COLORADO GEOLOGICAL SURVEY

1801 Moly Road
Golden, Colorado 80401

Karen Berry
State Geologist

November 19, 2020

Hannah Hippely
Planning and Community Development

Location:
Decimal Degrees
40.1510°, -105.2872°

Subject: Calwood Fire Emergency

Boulder County, CO;
County Technical Aid Request; CGS Unique No. BO-21-0002

Dear Hannah:

As requested, the Colorado Geological Survey (CGS) toured portions of the Calwood burn area with you on November 5, 2020. This included visual inspection of portions of Mountain Ridge and Foothills Ranch Subdivisions. The purpose of our visit was to evaluate impacts to identified geologic hazards (landslide susceptibility) from the fires and to evaluate for other hazards posed to rebuilding resulting from the fire. We offer the following observations and recommendations.

Landslide Susceptibility: Both subdivisions are:

- in landslide susceptibility zones as defined by Boulder County Geologic Hazard mapping; and,
- were constructed in a previous landslide deposit as depicted in the published (1988) geologic map of the Lyons Quadrangle (1:25 000 scale). The geologic map depicting the landslide deposit is overlain on Lidar imaging in Figure 1.

We did not observe any features related to the fire that would indicate any change in the landslide susceptibility at these locations. The geomorphology of the ground has not been significantly altered by the fire event. However, these locations remain susceptible to landslides and the water and grading recommendations by CGS in 1988 (limited irrigation; limited cuts and fills) remain valid.

Our observations indicate the original development made sound decisions about home site locations and associated cuts and fills within the landslide deposit. The extent and depths of cuts and fills are not excessive and do not appear to have created instability in the mapped landslide. We did not observe visible evidence of instability at the ground surface or at house locations. The Lidar image does not reveal active instability. The trees do not indicate soil creep or growth responses to ground movement such as "pistol butting" of tree trunks. In our opinion, potential for slope stability has not been altered due to the fire. CGS is not recommending a regional landslide study be conducted now due to the fire.

Fire-related geologic hazards: There are new geologic based hazards related to the fire that have not been previously mapped in these locations. As a direct result of the fire there is a high probability for mudflows, mudslides and debris laden flooding within the subdivisions at least through the first rain season and possibly as a result of snowfall this winter. We consider the entire area within both subdivisions vulnerable to surface runoff accompanied by mudflows, mudslides and debris laden flooding. It is unknown at what slope angle mudflows and/or mudslides may occur here. Publications by the United States Geological Survey and others (Springer) indicate landslide susceptibility (mudflows and mudslides are a type of landslide) on slopes as low as 10-degrees but these numbers are not specific to mudflows and mudslides at these locations. Figure 2 is a slope map derived from Lidar data showing slope angles in degrees.

As a rule of thumb, construction or disturbance to slopes as steep as 18-degrees or gradients of 3:1 (the ratio of vertical to horizontal) does not require stabilization or engineering in unconsolidated material that includes a mixture of clay, silt and sand. Long term stability generally requires engineering for unconsolidated material steeper than this. There are important exceptions to this general rule but both subdivisions include large areas steeper than 18 degrees as can be seen in Figure 2. These areas have been significantly disturbed by the fire in terms of the vegetation that helps maintain slope stability. There are boulders, cobbles, and fine-grained soil and ash that are no longer held in place by tree roots and other vegetation. This loose surface material can be seen in pictures 1 and 2.

Picture 1. Loose boulders

Picture 2. Loose cobbles, ash, and soil.

Mudflows, mudslides and debris laden flooding are hazards typical of burned forests especially where steep ground occurs such as at these locations. CGS has not evaluated the risk of these hazards but our experience in other recent fires in Colorado and Boulder County indicate a high probability these hazards will impact these subdivisions to some extent especially through the first rain and snow cycles. Exacerbating the problem is hydrophobicity of soils after fires. A hydrophobic soil results from the intense heat and gas being driven into the soil resulting in formation of a waxy substance that expels moisture resulting in an increase in volume of surface runoff. These fire-related hazards are directly related, to varying degrees, to hydrophobic soils, abundant ash and other fine debris, loose boulders and cobbles, downed trees and the slope of the ground. These new hazards are not related to the pre-existing landslide susceptibility of the underlying deposit but are related to the burn horizon at the ground surface. Hydrophobicity can take several years to be reduced naturally to the point where rainfall infiltrates significantly and surface runoff is decreased. The healing process can be helped by soil seeding and other labor-intensive activities that can break up the hydrophobicity of the soil.

Reconstruction of home-sites: CGS recommends that if and when home reconstruction is desired that it occur in the existing building footprint. We understand that damaged existing foundation elements will be removed and that a soils and engineering report prepared by a professional engineer will be required for any rebuilding. Additionally, CGS recommends that if a new building footprint or location of the foundation is desired that this be accompanied by a geologic hazard evaluation in addition to a soils and foundation investigation. This additional work should be prepared by a professional geologist and/or engineer experienced in geologic hazard evaluation.

Surface drainage: Existing drainage systems include culverts, ditches and swales. It should be expected that this drainage system will be overwhelmed by flow volumes that include mud, boulders, trees and fine debris. Problems with drainage system capacity should be evaluated by a Civil Engineer prior to reconstruction of homes within the subdivisions.

If you have questions or require further information, please email jlovekin@mines.edu.

Sincerely,
Jonathan R. Lovekin, P.G.
Senior Engineering Geologist

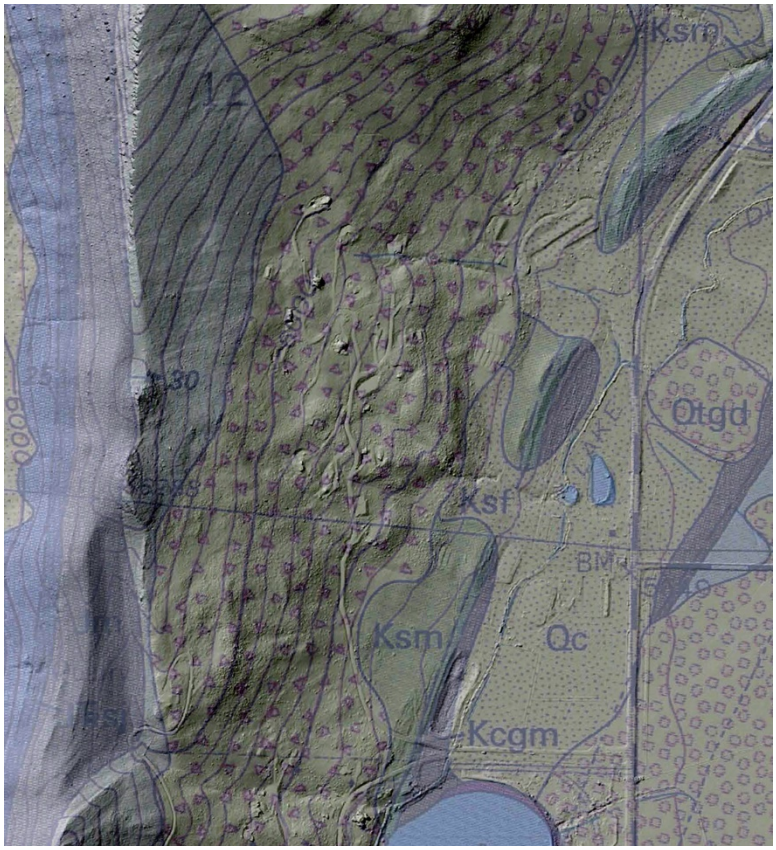
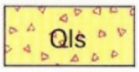


Figure 1. Lidar hillshade depicting pre-fire home sites overlain by the Geologic Map of the Lyons Quadrangle, USGS GA-1629, published in 1988. Subdivisions are within the landslide area with triangular symbols. The morphology of the landslide feature (hummocky ground) is illuminated by the Lidar image.



Landslide deposit (Quaternary)—Slumps and earthflows composed of clay, silt, sand, and boulders as much as 10 ft in diameter. Also includes small block glides having poorly defined boundaries and internal structures

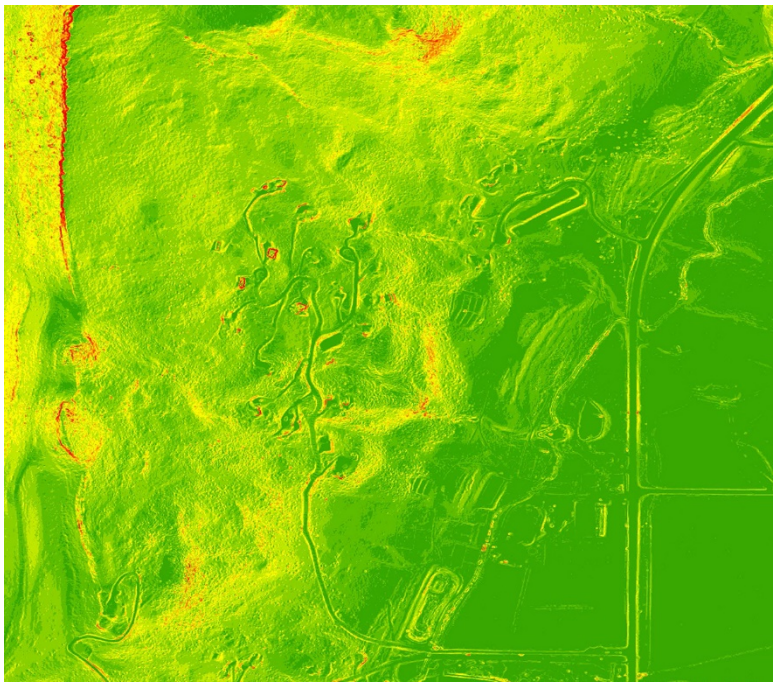


Figure 2. Slope map derived from Lidar data. Color legend is based on slope in degrees.

- 0 - 6.284144682
- 6.284144683 - 12.56828936
- 12.56828937 - 18.85243405
- 18.85243406 - 24.78745958
- 24.78745959 - 30.72248511
- 30.72248512 - 37.35574894
- 37.35574895 - 46.43284682
- 46.43284683 - 59.35025533
- 59.35025534 - 89.025383