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GEOLOGIC HAZARD ASSESSMENT
PROPOSED GALLO CABINS
TRACT EX1 #637723
GALLO HILL ROAD
MARBLE, COLORADO

PROJECT NO. 17-7-374

MAY 19, 2017

PREPARED FOR:

SLOW GROOVIN HOLDING, LLC
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PURPOSE AND SCOPE OF STUDY

This report presents the results of a geologic hazard assessment for the proposed Gallo Hill Cabins, Tract EX1 #637723, Gallo Hill Drive, Marble, Colorado. The study was conducted in accordance with our agreement for geotechnical engineering services to Slow Groovin Holding, LLC. dated May 5, 2017.

PROPOSED CONSTRUCTION

The proposed cabin development will consist of 5 one story wood frame structures above a crawlspace. Grading for the structures is assumed to be relatively minor with cut depths between about 3 to 4 feet. Access will be by a gravel drive off of Gallo Hill Drive and each cabin will have two parking spaces. A septic system is proposed on the southern part of the site.

SITE CONDITIONS

The property is vacant of structures and consists of 3.4 acres. A dirt trail leads from the roadway into the center part of the site. The site is vegetated with scattered evergreen trees, aspen trees, scrub oak, brush, grass and weeds. The site is located on a south facing hillside. The ground surface is somewhat irregular from past debris flow events but generally slopes down to the southwest at grades of about 14 to 18 percent. The northwest part of the property borders Slate Creek. The creek is deeply incised and about 30 to 40 feet below the property. Numerous cobbles and small boulders are visible on the ground surface. The Gallo Bluffs are visible to the north.

GEOLOGIC SETTING

The site is located north of the town of Marble, on the eastern edge of Slate Creek and west of Carbonate Creek at an elevation of about 8,150 feet. The main geologic features in the project area are shown on Figure 1. This map is based on our field work and is a modification of published regional maps by Gaskill and Godwin (1966), Rodgers and Rold (1972) and Wright Water Engineers (1996).

Outcrops of upper Mancos Shale (kmu) are common along the Slate Creek canyon sides, the surrounding area and the lower portion of Gallo Bluff. The Cretaceous Mesaverde Formation is exposed in the upper portions of Gallo Bluff. The upper Mancos is a dark gray, silty to clayey shale with thick zones of sandy shale and siltstone and some lenticular sandstone beds. The bedding strikes to the northeast and typically dips between 12 and 30 degrees to the west-southwest in the project area. The site and building area are likely located on an old landslide complex (Ql3) that involves surficial soils and underlying Mancos Shale. The complex developed in post-glacial time, during about the past 15,000 years. It appears to have been dormant with respect to large scale displacement or movement for a long time. It is described as an area of old landslides that shows no indication of large, fairly recent movements (Rodgers and Rold, 1972). The landslide complex is overlain by mud flow deposits at the site. The site is mapped within a dormant alluvial fan area (Qf2).

Geologically young faults are not present in the project vicinity. The closest geologically young faults that may be capable of producing large earthquakes, are in the southern section of the Sawatch fault zone in the Rio Grande Rift about 53 miles to the southeast, Fault Zone Q56b on Figure 3.

GEOLOGIC SITE ASSESSMENT

The proposed cabins are not located in potential rockfall or avalanche areas. The property is mapped as lying in a dormant mudflow area and area of unstable slopes by Gunnison County (Wright Water Engineers, 2001). The site is located on the oldest class of landslides present in the Marble area and there is a potential risk of landslide movement. The site is also mapped as lying in a generalized hazard or problem area (W.P. Rodgers, 1972). The proposed cabins could also be subject to moderate levels of earthquake related ground shaking. These geologic conditions, their potential risks and mitigations to reduce the potential risks are discussed below.

LANDSLIDE REACTIVATION

The site is located on an ancient landslide that has been active during the past 10,000 to 15,000 years but appears to have been dormant, with respect to large scale movement, for a long time. It is not possible to determine the likelihood of a large scale landslide reactivation that could damage the cabins with a high level of confidence. In our opinion, the risk is low that a large scale landslide reactivation will occur during the next 50 years, but the site can not be considered totally risk free. Landslide scarps are located 1,300 feet northwest, and about 3,500 feet northeast of the site. Considering the size of the ancient landslide, it is not feasible to mitigate the hillside stability by engineering methods and the risk of future landslide reactivation must be accepted by the owner. Based on the proposed rectangular cabin construction, damage from landslide reactivation or creep can be mitigated or lessened with rigid construction.

MUDFLOW POTENTIAL

Slate Creek is located along the base of Gallo Bluff and follows an entrenched course along the western edge of the Slate Creek mudflow area. This erosive channel with deeply incised oversteepened banks of old landslide and mudflow debris from the Mesaverde and Mancos is potentially very unstable (Wright Water Engineers, 1996). Both the rapidly wasting Gallo Bluff and the channel banks provide abundant sources for mudflow debris during strong runoff and periods of thunderstorms. Where the channel emerges from its entrenched course, about 2,000 feet north of the site, the gradient decreases and the mudflow debris are deposited all the way to the Crystal River. In order to protect the town from mudflows, the townspeople in 1920 diverted the main Slate Creek channel to the extreme western part of the fan. This diversion is located about 1,500 north of the site. Studies by Rogers and Rold (1972) indicate a Slate Creek debris flow frequency on the average of approximately one every two years. In our opinion, the risk of mud flow debris impacting the site is low provided the channel remains in its current location. The site can not be considered totally risk free of potential future debris flow impacts.

UNSTABLE SLOPES

Robinson and Cochran evaluated the slope stability of the Marble Ski Area in 1973 and established five classifications of stability. The site is bisected by Slope Stability Class IV and Class III as shown on the (Wright Water Engineers, 1996) Gunnison County Geologic Hazard Maps. The boundary is shown on Figure 2. Slope instability problems in the project area include deep soil creep of old landslides which could easily be reactivated by construction activity and potential unstable slopes where new slides could be activated by construction activity. Active landslides are not located near the project site. Unstable Slopes Class III is defined as generally stable colluvial slopes subject to creep and stabilized landslides. Cuts and fill should be minimal. Unstable Slopes Class IV is defined as steep slopes of surficial deposits subject to creep, slopes adjacent to stabilized landslides and unstable surficial deposits. Cuts, fill and excavations should be avoided. Surface and subsurface drainage control is important in both slope classes.

The risk of construction-induced slope instability at the site appears low provided the cabins are setback from the steep channel slope of Slate Creek and cut and fill depths are limited. We recommend a minimum setback of 40 feet from the top of the channel bank for the cabins. We assume the cut depths for the crawlspaces to about 3 to 4 feet. Fills should be limited, especially near the top of the channel bank where the slope steepens. Roadway, driveway and utility cuts should be kept shallow.

Permanent unretained cut and fill slopes should be graded at 2 horizontal to 1 vertical or flatter and protected against erosion by revegetation or other means. The risk of slope instability will be increased if seepage is encountered in cuts and flatter slopes may be necessary. If seepage is encountered in permanent cuts, an investigation should be conducted to determine if the seepage will adversely affect the cut stability. This office should review site grading plans for the project prior to construction.

SEISMIC MITIGATION

Historic earthquakes within 150 miles of the project site have been moderately strong with magnitudes less than M 5.5 and maximum Modified Mercalli Intensities less than VII, see Figure 3. Historic ground shaking at the project site does not appear to have exceeded Modified Mercalli Intensity VI (Kirkham and Rodgers 1985). Modified Mercalli Intensity VI ground shaking should be expected during a reasonable exposure time for the proposed cabins, but the probability of stronger ground shaking is low. Intensity VI ground shaking is felt by most people and causes general alarm, but results in negligible damage to structures of good design and construction.

The cabins should be designed to resist moderately strong ground shaking with little to no damage and to collapse under stronger ground shaking. The U.S. Geological Survey 2002 National Seismic Hazard Maps indicate a peak ground acceleration of 0.07g has a 10%

exceedance probability for a 50 year exposure time and a peak ground acceleration of 0.24g has a 2% exceedance probability for a 50 year exposure time at the project site (Frankel and Others, 2002). This corresponds to a statistical recurrence time of about 500 years and 2,500 years respectively. These accelerations are for firm rock sites with shear wave velocities of 2,500 fps or greater inn the upper 100 feet and should be modified for soil profile amplification at the project site. The seismic soil profiles at the site should be considered as Class D, stiff soil sites as described in the 2009 International Building Code unless site specific shear wave velocity studies indicate otherwise.

LIMITATIONS

This study has been conducted in accordance with generally accepted geotechnical engineering and geology principles and practices in this area at this time. We make no warranty either express or implied. The conclusions and recommendations submitted in this report are based upon our field observations, interpretations of previous regional geologic studies and mapping and our experience in the area.

This report has been prepared for the exclusive use by our client to evaluate the potential influence of geology on the proposed development. We are not responsible for technical interpretations by others of our information.

Respectfully Submitted,

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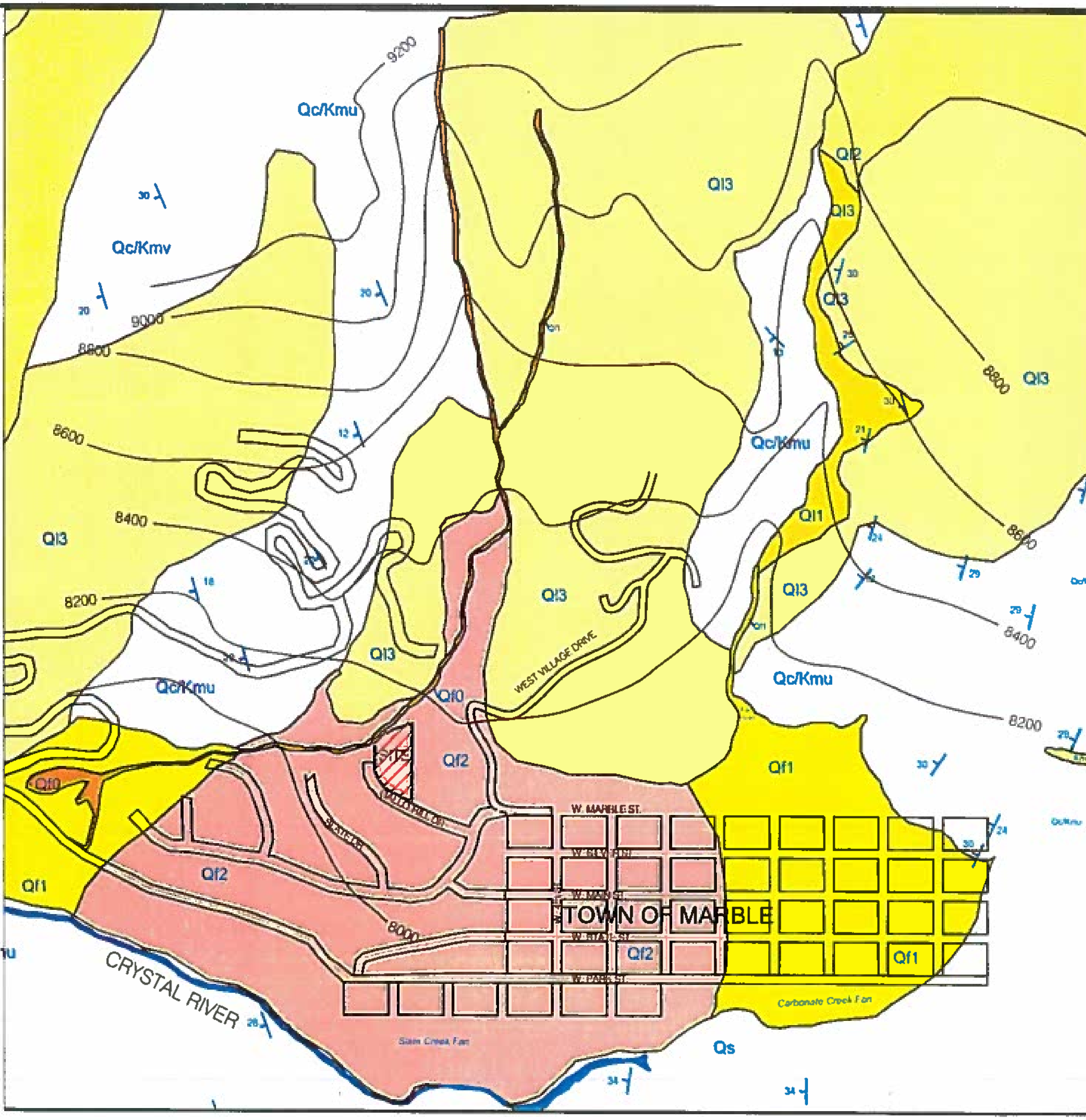


Explanation:

Qc	Colluvium
Qa/Qs	Post Glacial Alluvium and Swamp Deposits
Qf0	Mud Flow Spring 2009
Qf1	Active Alluvial Fan Areas
Qf2	Dormant Alluvial Fan Areas
Ql1	Youngest Landslides
Ql2	Intermediate Age Landslides
Ql3	Oldest Landslides
Kmv	Mesaverde Formation
Kmu	Upper Mancos Shale

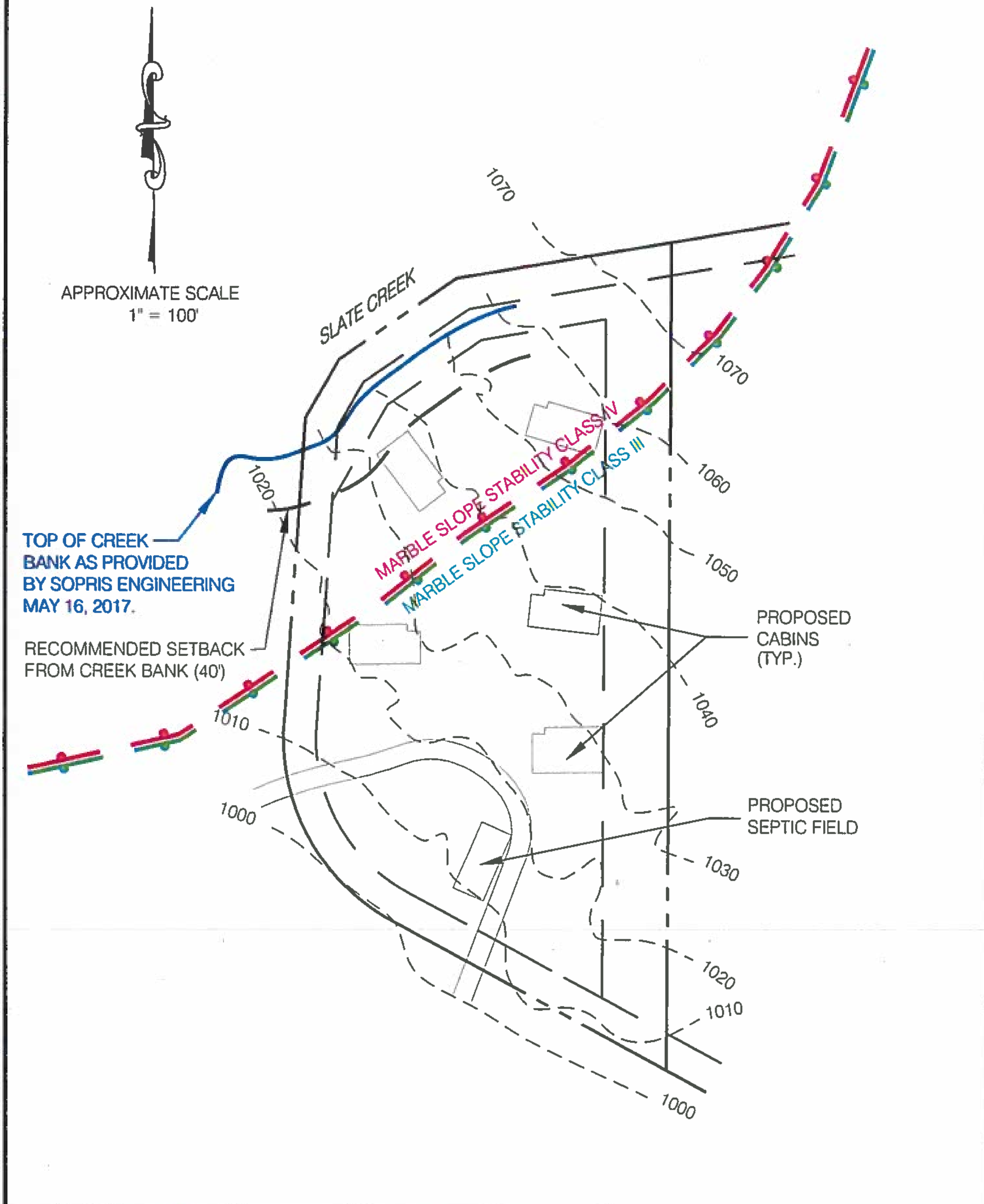
Contact: Approximate boundary of map units.

30 **Strike and Dip:** Strike and dip of bedding in degrees.

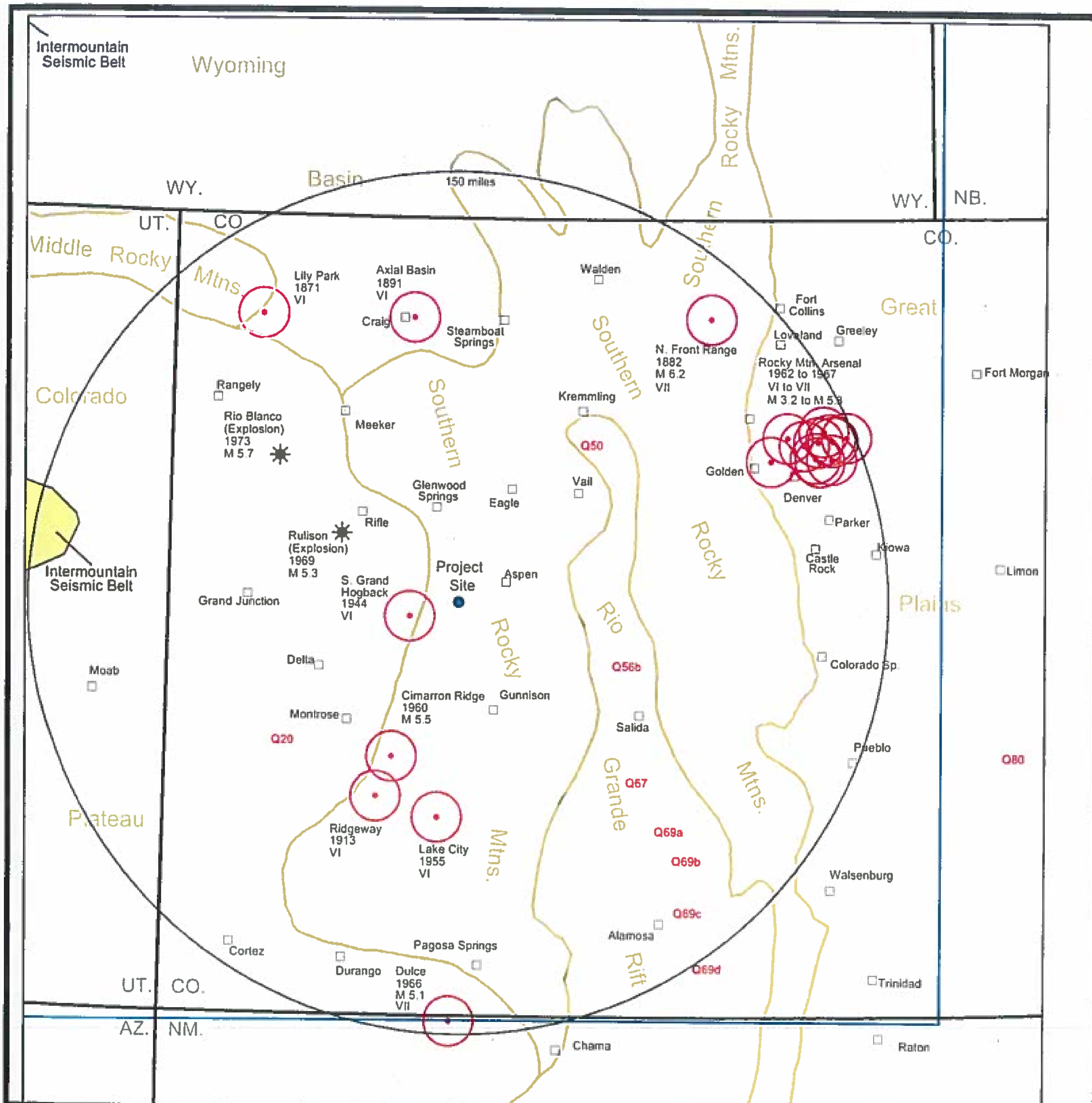
N

0 — 1000 ft.
Scale: 1 in. = 1000 ft.
Contour Interval: 25 ft.

17-7-374	H-P≋KUMAR	PROJECT AREA GEOLOGY	Figure 1



17-7-374	H-P≋KUMAR	SITE MAP	Figure 2



Explanation:

Larger Historic Earthquakes: Earthquakes with maximum intensity greater than VI or magnitude greater than M 5.0 from 1867 to present.

Nuclear Explosion: Large underground nuclear explosion for natural gas reservoir enhancement.

Historic Seismic Zones: Areas with historically high seismic activity.

M Local, surface wave or body wave magnitude
VI Modified Mercalli intensity

N

0 50 mi.
Scale: 1 in. = 50 mi.

References:
Widmann and Others (1998)
U. S. Geological Survey Earthquake Catalogs

17-7-374	H-P KUMAR	Geologically Young Faults and Larger Historic Earthquakes	Figure 3