

What types of geologic hazards can occur in Virginia, and what areas are most vulnerable?

Earthquakes

Virginia has a moderate earthquake risk, which is similar to most other states on the eastern seaboard. The first recorded earthquake in Virginia occurred in 1774. Since then, 300 earthquakes have been recorded within or near the boundaries of the Commonwealth. Eighteen of these earthquakes had a magnitude of 4 to 4.5 or higher on the Richter scale. The third largest earthquake in the eastern United States in the last 200 years occurred in Giles County in 1897 and measured 5.8 on the Richter scale.

Virginia contains two named seismic zones: the Giles County Seismic Zone, centered along the New River, about 20 miles west-northwest of Blacksburg and the Central Virginia Seismic Zone, extending west from Richmond toward Charlottesville and the Blue Ridge Mountains. Other recorded epicenters are scattered widely across the state. Some of the most strongly felt earthquakes in Virginia actually had their epicenters outside the state, like the Charleston, SC earthquake of 1886 that was felt all across Virginia. All parts of Virginia should be considered susceptible to earthquakes. However, the magnitude and associated damage likely would be minor, except in the seismic zones where moderate to severe damage could occur.

Landslides

Landslides are Virginia's most widespread geologic hazard; they are most likely in areas of steep slope, but can occur even on fairly gentle slopes if conditions are right. Landslides commonly occur in association with heavy rainfall or large magnitude earthquakes. Certain man-made changes to the land, such as slope modification or drainage alteration, can increase the likelihood of landslides. The most disastrous landslide events in the Commonwealth are associated with heavy rainfall events along the steep slopes of the Blue Ridge Mountains.

Sinkholes and Subsidence

Sinkholes form in areas with soluble rock such as limestone, dolomite or gypsum. They are basin-like, funnel-shaped or vertical-sided depressions in the land surface. A sinkhole can be the result of natural (the collapse of a cave) or man-made (mining) activity. Where sinkholes and caves have formed, streams might sink into the ground. This type of terrain is referred to as karst. In karst areas, sinkholes are input points where surface water enters the groundwater system.

The 26-county area of Virginia's Valley and Ridge provinces and limited areas in the Piedmont province are susceptible to karst related sinkholes. Areas over underground mine workings are also susceptible to sinkhole formation. These include:

- Areas over abandoned coal mines in Buchanan, Dickenson, Lee, Scott, Russell, Tazewell and Wise counties and the City of Norton in southwest Virginia; Henrico, Chesterfield and Goochland counties in the Richmond coal basin; and Montgomery and Pulaski counties in the Valley coal basin.
- Areas over abandoned underground gypsum mines in Smyth and Washington counties.
- Areas over other types of underground mining in various parts of Virginia.

Shoreline Erosion

Shorelines along Virginia's rivers and coasts are especially desirable building sites for homes and associated community businesses. These areas should be monitored for shoreline erosion. Shoreline erosion is accentuated by heavy rainfall and the increased wave activity associated with severe storms, such as tropical storms and hurricanes.

Other Geologic Hazards

The extent of all geologic hazards has not been defined in Virginia by hazard mapping. Expansive soils, frost heave and radon emission are types of geologic hazards that are influenced by wet and dry cycles (expansive soils and radon) and freeze-thaw cycles (frost heave). Frost heave is commonly defined as a section of ruptured pavement caused by the expansion of freezing water immediately under the road. Some information on expansive soils and frost heave distributions might be available in soil reports or from localities in susceptible areas. Information about areas susceptible to radon is available from the [Virginia Department of Health](#). [external link -- will open in a new browser window]

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What are the likely impacts of these geologic events?

Earthquakes

Virginia has an average of one earthquake each year. Most are magnitude 4.0 or less, which generally have little to no effect on structures. Should Virginia experience an earthquake with a magnitude 5.0 or higher, there would likely be extensive damage.

Landslides

The most common effect of landslides in Virginia is the impact to roads and highways. Landslides can destroy buildings and disrupt power, telephone, water and sewer services. Perhaps the most devastating landslide event in Virginia was associated with Hurricane Camille, which dumped in excess of 25 inches of rain over a five-hour period, triggering hundreds of debris flows that killed at least 114 people and swept away or buried 900 buildings and more than 100 bridges and miles of roads in parts of Nelson and Rockbridge counties. A different type of storm impacted Greene and Madison counties on June 27, 1995, triggering more than 1000 debris flows. Exceptional storm events could trigger similar clusters of debris flows in other areas of the Blue Ridge Mountains in the future. Lesser property damage and loss of life from landslides might occur in other areas in response to exceptional storm events.

Sinkholes and Subsidence

There are three potential problems associated with karst sinkholes:

- Subsidence: Refers to a gradual sinking of the ground, but can be an instantaneous or catastrophic collapse. Formation of sinkholes is common in karst terrains. Man-made modifications to the distribution and circulation of water in those areas commonly results in the acceleration of sinkhole collapses.

- Flooding: Sinkholes commonly flood when they become plugged with sediment or receive an increase in runoff from artificial surfaces like parking lots and roads. These man-made conditions increase the chance of sinkhole flooding.
- Pollution: The dumping of solid wastes such as dead animals, garbage and other refuse into sinkholes is a major hazard to groundwater resources. Existing state law prohibits the dumping of waste in sinkholes. Never dump anything into a sinkhole that you wouldn't want in your drinking water.

Sinkholes and subsidence associated with underground mine collapses have resulted in losses of homes and other buildings, roadways, utilities and other infrastructure.

Shoreline Erosion

During severe storms, damage to structures might not be limited to flooding, but also might involve shoreline erosion from rising floodwaters or storm surges that result in the undermining and destruction of homes, businesses, roadways, bridges and utility lines. Scour, caused by storm water undermining bridge supports and foundations, is the number one destroyer of bridges. Bridge scour might compromise access by highway and rail service.

Other Geologic Hazards

Impacts from expansive soils range from jammed doors and windows to buckled floors and collapsed structure walls. Damage from frost heave susceptible soils typically disrupts walkways, pavement and some utility lines similar to the damage resulting from expansive soils. Radon impacts are limited to health effects of employees working in lower floor and sub-floor levels exposed to concentrations of radon gas for long periods.