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Utah Geological Survey

Project:			Requesting Agency:
Geologic reconnaissance of a slope failure in Spanish Fork Canyon, Utah County, Utah.			Emergency Response
By: Bill D. Black, Barry J. Solomon	Date: 11-16-95	County: Utah	Job No: 95-16
USGS Quadrangle: Mill Fork (962)			

INTRODUCTION

On November 3, 1995, a slope failure in Spanish Fork Canyon temporarily blocked U.S. Route 6 and the Denver and Rio Grande Western rail line. The slope failure occurred in a south-facing hillslope in the SW1/4NE1/4 section 33, T. 9 S., R. 5 E., Salt Lake Base Line, north of Soldier Creek (attachment 1).

The purpose of these investigations was to document the slope failure, assess whether or not the failure or remaining slope poses a safety hazard, and advise Utah Department of Transportation (UDOT) officials of our findings. The scope of work included a literature review, and field inspections on November 4 (Barry J. Solomon) and 6 (Bill D. Black). Alan Mecham, Merrill Jolley, and Ed Beck (UDOT Region Three) were present during the field inspection on November 6. Material deposited by the slope failure had been removed from the road and rail lines prior to the field inspections.

DESCRIPTION

The slope failure is an earth flow (attachment 2) approximately 80 feet (24 m) wide and 115 feet (35 m) long from the main scarp to the base of the source area. The steepness of the slope in the source area prior to failure was roughly 22 degrees (40 percent). The main scarp is nearly vertical and about 10 to 12 feet (3-4 m) high; an open crack extends east 16 feet (5 m) from the main scarp across the adjacent unfailed slope. The failure occurred as surficial material in the source area flowed south onto the flood plain of Soldier Creek. The source material flowed about 200 feet (61 m) across U.S. Route 6 and the Denver and Rio Grande Western rail lines, and was quickly cleared by UDOT and railroad crews. Assuming an average depth to the failure plane of 5 feet (1.5 m), total volume of the earth flow was approximately 1,700 cubic yards (1,300 m^3).

The earth flow occurred in a south-facing slope bordering the flood plain of Soldier Creek. The slope is underlain by alluvium and colluvium. Bedrock in the area is coarse conglomerate and sandstone of the Red Narrows facies of the Cretaceous North Horn Formation (Merrill, 1972). Several springs are in and around the source area. Merrill (1972) believes the springs are due to fracturing associated with the nearby Martin Mountain fault, about 0.4 miles (0.6 km) to the east. A tufa deposit was mapped by Merrill (1972) around the springs. Water was flowing from the source area following the earth flow.

The earth flow is composed of alluvium and colluvium, and blocks of tufa from around the springs. Springs in the source area and above the main scarp saturated the hillslope, and the earth flow likely occurred when high pore-water pressure caused the slope to become unstable. The tufa deposit may also have contributed to the failure by restricting ground-water flow and weighting the soil in the source area. Although no landslides are mapped in the area to suggest previous slope instability, the North Horn Formation is considered a landslide-prone geologic unit (Harty, 1991, 1992). However, undisturbed bedrock outcrops were observed above the main scarp and no in-place bedrock was involved in the failure.

SLOPE-FAILURE HAZARD AND RECOMMENDATIONS

A slope-failure hazard exists for portions of the unfailed slope on the eastern edge of the earth flow. The open crack extending from the main scarp through this section of the slope indicates the slope is unstable. Failure of this slope section could bring down an additional estimated 450 cubic yards (350 m^3) of material, which may again temporarily block the highway and rail lines and pose a hazard. A hazard also exists for smaller slope failures and erosion from the oversteepened main scarp. However, bedrock upslope from the main scarp should restrict the extent of erosion or generation of additional slope failures, and improved drainage from the springs as a result of the failure may increase slope stability.

We recommend reducing the hazard from additional slope failures or falling debris. Further study may be needed to determine the best hazard-reduction techniques, which may include placing concrete barricades along the toe of the source area and warning signs along the highway, removing the unstable material on the eastern edge of the source area (in imminent danger of failing), and improving slope drainage. Barricades alone at the base of the unfailed slope section would be unlikely to stop material from a large failure. Even after hazard-reduction techniques are implemented, the slope should be monitored for evidence of instability.

REFERENCES

Harty, K.M., 1991, Landslide map of Utah: Utah Geological and Mineral Survey Map 133, 28 p., scale 1:500,000.

---1992, Landslide map of the Nephi 30' x 60' quadrangle, Utah: Utah Geological Survey Open-File Report 263, 12 p., scale 1:100,000.

Merrill, R.C., 1972, Geology of the Mill Fork area, Utah: Brigham Young University Geology Studies, v. 19, pt. 1, p. 65-88.

Varnes, D.J., 1978, Slope movement types and processes, *in* Schuster, R.L., and Krizek, R.J., editors, Landslides, analysis and control: Washington D.C., National Academy of Sciences, Transportation Research Board Special Report 176, p. 11-33.

Attachment 1.
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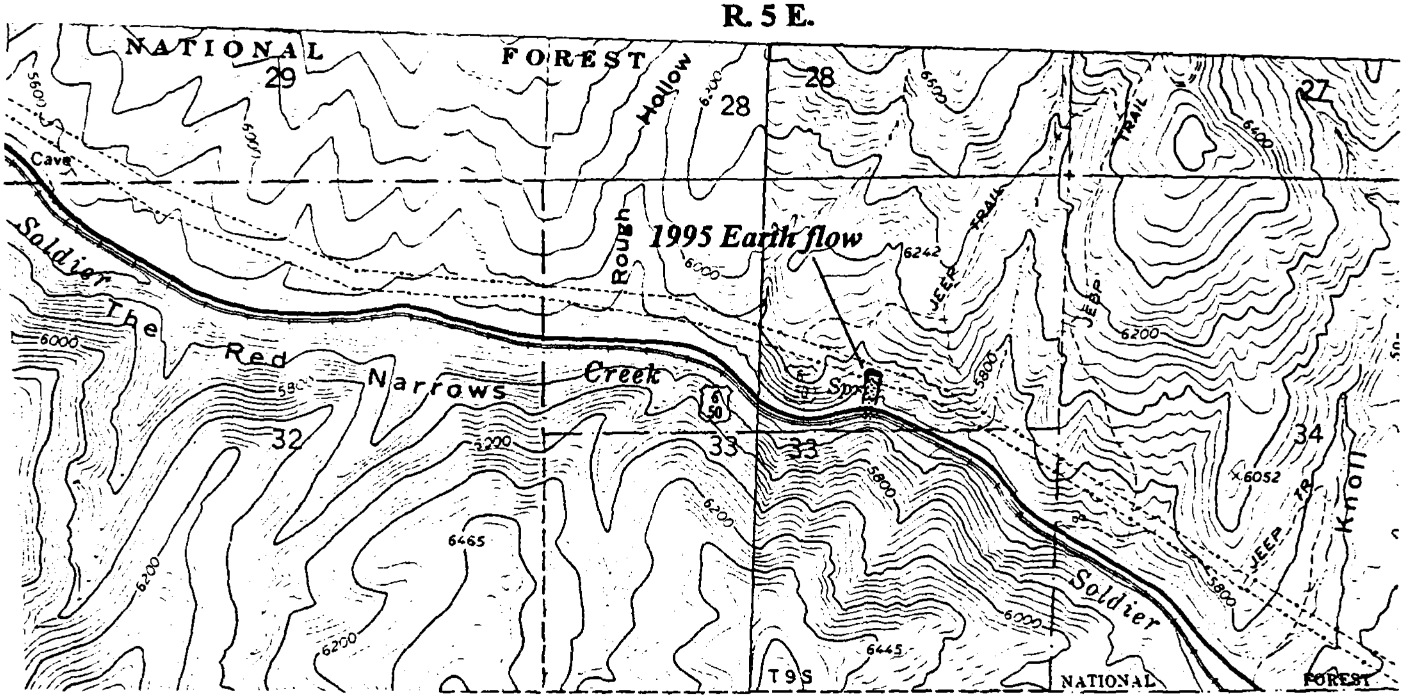
Base map from **THISTLE** and **MILL FORK**, U.S.G.S. 7-1/2' topographic quadrangles.

R. 5 E.

T. 9 S.



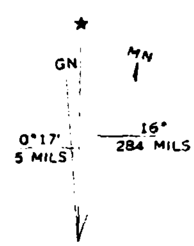
SCALE 1:24000

1 ½ 0 1 MILE

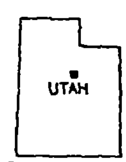
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETRE

CONTOUR INTERVAL 40 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929



UTM GRID AND 1967 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET



QUADRANGLE LOCATION

Attachment 1. Location map.

Attachment 2.
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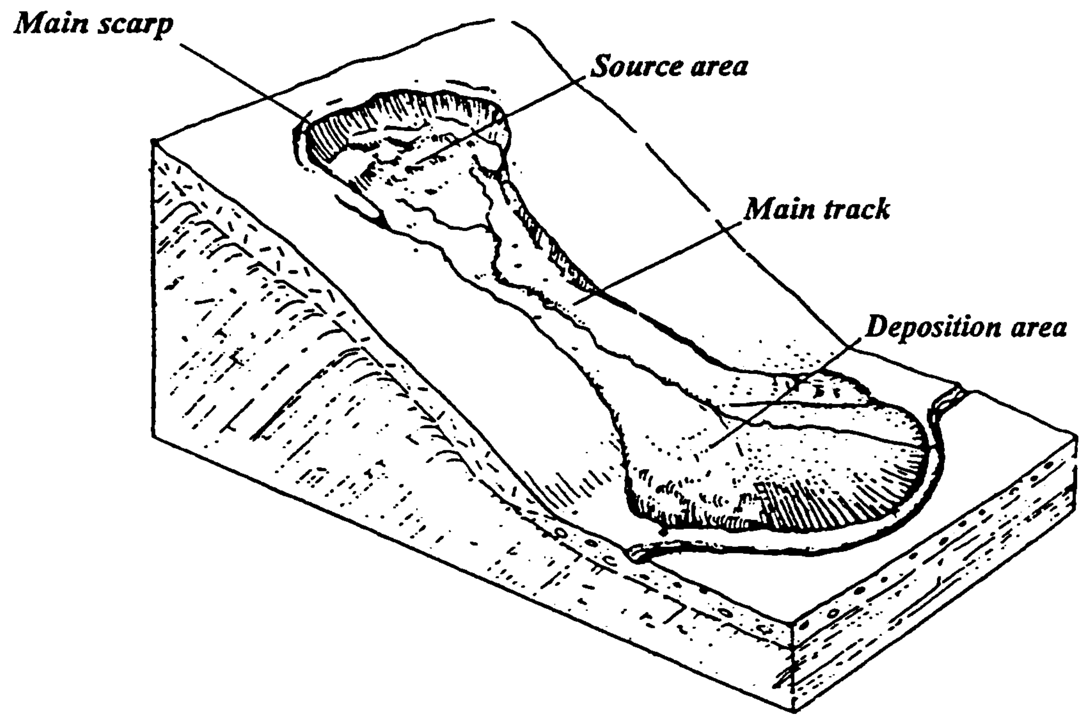

Attachment 2. Block diagram of features commonly associated with an earth flow (modified from Varnes, 1978).