Utah Geological Survey

Project: Investigation of the May 12, 2005, 1550 East Provo rock fall, Provo, Utah			
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USGS Quadrangles: Orem (1088), Bridal Veil Falls (1087)	Section/Township/Range: Sections 32 and 33, R. 3 E., T. 6 S., SLBM		
Requested by: Robert Carey, DES Ed Scott, Provo City			Job number: 05-06

INTRODUCTION

In the late afternoon of May 12, 2005, a rock fall released from a cliff band high on "Y" Mountain (figures 1 and 2) above Provo. One of the rocks severely damaged a guest house at 1468 South 1550 East in Provo (figure 3). No one was home at the time; the structure is likely a total loss. Some of the rocks crossed a buried Questar gas pipeline, and Questar personnel inspected the pipeline for damage.

Robert Carey, Utah Division of Emergency Services and Homeland Security, requested we investigate the rock fall shortly after it occurred on May 12, 2005. Francis Ashland and Michael Kirshbaum, Utah Geological Survey, investigated the rock fall around dusk on May 12, and Richard Giraud performed a more thorough investigation on May 13. The purpose of our investigation was to determine the geologic characteristics of the rock fall and evaluate the hazard potential for future rock falls to aid Provo City emergency managers in assessing the risk to houses and city infrastructure in the area. On May 16, 2005, we provided Provo City emergency manager Ed Scott and Provo Mayor Lewis Billings a letter with our initial conclusions and recommendations regarding the rock fall. This report provides supplemental information on the rock-fall hazard and restates our conclusions and recommendations.

CONCLUSIONS AND RECOMMENDATIONS

The rocks fell from a cliff band about 2,600 vertical feet above the guest house that was damaged (figure 2). We were unable to investigate the source area to look for unstable rocks. Abundant rock-fall sources are present all along the front of "Y" Mountain, and previous rock-fall debris throughout this neighborhood indicates the remaining house on the lot and adjacent houses are in a rock-fall-hazard area. This area is also within the rock-fall-hazard area mapped by Robison (1990). Unfortunately, the timing of rock falls cannot be predicted, although they are most common during and following storms and earthquakes, and during periods of freeze-thaw such as spring and fall. Therefore, although we were in a period of heightened hazard at

the time of the rock fall because of recent precipitation, the occurrence of this rock fall does not necessarily indicate a greater hazard at this locality than elsewhere.

Because the remaining house on the lot and adjacent houses are pre-existing older homes, we recommend that residents be informed they are in a rock-fall-hazard area, and that they may wish to hire a geological consultant to investigate, to the extent possible, the risk from rock falls to the neighborhood or to individual houses. A geologic consultant could also evaluate rock-fall risk-reduction protection measures such as upslope catchment structures and their cost.

DESCRIPTION AND GEOLOGIC SETTING

The rock fall occurred on "Y" Mountain, a steep mountain front along the southern Wasatch Range above Provo. The source of the rocks was an upper cliff band in the Mississippian Deseret Limestone about 2,600 feet above the house (figure 4; Hintze, 1978). Plentiful other source-area cliffs extend throughout the source area of this rock fall. The lower slope where the rocks came to rest is mostly colluvium, and the upper slope below the cliffs is talus. The average slope from the apex of the talus slope to the rock's resting place, known as the "shadow angle" (Evans and Hungr, 1993), is about 28.5°. Minimum shadow angles are used to estimate maximum rock-fall runout distances, and typical minimum "shadow angles" for rock falls measured elsewhere are about 22° (Wieczorek and others, 1998). This indicates that rocks may potentially travel farther downslope and that the rock-fall hazard area includes parts of the neighborhood to the west as shown by Robison (1990).

The rock that impacted the guest house measures approximately 7 x 5.1 x 4.5 feet (figure 5), and we estimate that it weighs about 13 tons. Many other rocks from the same rock fall were present on slopes below the cliff band in the runout track (figure 6) and on the slope just above 1550 East. The guest house was severely damaged (figure 3), but none of the other structures in the area were affected. The rock impacted and displaced the southwest concrete foundation corner of the house onto the driveway (figures 3 and 5). The west house wall was detached from the main structure and contents inside the house were damaged (figure 3). Impact craters (bounce marks; figure 7) were evident on the 20° slope directly above the house. The rocks traveled a total slope distance of over 1 mile (about 5,500 feet) and likely achieved a relatively high velocity and bounce height as they advanced down the slope. Abundant previously fallen rocks on the slope and among the homes in the area indicate that rock falls are relatively common on a geologic time scale in this area.

PROBABLE CAUSES

The exact timing of rock falls can sometimes be attributed to a specific cause, but not always. Rock falls are generally the result of the cumulative effects of weathering, erosion, water and freeze-thaw in fractures in an outcrop, and other geologic processes (particularly earthquakes). In this particular case, the rock fall occurred shortly after a significant storm on May 10-12 that dropped over 3.7 inches of rain and snow at the Cascade Mountain Snotel site (MesoWest, 2005) about 3 miles southeast of the source area. It was raining at the time of the

rock fall. Precipitation at the Orem National Weather Service station for the period September 2004 to April 2005 (National Weather Service Forecast Office Salt Lake City, 2005) was 121% of normal. Soil moisture and amounts of water infiltrating into fractures in rock outcrops have likely increased greatly this spring in the rock-fall source area, increasing pore pressures and the potential for rock falls. These conditions probably contributed to the timing of this event.

SUMMARY AND FUTURE HAZARD POTENTIAL

On May 12, 2005, a rock fall from a cliff band on "Y" Mountain about 2,600 feet vertically above 1550 East Street in Provo rolled over a mile and damaged a guest house at 1468 South 1550 East. A significant rainfall event, repeated snowfall and melting this winter and spring, and overall above-normal rainfall this year probably contributed to the timing of the rock fall on May 12. Abundant rock-fall sources are present all along the front of "Y" Mountain, and rocks throughout this neighborhood from previous rock falls indicate a significant rock-fall hazard in the area.

The timing of rock falls cannot be predicted, but they are most common during and following storms and earthquakes, and during periods of freeze-thaw such as spring and fall. Although we were in a period of heightened rock-fall potential, the occurrence of this rock fall does not necessarily indicate a greater hazard here than elsewhere; rock falls are possible at any time and typically occur with no warning. Residents should be informed they are in a rock-fall-hazard area, and that they may wish to hire a geological consultant to investigate the risk from rock falls to the neighborhood or to individual homes and the feasibility or rock-fall risk-reduction structures.

LIMITATIONS

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REFERENCES

Evans, S.G., and Hungr, O., 1993, The assessment of rockfall hazard at the base of talus slopes: Canadian Geotechnical Journal, v. 31, p. 620-636.

Hintze, L.F., 1978, Geologic map of the "Y" Mountain area, east of Provo, Utah: Brigham Young University Geology Series Special Publication no. 5, scale 1:24,000.

MesoWest, 2005, Current weather summary for Utah: Online, http://www.met.utah.edu/cgi-bin/droman/meso_base.cgi?stn=CAMU1&time=GMT, accessed May 26, 2005.

National Weather Service Forecast Office Salt Lake City, Utah, 2005, Monthly weather summary: Online, http://www.wrh.noaa.gov/climate/index.php?wfo=slc, accessed September 2004 thorough April 2005.

Robison, R.M., 1990, Utah County natural hazards overlay (NHO) zone: Unpublished Utah County Planning Department maps, scale 1:50,000 and 1:24,000.

Wieczorek, C.F., Morrissey, M.M., Iovine, G., and Godt, J., 1998, Rock-fall hazard in the Yosemite Valley, California: U.S. Geological Survey Open-File Report 98-467, map scale 1:12,000.

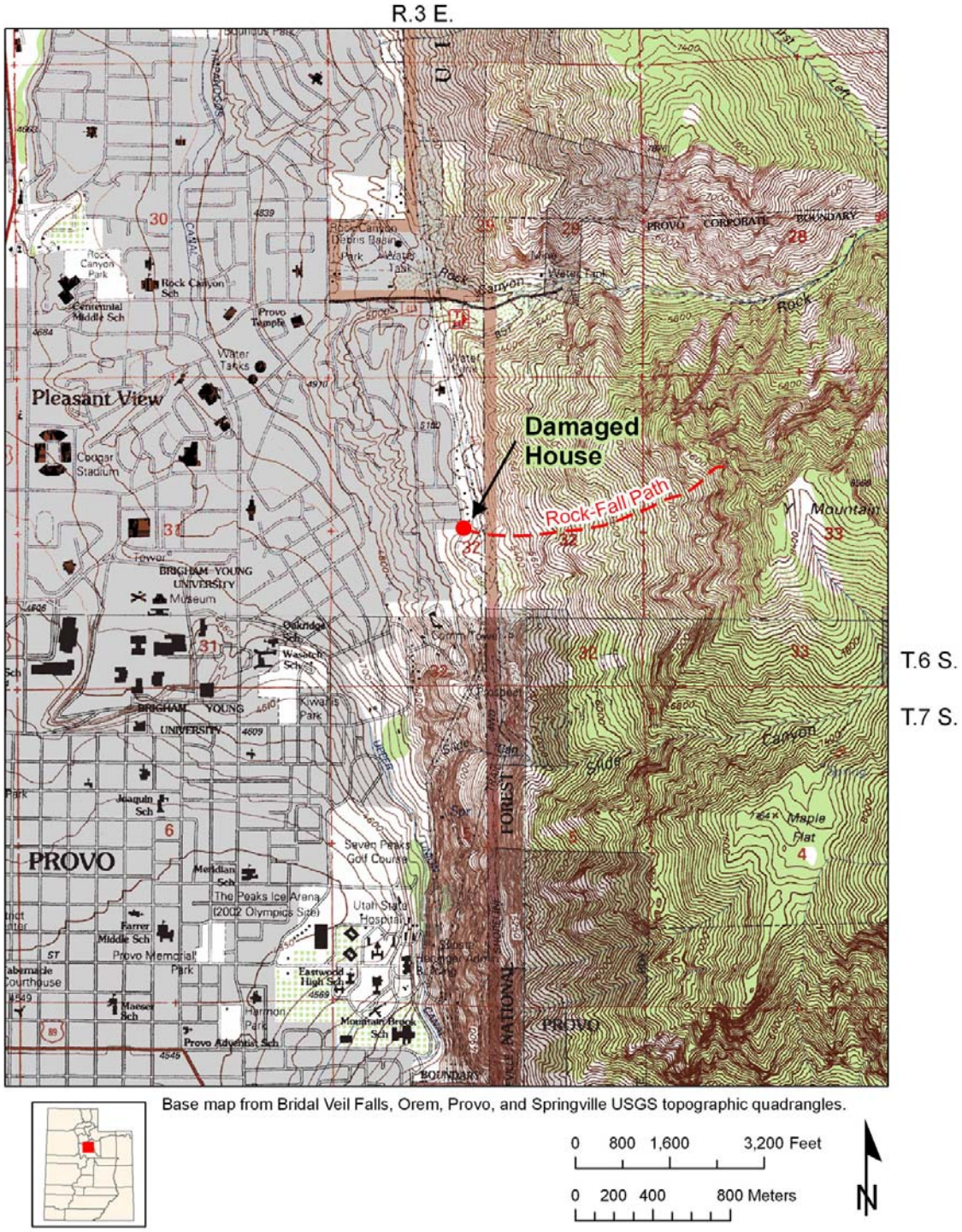

Figure 1. Location map for the 1550 East Provo rock fall.

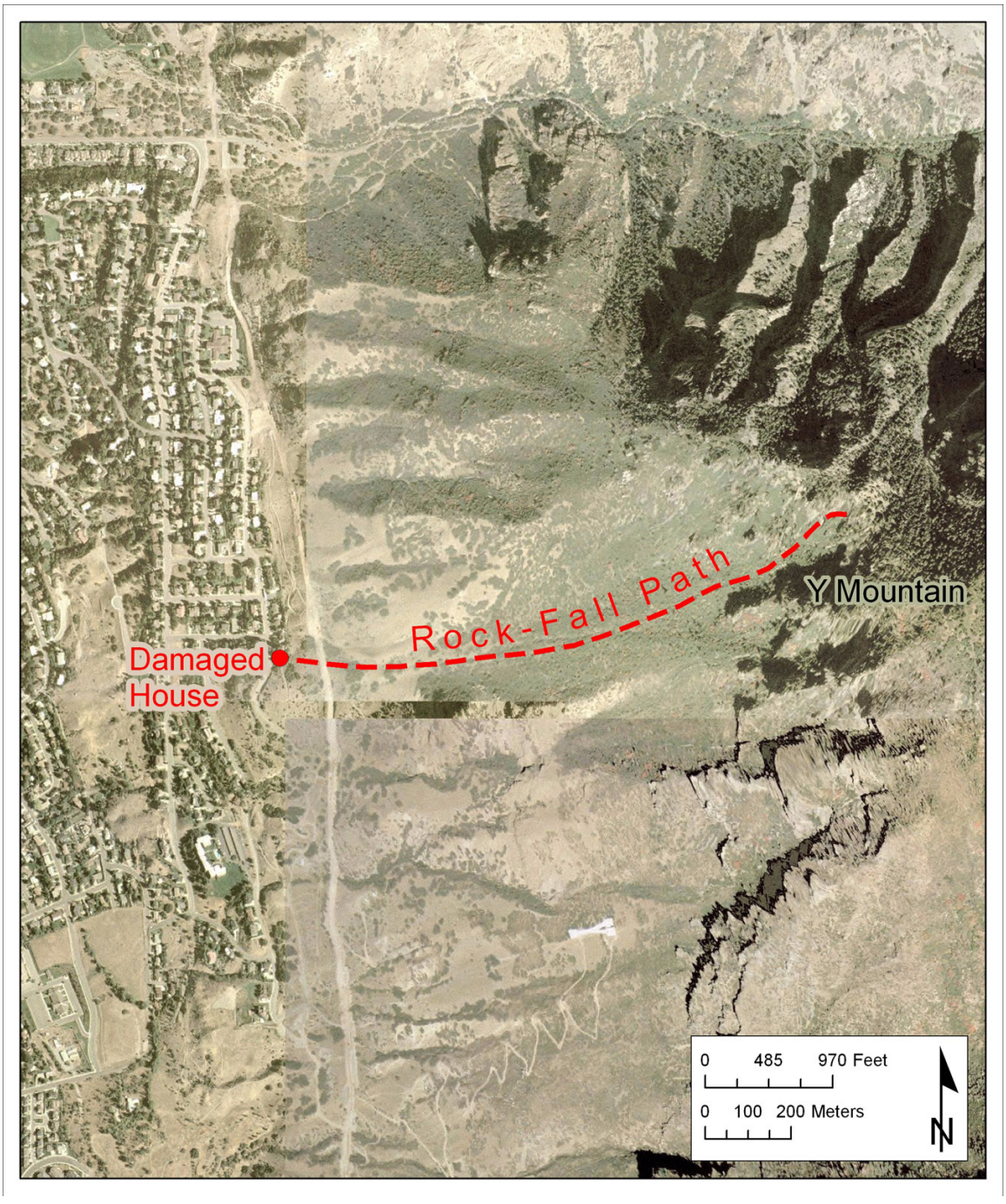

Figure 2. “Y” Mountain source area, the rock-fall path, and damaged house.

Figure 3. Damage to the guest house. The damaging rock is on the left behind the trash can, against the base of the tree. Parts of the concrete house foundation are behind and to the right of the trash can.

Figure 4. View east to the rock-fall source area in the Mississippian Deseret Limestone on the north end of "Y" Mountain showing path of the rock fall (arrows) as indicated by dark soil and rock fragments on the snow surface.

Figure 5. The rock that damaged the guest house. Part of the concrete house foundation wall is in the foreground.

Figure 6. View of the rock fall runout track on May 17, 2005. Dark brown soil streaks show the path of rocks that traveled downslope. Recent snowfall obscures the runout track in the upper part of the photo (photo by Dave Bennett).

Figure 7. Impact crater (bounce mark) on the slope just above the guest house (yellow object is notebook for scale).