

Karen Berry, PG, AICP  
State Geologist and Director  
Colorado Geological Survey at the Colorado School of Mines  
and  
President-Elect  
Association of American State Geologists

Senate Committee on Energy and Natural Resources  
Hearing on Natural Hazards  
January 30, 2018

## Introduction

Chairman Senator Murkowski, Ranking Member Senator Cantwell and members of the committee, my name is Karen Berry. As President-Elect of the Association of American State Geologists, and as the Director of the Colorado Geological Survey at the Colorado School of Mines, I would like to thank you for the opportunity to discuss the importance of protecting public safety and reducing economic losses by mapping, monitoring, and mitigating geologic hazards.

Colorado is a geologically diverse state with the nation's highest average elevation, wide river valleys, and rugged canyons. It has hundreds of mountains that reach elevations of 11,000 to 14,000 feet. Geologic hazards, such as landslides, rockfall, debris flows, sinkholes, expansive and collapsible soil are present in every part of the state from the plains to the highest peaks.

In addition, nowhere else in the United States are avalanches more deadly. The reason lies in Colorado's snowpack. It is shallower, colder, and weaker than the deep, dense snowpack found in the mountains to the West. Each year, avalanches in Colorado threaten major transportation corridors; and on average, catch 100 or more victims, six will suffer serious injury, and six will die.

In the next three decades, Colorado's population is expected to increase by 40%. As the population increases in hazard prone areas, communities are more vulnerable to loss of life and economic damages. Community resilience, or the ability of a community to withstand or mitigate the effects of a disaster, is greatly dependent on knowing vulnerabilities to hazards and planning for those hazards.

Many communities in Colorado, and throughout the nation, do not have the basic tools needed to build community resilience: a map of potential hazards and land-use plans that address these risks. In Colorado, only 38% of the state has been mapped at the scale needed to build community resilience. Many other states have similar issues.

In Colorado, we have seen the lack of basic tools, to educate and inform the public, negatively impact military families. When military personnel are transferred, they get ten days to find a house in a good school district, close to base, at a price they can afford, make an offer, and evaluate the condition of the house. That's barely enough time to find a knowledgeable real estate agent let alone investigate potential geologic hazards and hire a geologist or geotechnical engineer to evaluate a property. Military and veteran families have unknowingly purchased homes that were later destroyed by wildfire, debris flows, or landslides.

### Examples of Past Disasters in Colorado

Year	Event	Impacts
1976	Big Thompson Canyon flood, landslides and debris flows	143 people killed and over \$35 M in damages.
1984	Western Slope floods, debris flows and landslides.	Over \$6.6 M spent in disaster assistance; 10 homes condemned and 1 killed.
1999	Front Range floods, mudslides, and landslides	Over \$30 M in infrastructure and property damage.
2004 and 2006	Rockslides I-70 Mountain Corridor	Up to 17 miles of road closed and 1 killed.
2010	Landslides-Statewide	9 people killed and 4 injured. Direct losses due to property damage exceeded \$9 million.
2013	Front Range floods, landslides and debris flows	Over 600 debris/mudflows and landslides cause flood surges and contribute to overall damages estimated at over \$2 billion. 3 killed by debris flows.
2013	Rockslide on USFS trail	Family of 5 killed
2014	West Salt Creek Landslide Complex	Three people killed. Landslide moved 3 miles down valley in minutes, with little advance warning, and covered a square mile. The landslide volume estimated at 38 M yd <sup>3</sup> . Remaining landslide block still poses a threat.

### Indirect Economic Costs of a Natural Disaster

When a geologic-related disaster damages or destroys a community's business hub, or closes a major transportation corridor, there are losses due to lost economic opportunities. Tourism is the largest industry in Colorado. The Colorado Department of Transportation estimates that businesses, in the mountain resort region, along I-70 conduct \$6.4 M in tourism-related transactions each day. It doesn't take long for a road closure due to an avalanche or landslide to impact businesses and communities. In Colorado, many cities and towns are almost totally dependent on revenue from

tourism to fund the critical services they provide to their citizens. Similar types of economic impacts occur across the nation.

## Vulnerability to Geologic Hazards

Value of State Owned Assets at Risk by Type of Geologic Hazard

Landslide	Rockfall	Mud and Debris Flows	Potentially Unstable Soil
\$528,000,000	\$19,000,000	\$2,255,000,000	\$88,000,000
Colorado Natural Hazard Mitigation Plan, 2013			

What is Colorado’s vulnerability to geologic hazards? Since most of the state is not adequately mapped, we don’t really know. However, of the areas that are mapped, it is estimated that that approximately \$2.9 billion in state-owned assets are vulnerable to landslides, rockfall, debris flows, and potentially unstable soil.

The State of Colorado is now analyzing vulnerability of private assets to known geologic hazards. In 2016, residential and commercial property in Colorado was valued at \$76 B. Though the assessment isn’t completed, we know many of the counties with significant private and public investment also have significant geologic hazards.

Currently, the seismic hazard in Colorado is rated low to moderate. However, we really don’t know our risks. We have limited knowledge of potentially active faults and we have a sparse seismic network to monitor earthquakes. Other states have similar issues. The largest known earthquake in Colorado occurred in 1882 and had an estimated magnitude of 6.6. If that same event were to occur today, earthquake modeling (2011) suggests that economic losses would exceed 22 billion, up to 1000 lives would be lost, and 14,000 injured.

### How Do We Reduce Risks and Protect Public Safety

An insurance industry study looked at the relationship between state requirements for preparation of local government comprehensive plans and claims paid by property insurance companies for losses due to storm-related natural disasters (including some types of mass movements) between 1994 and 2000. During the period studied, insurance companies paid out more than \$26 B for disaster-related claims arising from losses to residential property. Analyses indicate that insured losses to residential property, over the period studied, could have been reduced by \$257 M if all states had required consideration of natural hazards in local comprehensive plans. Again, to address geologic hazards in a comprehensive plan requires knowing where the hazards are located and what are the risks. Basic information many communities lack.

We need the committee's assistance to fill those gaps.

- Reauthorization of and adequate funding for the National Cooperative Geologic Mapping Program will allow State Geological Surveys and USGS to map the nation's geology at the scale needed for land-use planning. Current mapping rates can be increased if more funding is provided.
- Reauthorization of and adequate funding for The National Earthquake Reduction Program will provide critical funding for research, monitoring, and mitigation, in order to reduce fatalities, injuries and economic losses caused by earthquakes. It also has an important land-use planning component.
- Without the LiDAR provided by the 3DEP program, state geological surveys would not be able to effectively identify, map and monitor all types of geologic hazards. Continuation and expansion of this program is an essential building block to increasing community resilience.
- Passage of and adequate funding for the National Landslide Preparedness Act; the proposed programs of landslide research, mapping, and monitoring; combined with public education and land use planning are important steps to enhance community resilience. It will give communities the tools they currently lack to avoid, reduce, and mitigate landslide disasters. The planning tools that are outlined in the Act can be used for other types of geologic hazards.

In summary, the Association of American State Geologists supports all four programs, and encourages reauthorization of NCGMP and NEHRP and passage of the 3DEP and the National Landslide Preparedness Act into law. AASG also supports of passage of the National Volcano Early Warning and Monitoring System Act. I appreciate the opportunity to discuss these important issues with the committee.