesque settings with great scenic views and photo opportunities. As luck would have it, however, this condition also ensures that gravity-induced earth movement will occur now and then, particularly where easily weathered shale and claystone bedrock occurs.

## TYPES OF LANDSLIDES

There are three basic types of landslides – falls, slides, and flows. These have been subdivided by geologists and engineers into many subtypes. In western Pennsylvania only four of these types and subtypes occur with any regularity. These include slumps, earthflows, debris slides, and rockfalls.

**Slump** (Figure 3A) is the downslope sliding of rock, soil, or fill material moving as a unit, characterized by movement along a curved slip plane (Figure 4). This movement acts to tilt the moving mass backward into the slope. Slumps often occur along streams where erosion of the banks allows the ground above to slide down to, or into, the stream. Slumps can be relatively small, involving only a few tens of cubic yards of material. They can also be very large, very complex, and very destructive of property. Slumps are a big problem in western Pennsylvania, causing extensive property damage throughout much of the area.

**Earthflow** (Figure 3B) is a visible, down-slope movement of soil and weathered rock acting as a thick, sticky fluid, typically flowing over bedrock or a layer of clay. The resulting landform is characterized by a scarp at the top of the flow, a mass of broken and disrupted soil in the midst of the flow, and raised, lumpy terrain at the bottom, or toe (Figure 4). Earthflows are very common in the Pittsburgh area, occurring most often in soils developed on slopes or old landslide deposits, especially on slopes underlain by the Pittsburgh red beds. Because of the unstable nature of these claystones, earthflows can occur anywhere these rocks form the soil or bedrock on sloping terrain.

**Debris slides** (Figure 3C) are rapid, down-slope movements of jumbled masses of soil, rock, and debris in which the mass slides forward and ends up as an irregular, lumpy deposit. The material commonly slides as a relatively intact unit. Many of the landslides that occur in western Pennsylvania act as debris slides during at least part of their downslope movement.

**Rockfalls** (Figure 3D) are masses of newly detached bedrock that fall from cliffs, steep slopes, cave roofs, or rock arches. Hard beds

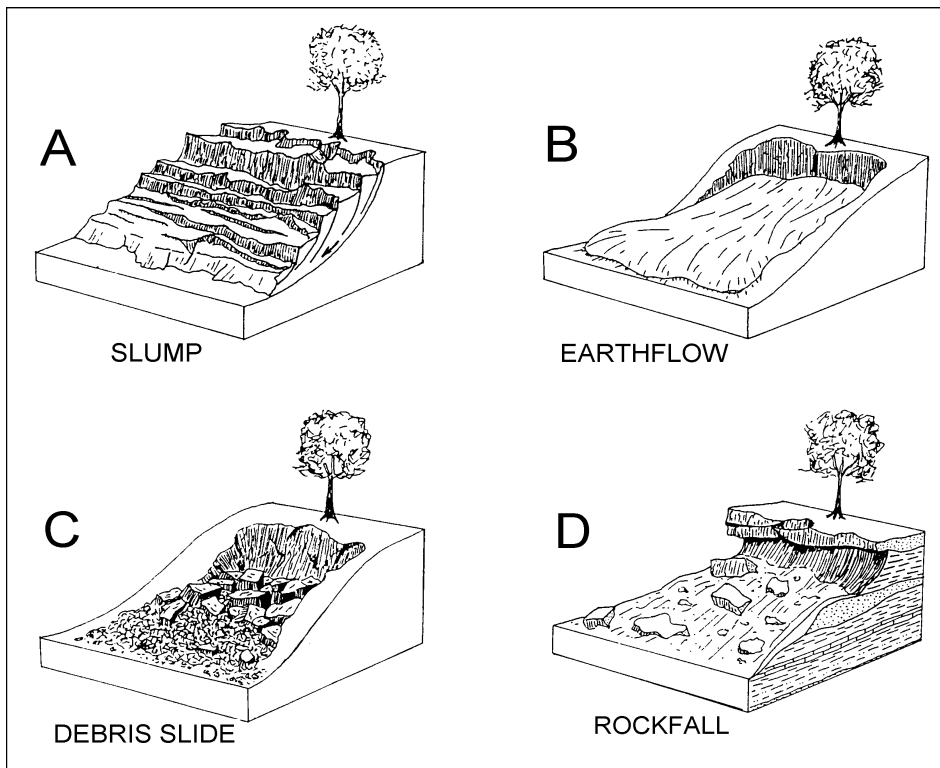


Figure 3. The most common kinds of landslides in western Pennsylvania.

build better lives for ourselves, we end up being responsible for initiating or intensifying certain conditions in areas where otherwise there would have been little or no risk. Some of the things we do to trigger landslides include: 1) excavations in unstable slope materials; 2) haphazard construction or improper use of pipelines; 3) overuse of fill materials on slopes, particularly at the heads of existing slide masses; 4) disruption of surface or subsurface drainage (streams and springs); 5) removal of materials at the bases of slopes; and 6) vibrations caused by heavy traffic, blasting, and driving piles near unstable slopes. For example, in 1951 a large landslide about 500 feet wide and several hundred feet long occurred in Allegheny County as a result of a seemingly innocuous little 8 foot cut made in the soils at the base of the slope. This resulted in the total destruction of six houses and damage to several others, as well as dislocation of a highway, a streetcar line, and overhead and underground utilities. Numerous similar, though less severe, situations occur throughout western Pennsylvania every year. Unfortunately, it is more often the unsuspecting homeowner, rather than the builder or land developer, who suffers once the slide begins to move.

#### WHAT CAN YOU DO?

Western Pennsylvania residents should become aware of the ever-present danger of landslides and other geologic hazards before purchasing new houses or building on undeveloped land. Standard homeowners insurance policies do not cover damages due to landslides, but special rider policies may be purchased at extra cost. Recognition of potential problems, however, is essential in avoiding what could become enormous remediation costs. The Pittsburgh office of the Pennsylvania Geological Survey has maps showing landslide potential throughout the western half of the state. Area citizens wishing to determine the potential for landslide damage are encouraged to call (412) 442-4235 and request assistance. A good guide to the hazards of owning a home or office in western Pennsylvania is "Lots of Danger! Property Buyer's Guide to Land Hazards of Southwestern Pennsylvania" which is available for \$4.00 + \$1.50 for shipping and handling from the Pittsburgh Geological Society, PO Box 58172, Pittsburgh, PA 15209, or call (412) 928-2255. Other useful references, all published by the U.S. Geological Survey (USGS), include: Circular 728, *Landsliding in Allegheny County, Pennsylvania*; Professional Paper 1229, *Landslides in the Greater Pittsburgh Region, Pennsylvania*; and Miscellaneous Field Studies Map MF-685B, *Map of Susceptibility to Landsliding, Allegheny County, Pennsylvania*, in 2 sheets at a scale of 1:50,000.

of sandstone or limestone underlain by relatively weaker shales or claystones occur throughout western Pennsylvania. Rapid disintegration of the softer rocks due to weathering and erosion leaves the harder rock hanging as unsupported ledges. In time weathering progresses to the point where the rock ledge can no longer sustain the stress created by its overhanging weight and the ledge falls. Rockfalls can be any size, and formed of any material. They can occur at anytime, but are most common in western Pennsylvania in the spring after the winter freeze-thaw cycles have loosened the rock. Dangerous rockfalls occur mainly along highway cuts having high, steep sides. Coal mines, quarries, and deep stream cuts also commonly experience rockfalls. Although rockfalls resulting in costly clean-up efforts occur frequently in western Pennsylvania, large, life-threatening rockfalls are very rare. A rockfall that killed 22 people on a bus in Beaver County in 1942 was a notable exception. Most of the rockfalls in

this area are better characterized as expensive inconveniences rather than killer landslides.

#### ANCIENT LANDSLIDES

Although most of the known landslides in western Pennsylvania have occurred since World War II, sliding certainly is not a new phenomenon in the area. The Monongahela River is named for the Native American word "Menaungehilla" which means "river with the sliding banks" or "high banks, which break off and fall down." Landslides were very common in western Pennsylvania during the Ice Age, between 900,000 and 10,000 years ago, and their results can be seen throughout the area. The ancient slide masses commonly occur on the sides of hills and have a flattened, linear shape that stands out as a distinct break in the general slope of the hillside. They are, perhaps, best seen during the winter months when the trees are bare of leaves. Builders like to use the flat upper surfaces as convenient places to construct buildings and roads on western Pennsylvania's otherwise steep topography. There is, however, an ever-present danger of reactivating a long-dormant slide, as many an unlucky homeowner, many businesses, developers, and the various state and local highway departments, have come to realize too late.

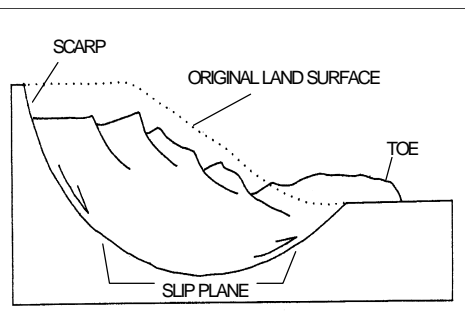


Figure 4. A slump in cross section showing typical landslide terminology.

#### MAN-MADE PROBLEMS

Since World War II, most of the landslides in western Pennsylvania have been the direct result of the activities of man. In attempting to

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