

COLORADO GEOLOGICAL SURVEY

1801 19th Street
Golden, Colorado 80401



Karen Berry
State Geologist

September 19, 2017

Chris Neubecker
Planning Manager
Community Development Department
75 South Frontage Road
Vail, CO 81657

Location:
S1/2 SE1/4 Sec. 2,
T5S, R80W of the 6th PM
39.6455, -106.3054

Subject: East Vail Rezoning Rock Fall Study Review - Revised
Eagle, CO; CGS Unique No. EA-18-0002

Dear Mr. Neubecker:

At your request, the Colorado Geological Survey (CGS) has reviewed geologic hazards for an approximately 23.3 acre parcel immediately north of the East Vail I-70 interchange. This letter has been modified from our original correspondence on September 18 to clarify avalanche and debris flow hazards to the subject property and to clarify CGS's recommendations. CGS understands that the applicant is requesting rezoning of the property, which is currently zoned as Two-Family Residential (R), into approximately 5.4 acres of Housing Zone District (H) in the western portion and approximately 17.9 acres of Natural Area Preservation District (NAP) in the eastern portion. For this review, CGS performed an independent desktop geologic hazard evaluation and reviewed the "East Vail Workforce Housing Parcel Rezoning Request" (Mauriello Planning Group, August 17, 2017) and "Rockfall Hazard Study, East Vail Parcel" (Cesare, Inc., June 19, 2017). CGS agrees with Cesare that rockfall, debris flow, snow avalanche, and an existing landslide are potential hazards to development on the subject property. In general, CGS strongly discourages residential development in high hazard areas as avoidance is the only way to ensure complete protection. However, based on the available information, CGS agrees that properly engineered, constructed, and maintained mitigation could reduce exposure of future structures in the proposed Housing Zone District (H) to the hazards described in the Cesare report. If the Town decides to approve the proposed rezoning, CGS recommends requiring additional hazard studies and completion of mitigation designs prior to final Development Plan approval. CGS has the following additional comments.

1) Rockfall Mitigation

Based on the information provided, Cesare's findings with regards to rockfall hazards appear to be reasonable. CGS agrees that Cesare's conceptual recommendations for rockfall catchment are appropriate. However, because CGS has not seen any specific development plans showing size or placement of buildings, CGS cannot comment on the potential feasibility or effectiveness of specific mitigation alternatives at this time. If the Town approves rezoning, CGS recommends that the Town require completion of rockfall mitigation design including: proposed barrier location on the property, calculations of anticipated impact forces and heights at the final barrier location, potential for any rocks to overtop the barrier, barrier structural/geotechnical design criteria, and barrier inspection, maintenance, and repair manual, prior to final Development Plan approval to ensure that the proposed mitigation will provide adequate protection and can be maintained to ensure future performance. CGS requests the opportunity to review and comment on any such additional rockfall hazard analysis and/or mitigation design.

2) Existing Landslide

Stability of old landslides involves extremely complex interactions of soil/rock strength, groundwater conditions, and external loading. There is no guarantee that a currently-inactive landslide will not reactivate or enlarge in the future, especially if development activities modify the land surface or change groundwater conditions. Any development on the existing landslide discussed by Cesare and delineated on Figure 7 of the Cesare report has the potential to reactivate landslide movement and cause damage to the subject property and/or adjacent properties. The extent, timing, and impacts of any such landslide reactivation would be extremely difficult to predict. Any future site development should avoid cutting or re-grading near the toe or loading the middle or upper surfaces of this landslide to reduce the chances of reactivating landslide movement. CGS agrees that the currently-proposed rezoning of the eastern portion of the site as Natural Area Preservation District is prudent to avoid any future construction on or beneath the existing landslide.

3) Debris Flow Hazards

CGS agrees with the “Debris Flow Considerations” discussed on Page 30 of the Cesare report. Based on our desktop review, it is CGS’s opinion that the western portion of the site is exposed to potential debris flows, especially beneath the incised drainages highlighted in attached Figure 1. Depending on local conditions, engineered debris-flow mitigation may be possible at the subject property. However, because debris-flow hazards have not been studied at this site, and because CGS has not seen any specific development plans showing size or placement of buildings, CGS cannot comment on the potential feasibility or effectiveness of debris-flow mitigation at this time. If the Town approves rezoning, CGS recommends that the Town require completion of a debris-flow hazard analysis and design of any necessary mitigation (including preparation of an inspection, maintenance, and repair manual) prior to final Development Plan approval to ensure that the proposed mitigation will provide adequate protection and can be maintained to ensure future performance. CGS requests the opportunity to review and comment on any such hazard analysis and/or mitigation design.

4) Avalanche Hazard

The subject property is included in snow-avalanche hazard maps for the Vail valley that were initially prepared for a CGS Open-File report in 1975, and were subsequently reproduced in CGS Special Publication 7 “Colorado Snow-Avalanche Area Studies and Guidelines for Avalanche-Hazard Planning”. Attached Figure 2 shows the 1975 map for the Vail area, which identifies “small avalanches” along the hillslope to the west of, and possibly including, the western portion of the subject site. As described in the map documentation, small avalanche areas are “not wide enough to be accurately displayed at the mapping scale of 1:24,000, so they are indicated as arrows. Although they appear small at this scale, they can also be very destructive.” Because it is not possible to rule out snow avalanche hazards to the subject property at this map scale, and because it does not appear that avalanche hazards have been specifically evaluated for the subject site, CGS recommends that the Town require completion of an avalanche hazard analysis and design of any necessary mitigation prior to final Development Plan approval to ensure that the proposed mitigation will provide adequate protection and can be maintained to ensure future performance. CGS recommends that any such hazard analysis and/or mitigation design be reviewed by the Colorado Avalanche Information Center.

5) Potentially Unstable Slopes

Based on our desktop review and the information presented in the Cesare report, the western portion of the site is underlain by potentially unstable slopes. Potentially unstable slopes can be destabilized by site development activities either during or after construction if proper care is not taken. In many cases, hazards posed by potentially unstable slopes can be mitigated by proper pre-construction investigation and planning, engineering design, construction methods, and post-construction site maintenance. If the Town approves rezoning, CGS recommends that the Town require an evaluation of slope stability for any proposed cuts, fills, and structural foundations, including those associated with proposed geologic-hazard mitigation structures, prior to final Development Plan approval to ensure that the proposed mitigation will provide adequate protection and can be maintained to ensure future performance. The evaluation should be performed by a licensed geotechnical

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engineer or qualified engineering geologist with experience evaluating slope stability conditions and designing slope stabilization structures. The evaluation report should recommend any necessary construction precautions, foundation loading considerations, and/or required slope-stabilization measures. CGS requests the opportunity to review and comment on any such hazard analysis and/or mitigation design.

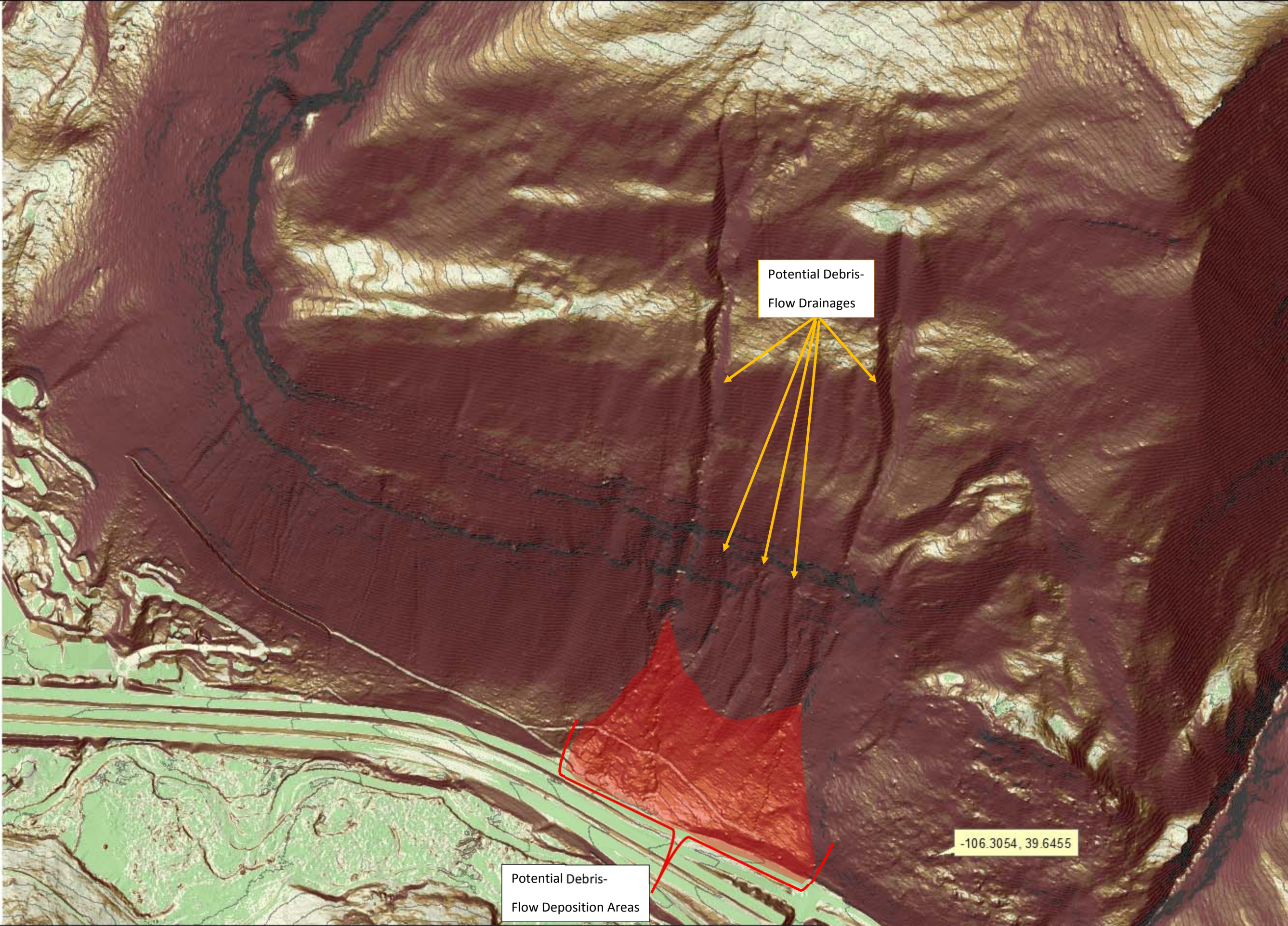
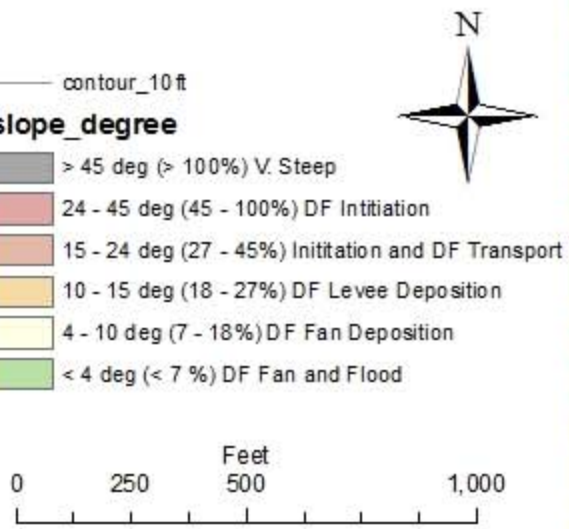
Thank you for the opportunity to review and comment on this project. If you have questions, please contact me by phone at 303-384-2632 or e-mail kemccoy@mines.edu.

Sincerely,

A handwritten signature in blue ink, appearing to read "Kevin McCoy", is positioned above the typed name.

Kevin McCoy
Engineering Geologist

LiDAR-Based Slope Map
Color-Coded to
Highlight Debris Flow Areas



Notes:

1 - Color coding shown on this slope map is based on generalized literature values for debris-flow initiation, transport, and deposition zones and is not specifically calibrated for local conditions.

2 - Slopes steeper than 45 degrees are generally more likely to be rockfall sources than debris flow sources and have therefore been ignored.

3 - This map was prepared for informational purposes only. It is not intended as a hazard map and it should not be used to assign specific hazard or risk to any site.

4 - This map is not a substitute for a site-specific engineering geologic investigation and should not be used for any engineering design or as a the basis for land-use planning decisions.

Figure 1

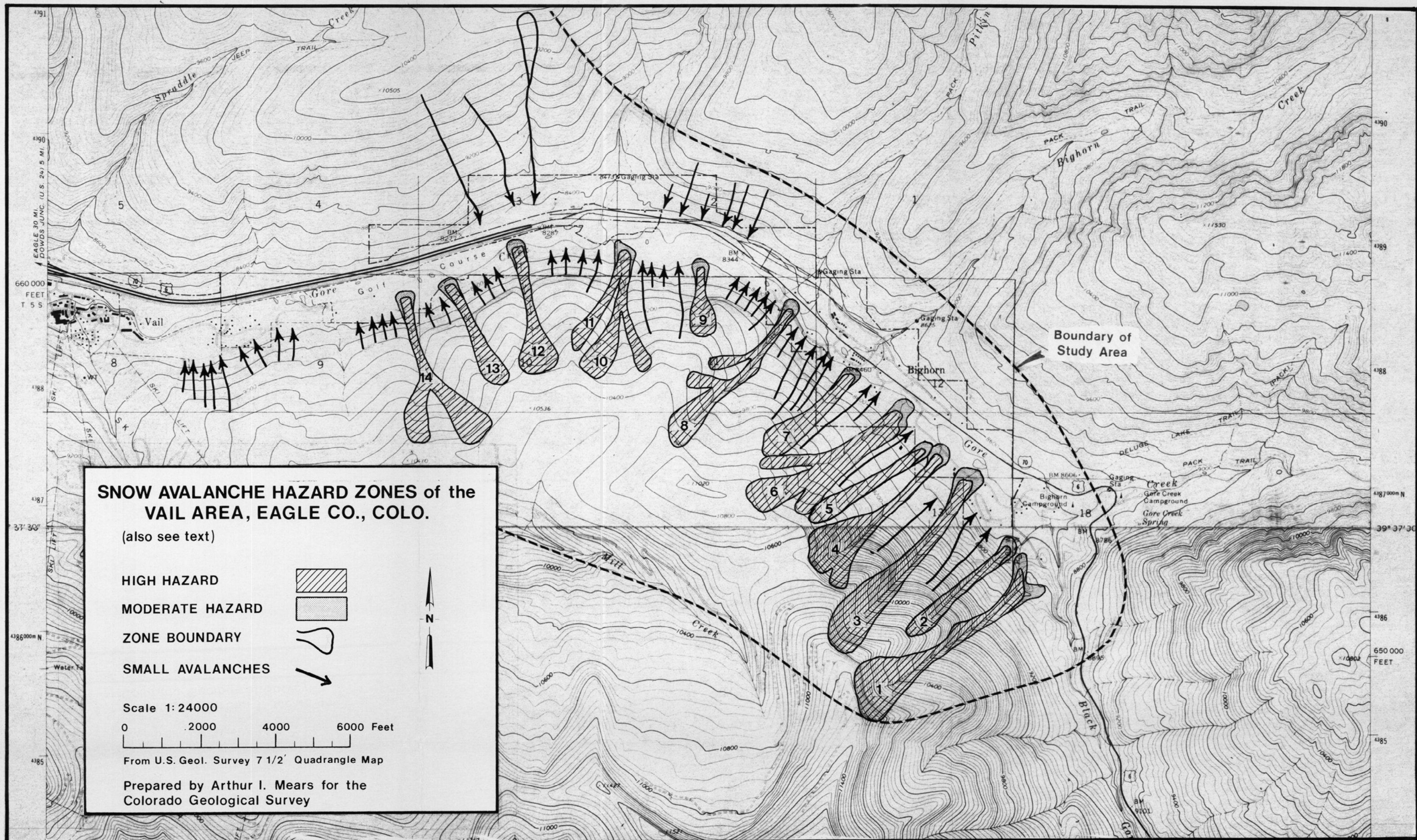


Figure 2