

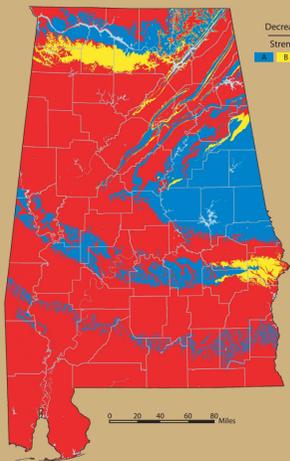
# Susceptibility to Landslides in Alabama

This map shows the relative likelihood of landsliding based on regional estimates of rock strength and steepness of slope. On the most basic level, weak rocks and steep slopes are more likely to generate landslides. The map uses detailed information on the location of past landslides, the location and relative strength of rock units, and steepness of slope in a methodology developed by Wilson and Keefer (1985). The result shows the distribution of one very important component of landslide hazard. It is intended to provide infrastructure owners, emergency planners and the public with a general overview of where landslides are more likely. This map is not appropriate for evaluation of landslide potential at any specific site.

By: Sandy M. Ebersole, Steven Driskell and Anthony M. Tavis. Geologic Mapping and Hazards Section, Geological Survey of Alabama, December 2011.



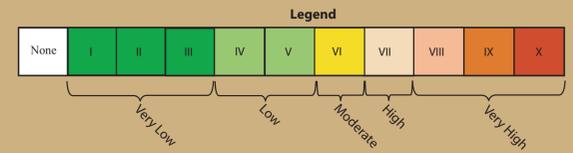
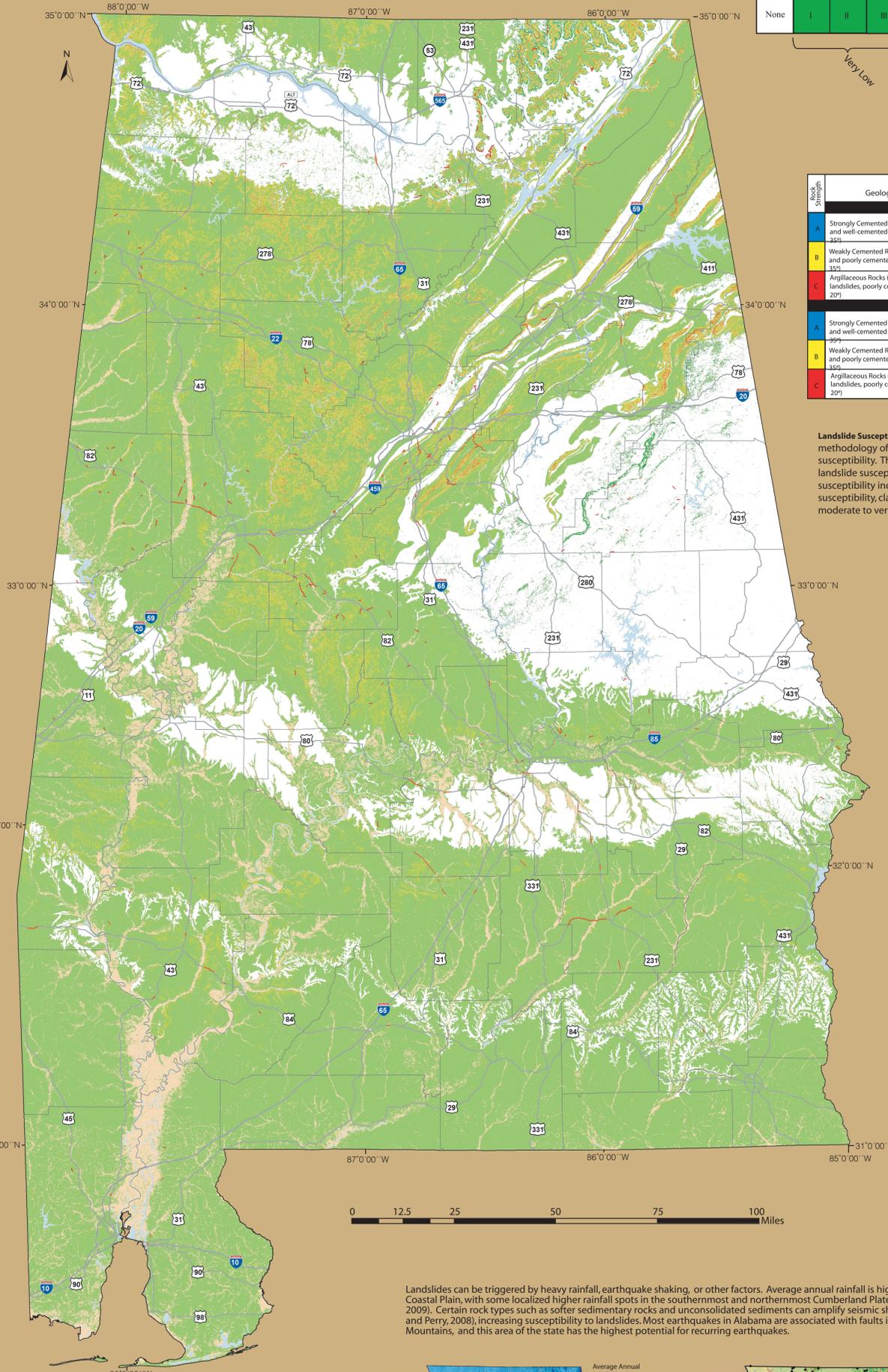
**Geology:** A general statewide geologic map is augmented with detailed geologic maps covering the most populous parts of the state to create a final map. The physical properties of the geologic units were interpreted from the descriptions on the geologic maps to determine the rock strength units.



**Rock Strength:** A relative rating of rock strength, a measure of resistance to landsliding, was developed from the geologic and landslide inventory maps. Each geologic unit was classified into one of three rock strength categories according to the methodology of Wiczorek and others (1985). Crystalline rocks and well-cemented sandstones are placed in the highest rock strength unit, weakly cemented sandstones in an intermediate unit, and shale, claystone, pre-existing landslides and unconsolidated surficial units in the weakest unit.



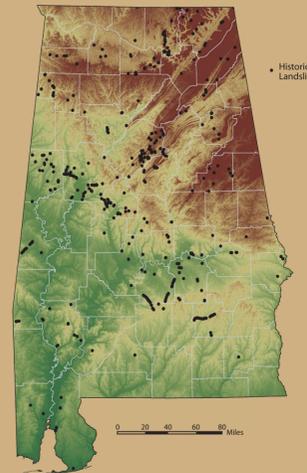
**Slope:** Slope was computed from the 30-meter National Elevation Dataset (NED). Slope values were then grouped into categories based on the HAZUS slope ranges used in modeling landslide susceptibility.



**Model Matrix**

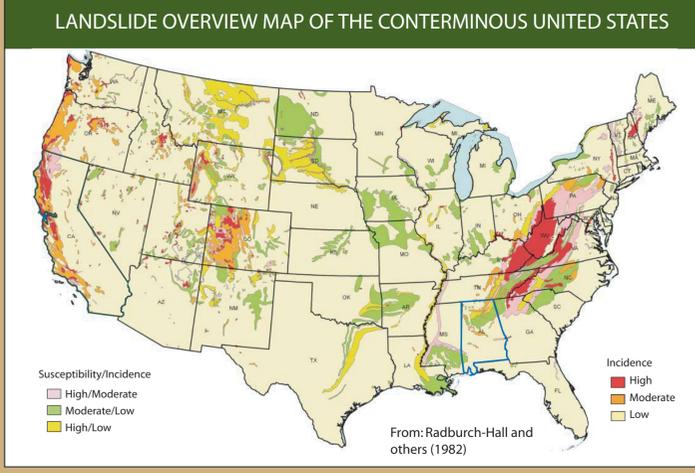
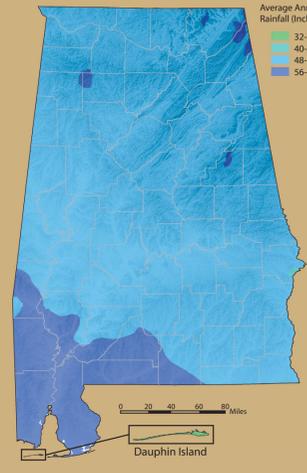
Geologic Group	Slope Angle, degrees				
	0-10	10-15	15-20	20-30	30-40
<b>(a) Dry (groundwater below level of sliding)</b>					
A Strongly Cemented Rocks (crystalline rocks and well-cemented sandstone, $c' = 300 \text{psf}$ , $\phi' = 35^\circ$ )	None	None	II	IV	VI
B Weakly Cemented Rocks and Soils (sandy soils and poorly cemented sandstone, $c' = 0$ , $\phi' = 35^\circ$ )	None	III	IV	V	VII
C Argillaceous Rocks (shales, clayey soil, existing landslides, poorly compacted fills, $c' = 0$ , $\phi' = 20^\circ$ )	V	VI	VII	IX	IX
<b>(b) Wet (groundwater level at ground surface)</b>					
A Strongly Cemented Rocks (crystalline rocks and well-cemented sandstone, $c' = 300 \text{psf}$ , $\phi' = 35^\circ$ )	None	III	VI	VII	VIII
B Weakly Cemented Rocks and Soils (sandy soils and poorly cemented sandstone, $c' = 0$ , $\phi' = 35^\circ$ )	V	VIII	IX	IX	X
C Argillaceous Rocks (shales, clayey soil, existing landslides, poorly compacted fills, $c' = 0$ , $\phi' = 20^\circ$ )	VII	IX	X	X	X

**Landslide Susceptibility:** Rock strength and slope are combined according to the methodology of Wilson and Keefer (1985) to create classes of landslide susceptibility. These classes express the generalization that on very low slopes, landslide susceptibility is low even in weak materials, and that landslide susceptibility increases with slope and in weaker rocks. Very high landslide susceptibility, classes VIII, IX, and X, includes very steep slope in hard rocks and moderate to very steep slopes in weak rocks.



**Landslide Inventory:** Areas with historical landslides are often more susceptible to landslides in the future. Location of landslides on this map were digitized from Rheams (1982).

Landslides can be triggered by heavy rainfall, earthquake shaking, or other factors. Average annual rainfall is higher in the southern Coastal Plain, with some localized higher rainfall spots in the southernmost and northernmost Cumberland Plateau (Daly and Taylor, 2009). Certain rock types such as softer sedimentary rocks and unconsolidated sediments can amplify seismic shaking (Ebersole and Perry, 2008), increasing susceptibility to landslides. Most earthquakes in Alabama are associated with faults in the Appalachian Mountains, and this area of the state has the highest potential for recurring earthquakes.



**Sources:**  
 Daly, C. and Taylor, G., 2009, United States average annual precipitation, 1961-1990: Spatial Climate Analysis Service, Oregon State University; USDA - NRCS National Water and Climate Center, Portland, Oregon; USDA - NRCS National Cartography and Geospatial Center, Fort Worth, Texas, Corvallis, OR, USA. <http://nationalatlas.gov/atlasftp.html>.  
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 Federal Emergency Management Agency, 2005, HAZUS Technical Manual, Chapter 4, Potential Earth Science Hazards (PESH): p.4-31 - 4-35.  
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 Rheams, K.F., 1982, Inventory of landslides, slope failures, and unstable soil conditions in Alabama: Geological Survey of Alabama Open-File Report, p. 8-35.  
 Wiczorek, G.F., Wilson, R.C. and Harp, E.L., 1985, Map showing slope stability during earthquakes in San Mateo County, California: U.S. Geological Survey Miscellaneous Investigations Map I-1257-E, scale 1:62,500.  
 Wilson, R.C., and Keefer D.K., 1985, Predicting areal limits of earthquake-induced landsliding, in Ziony, J.L., ed., Earthquake hazards in the Los Angeles region—an earth science perspective: U.S. Geological Survey Professional Paper 1360, p.317-493.

