



# What are landslides and what causes them?:

A landslide is a large gravity driven movement of rock, earth or debris, down a slope of a hill or a cliff. They can happen suddenly or move slowly over long periods of time.

Several factors can increase a slope's susceptibility to a landslide event:

At the BGS we're experts in the location and properties of different rocks and soils. We know that mud- and clay-rich rocks are most susceptible to landslides and we also know where these rocks occur in the UK and how deep they are. Using this knowledge we have built a **National Susceptibility Map** for landslides as part of our **GeoSure** dataset. Whilst it can't predict the size of the event or when it will occur, the map does highlight areas where the right factors are present (rock type, steepness of the slope) and there is increased susceptibility for landslides. This digital dataset is a licensed product that anyone can buy and use, including local authorities and asset managers. This enables users to identify areas that could be affected by landslide events, especially those which could potentially cause damage to infrastructure, such as railways, roads, buildings, gas lines and electricity stations.

## Do you know which type rocks are more susceptible to landslides?

Rainfall has a major part to play in increasing an area's susceptibility to landslides. When a slope has too much water in it, the weight of the water exceeds the amount that the rocks and soils can support and

gravitation forces take over. The slope will then fail causing a landslide. In 2012 the UK experienced a very wet summer and winter. During this time we saw a direct correlation between an increase in the number of landslides and an increased amount of rainfall. During July and December there was a five-fold increase in the number of landslides compared with previous years. The graph on the right shows the clear correlation.

## Can you predict landslides?

At the BGS we're using our wealth of experience and expert knowledge to move towards forecasting when a landslide event is more likely to happen. One of the ways we're doing this is by using cutting-edge techniques to monitor and study landslides at test sites around the UK. Understanding the different triggers and combinations of events that lead to landslides is the prime objective of landslide research. Our research is part of wider collaboration with other institutes as part of the Natural Hazard Partnership. We're looking at defining thresholds relating to weather patterns, areas affected, and type and size of events all over the UK. This work is in its infancy but it's an exciting and increasingly important area of research for UK science.

- **water** (rainfall and flooding) – water increases the weight of the material (rock or earth) on the slope by filling the small spaces (pores) in the rock or earth. This increases to a point where the rock or earth can no longer hold its own weight and an increased likelihood of the slope failing and a landslide event occurring.
- **erosion processes** – such as coastal erosion and river erosion weaken the base of slopes by removal of material (rock or earth). This undermines the base of the slope, removes support for the upper part of the slope and ultimately leads to failure of the slope.
- **steepness of slope** – the steeper the slope the greater the effect of gravity on the slope material.
- **type of rock** – soft rocks can be more easily eroded and generally have much smaller pores, hence a lower capacity to hold water. Hard rocks have larger pores, hence a greater capacity to hold water, but are faulted and fractured more than softer rocks.
- **fractures, joints, faults and orientation of bedding** – These are planes of weaknesses in the structure of the rock and can cause water to seep into the rock and erode and weaken the rock, which can aid the effect of gravity.
- **weathering processes** – for example freeze-thaw weakens and erodes the rock and earth structure, which can aid the effect of gravity.
- **vegetation** – this can naturally weaken and erode rock and earth by breaking material apart.
- **volcanoes and earthquake activity nearby** – vibrations and ground movement can destabilise slope material.
- **man's activity** – mining, traffic vibrations or urbanisation (changes in surface water drainage patterns) all contribute to weakening slopes.



Burton Bradstock Landslide. Access to the beach where the fatal landslide occurred is restricted while geologists assess the immediate danger. Taken 25 Feb 2012.



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The British Geological Survey's initial findings suggest the recent heavy rain was a contributing factor that caused the rock fall at Barton Bradstock. Taken 25 Feb 2012.

## Rainfall and landslides

Met Office statistics show that 2012 was the wettest year for England and the third wettest for Wales. Overall, it was the second wettest year in the UK since national records began in 1910 (2000 saw just 6.6 mm more rainfall).

The BGS Landslides Team have been monitoring the media and scientific literature for reports of landslides since 2006 and recording them in our National Landslide Database. The extreme weather of 2012 resulted in a fivefold increase in landslides and slope failures (landslides on man-made slopes such as railway embankments), particularly during the months of July and December.

Landslides occurring after the periods of higher than average rainfall are commonly shallow in nature and likely to result from one or more of the following:

- water loading of the slope
- reduction in soil strength
- removal of soil particles or other material changing the slope



Wide cracks are visible in the rock face and leave unsupported blocks of rock free to fall. Taken 25 Feb 2012.



Sections of the South Coast Path have been temporarily closed to allow geologists to assess the hazards. Ground cracks along cliff edges may indicate danger of instability and should not be approached. Taken 26 Feb 2012.

## Landslides and people

Following extreme rainfall events like those in 2012, we see an increasing number of landslides occurring on engineered and man-made slopes such as railway cuttings and embankments. By studying these events we can understand their causes and begin to better identify areas that have a susceptibility to failure. All the information that is collected on landslide events is continually fed into improving our UK Landslide Susceptibility Map. This is a licensed product that anyone can buy and use, including local authorities and asset managers, to help identify areas that have the potential for being affected by a landslide or slope failure event that could impact on infrastructure, the economy and lives.

The map uses information from our National Landslide Database, a digital record and map of all reported and historical landslides in Great Britain that the BGS has collected. It is the most comprehensive data set of landslide events in Great Britain and is available for free via our website. There's also an opportunity to contribute to our research as a citizen scientist by reporting a landslide and uploading information, including photographs, to the database.

There are certain things that local authorities and individuals can do to prevent landslides. The main thing is to make sure an area's water is managed properly. This could require 'soft engineering' solutions to direct water away from areas that have

increased susceptibility. Large mitigation measures can also be constructed through 'hard engineering' solutions; examples include large gabion baskets or retaining walls. They will strengthen and stabilise a slope and are often seen around the coast and along road and rail routes.



The British Geological Survey's Landslide Response Team map the collapsed cliff from a safe distance using Terrestrial Laser Scanning technology. Taken 25 Feb 2012.

More information: [www.bgs.ac.uk/landslides](http://www.bgs.ac.uk/landslides)

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