

# MAPPING AREAS OF LANDSLIDE SUSCEPTIBILITY IN COLORADO SPRINGS, COLORADO

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The City of Colorado Springs lies at the boundary between the Great Plains and the Front Range of the Rocky Mountains. The western part of the city occupies a series of foothills and mesas that are susceptible to landslides. Colorado's second-largest city has undergone dramatic population growth during the 1990s, fueled by the growth of high-tech electronics industries. Western Colorado Springs, with its hilly terrain and postcard-like vistas, has become a desirable place to live for this affluent populace. Accordingly, mesa-top and hillside subdivisions and view lots are in high demand, land prices have skyrocketed, and there is an ongoing pressure to build in these problematic areas. The landslide hazard became apparent during the early and middle 1990s, when several older landslides apparently reactivated due to the combined effects of slope modification, turf irrigation, and wet winters. In the spring of 1999, a multiple-day rainfall event brought widespread landsliding to dozens of areas in the city, resulting in tens of millions of dollars in damage and a federal disaster declaration by FEMA. The city, assisted by FEMA and the Colorado Geological Survey (CGS), conducted a multi-million dollar relief program in which over 25 landslide-affected houses were purchased and razed.



Figure 2: Landslides and landslide damage in Colorado Springs. Photos by David Noe, Colorado Geological Survey.

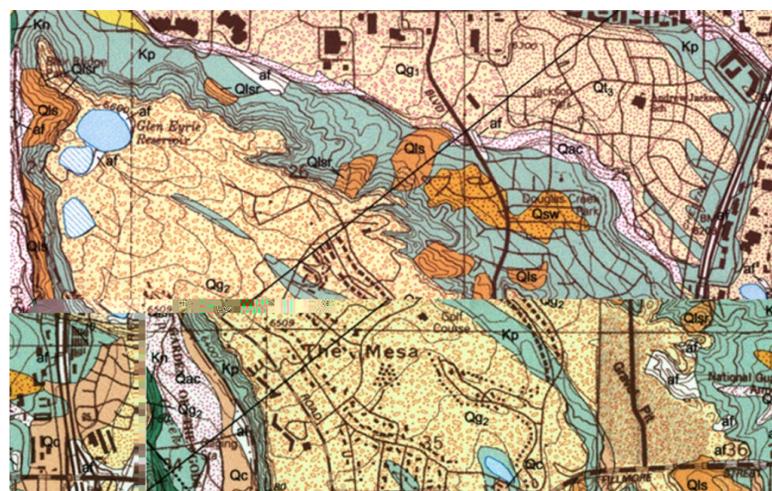


Figure 3: Geologic map of the Mesa, an area in west central Colorado Springs. Pertinent units include Pierre Shale bedrock (Kp), landslides (Qls), and recent landslides (Qlsr) along the side-slopes of the mesa, and mesa-capping alluvial terrace gravels (Qg<sub>2</sub>). From Thorson et al. (2001).

The landslide susceptibility map contains an inventory of known landslides from various published and unpublished sources. The susceptible areas include all areas having a similar geologic setting with the inventoried landslides. These areas were delineated using historic landslide data, geomorphic features, bedrock geology as shown in the basic geologic mapping, slope, and aspect. In particular, landslide-prone areas exist on slopes with grades greater than 12% (7), underlain by weak, clay-bearing formations such as the Cretaceous Pierre Shale.

The main purpose of the landslide susceptibility map is disclosure. The existence of a susceptible area signifies that further investigation is needed in order to evaluate the site-specific landslide hazard. A 1:12,000-scale, GIS version of this map has been delivered to the city planning department and a 1:24,000-scale, hard-copy version for public sale is nearly completed.

## References for CGS Mapping in Colorado Springs Area

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Morgan, M.L., Rowley, P.D., Siddoway, C.S., Temple, J., Keller, J.W., Archuleta, B.H., and Himmelreich, J.W. Jr., in preparation, Geologic map of the Cascade Quadrangle, El Paso County, Colorado: Colorado Geological Survey, DRAFT, scale 1:24,000.

Rowley, P.D., Himmelreich, J.W. Jr., Kupfer, D.H., and Siddoway, C.S., *in publication*, Geologic map of the Cheyenne Mountain Quadrangle, El Paso County, Colorado: Colorado Geological Survey, scale 1:24,000.

Thorson, J.P., Carroll, C.J. and Morgan, M.L., 2001, Geologic map of the Pikeview Quadrangle, El Paso County, Colorado: Colorado Geological Survey Open-File Report 01-3, scale 1:24,000.

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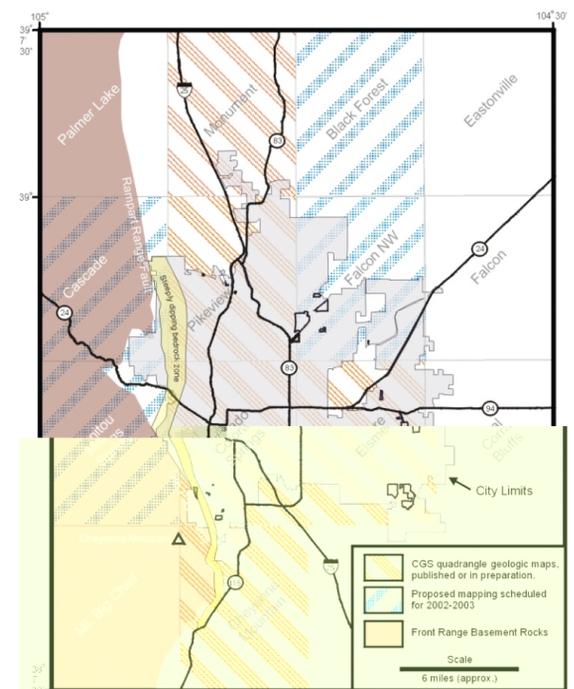


Figure 1: Index map of 1:24,000 quadrangles in the Colorado Springs area being mapped by CGS under the STATEMAP program. Interim map from White and Wait (in prep.).

Beginning in 1995, the city of Colorado Springs has called on the CGS to assist them with critical landslide issues. A multifaceted approach has resulted, consisting of technical assistance (providing expert, third-party reviews of geologic and engineering reports for the city planning department), education (hosting local workshops on geologic hazards), and mapping.

The mapping piece involves creating basic and hazard-specific geologic maps that can be used as information sources by all stakeholders, to aid in decision-making processes. The basic mapping program began in 1999, and is ongoing. It involves the geologic mapping of nine, 1:24,000-scale quadrangles in the greater Colorado Springs area, under the auspices of the STATEMAP program. These maps emphasize the bedrock and surficial geology, including mappable landslide deposits. In addition, the CGS is completing hazard-specific maps of landslide susceptibility, funded by the city and FEMA. Because the two mapping projects are coincident, there has been much sharing of information by the mapping and engineering geologists to ensure that the information shown on both maps is consistent.

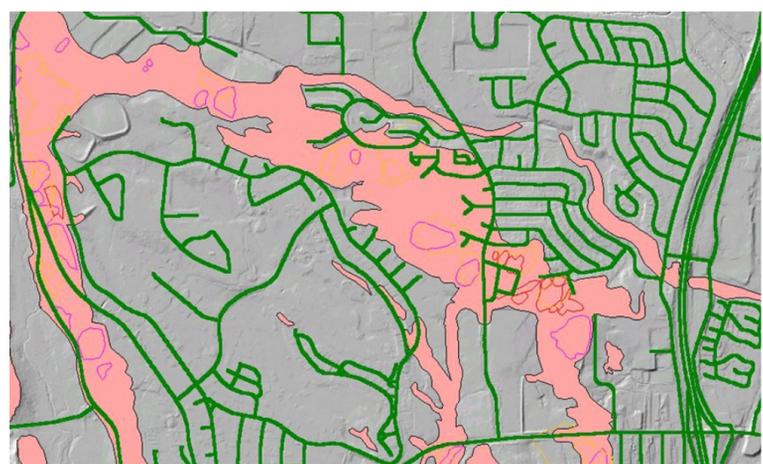


Figure 4: Landslide susceptibility map of the Mesa area, Colorado Springs. Open ovals represent landslides in the landslide inventory, with different colors representing different sources of information (yellow for CGS mapping). Solid pink area is the landslide susceptibility area; compare this area to the geology map. Interim map from White and Wait (in prep.).