



# Mass Wasting Susceptibility: Pennsylvania Highways



## Abstract

Slope stability along US highways is a special problem that needs surveying all over the country to protect drivers. Based on ArcGIS analysis, locations that have the highest susceptibility to mass wasting (landslides and rock falls) are suggested for warning signs and reinforcement in Pennsylvania.

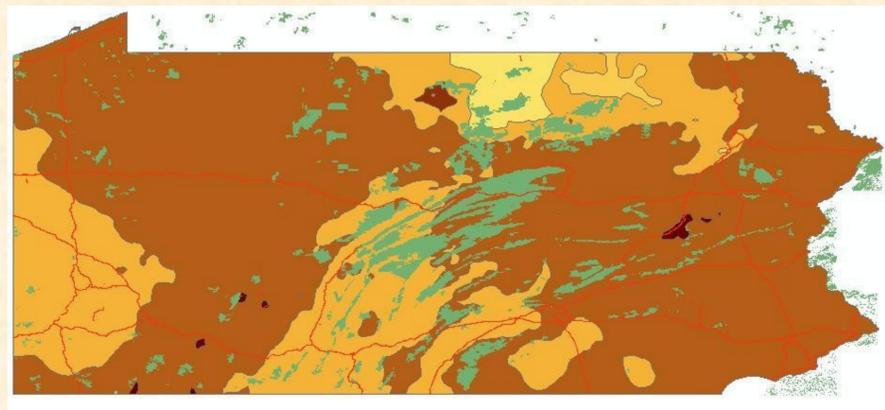
## Methods

To locate areas of highest risk of rock fall, several factors were taken into consideration that impact landslide and rock fall potential. They are, in order from most important to least important: **slope, bedrock, precipitation, and forest cover.**

**Step 1:** Base layers were obtained for highways, precipitation, and forest cover. These were overlain to find areas along the highways that have a high precipitation and a low vegetation cover. Precipitation is important because water loosens bedrock and saturates soil, giving it weight and a better ability to flow. Also, higher precipitation areas are more susceptible to weathering than low precipitation areas due to freeze-thaw and chemical degradation. Forest cover holds rock and soil in place. The fewer trees and bushes, the easier it is for unconsolidated soil to become loose and slide.

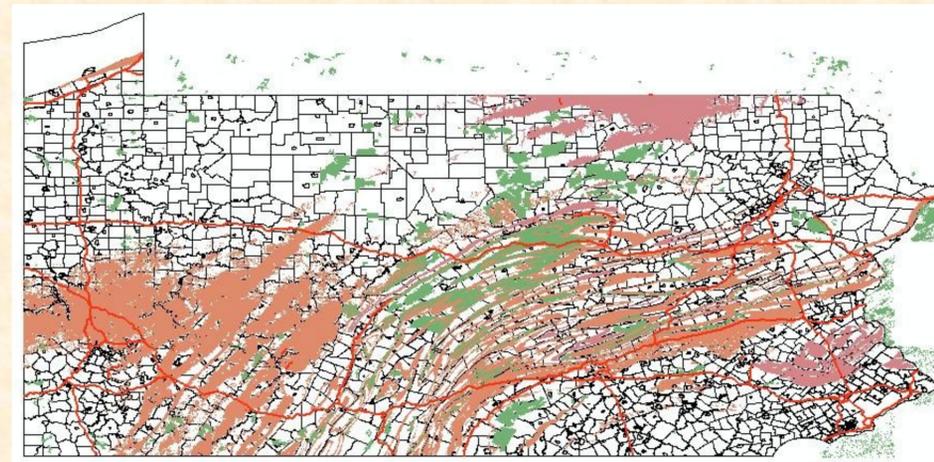
Green = Forest Cover

Light Yellow—Dark Red = Low—High Precipitation



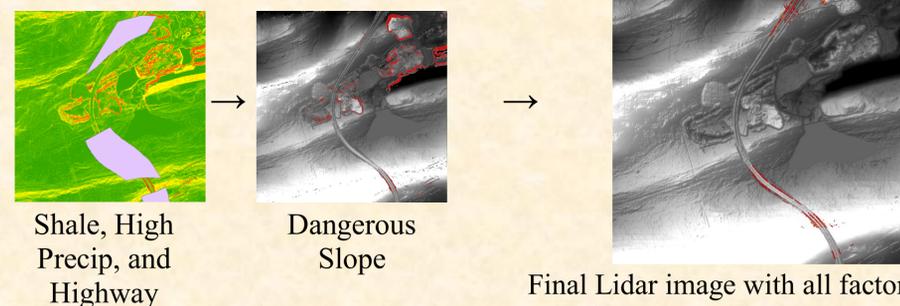
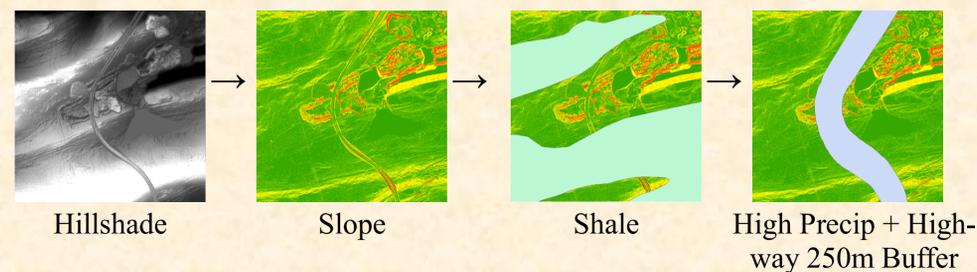
**Step 2:** Bedrock is of great importance in determining if a landslide is possible in the area. For example, a gneiss is much less susceptible than a shale. In Pennsylvania, the two types of bedrock that are the most susceptible to mass wasting are shale and mudstone. Other layers for this second step are again highways and vegetation as well as counties to give an outline of the state.

Tan = Shale ; Pink = Mudstone ; Green = Forest Cover



**Step 3:** Lidar hillshade data was obtained and was overlain the precipitation map. Using spatial analyst the slope was found and reclassified to show only areas of greater than 30 degrees. As polygons, the four factors of mass wasting were intersected with a highway polygon buffered to include 250 meters on either side.

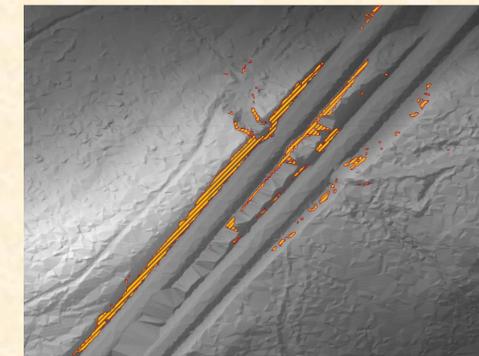
An example of the sequence of events for layering and intersecting is seen below. (No forest cover in the area so not seen)



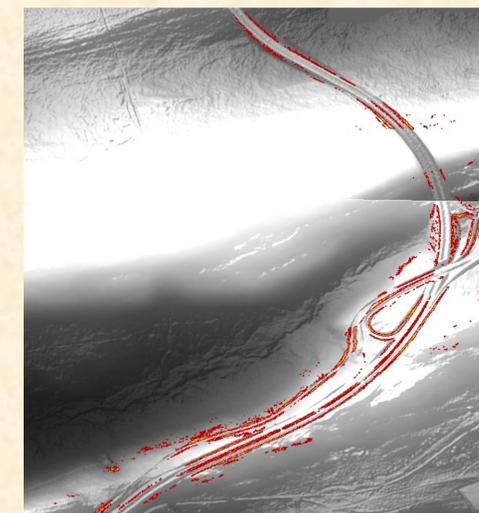
Final Lidar image with all factors intersected. Red areas have a slope above 30 degrees, shale, high precipitation, and no forest cover.

## Results

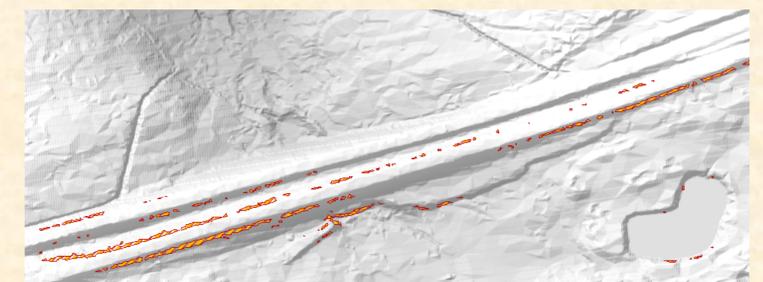
All locations have fallen under the eastern, red area of the precipitation map of PA. This is along Interstate 81.



Area 1 of potential for mass wasting, most likely rock falls due to the thin area of danger.. The location is  $-76.025$   $40.907$  Decimal Degrees.



Area 2 covers a greater distance. The red clover leaf can be ignored because after highway construction, these areas are generally supported with extra rock and soil over the bedrock. The location is  $-76.028$   $40.873$  Decimal Degrees.



Area 3 of susceptible land. The location is  $-76.133$   $40.792$  Decimal Degrees.

**I recommend that all three areas be inspected. They are likely in need of warning signs and/or maintenance.**

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### References

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