Geologic Report on the 1993 Bliss Landslide, Gooding County, Idaho

Virginia S. Gillerman

Staff Report 01-1
December 2001

Idaho Geological Survey
Morrill Hall, Third Floor
University of Idaho
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INTRODUCTION

On July 24, 1993, a section of ground south of the town of Bliss in Gooding County failed and slid southward into the Snake River. According to local witnesses the river was temporarily blocked before a new channel cut through the debris. The toe of the landslide is currently being eroded by the river. The slide destroyed a portion of the Shoestring Road which provided access from Bliss to a bridge across the Snake River. Approximately 100 acres have been totally disrupted by the landslide, which has grown in size by creep (very slow downslope movement) and at least one additional catastrophic movement since July 27. New tension cracks and old landslide scarps cover an additional estimated 100 to 150 acres in sec. 7, T. 6 S., R. 13 E., as shown in Figure 1.

At the request of the Idaho Bureau of Disaster Services, the Idaho Geological Survey (IGS) has reviewed the local geology and conducted three separate field visits in an effort to evaluate the geotechnical stability of the slide and adjoining area and estimate safety hazards and causes of the slide. One-day visits to the area were made on July 27, three days after the initial slide, on August 6 with KTVB news personnel, and on August 12 at the request of the Governor's office. During the last visit, two geologists walked across the full width of the slide and along old Highway 30, which borders the current slide and crosses two old landslide scarps. Figure 1 is a map of the slide and old scarps.

GEOLOGY

REGIONAL GEOLOGY

Geology in the Glenns Ferry to Hagerman area, including Bliss, has been mapped by Malde and Powers (1972), revised slightly by Malde (1982) and Covington and Weaver (1989). Figure 2 is a portion of Covington and Weaver's geologic map for the Bliss area. Additional information is from the field observations of Virginia Gillerman and other IGS staff.

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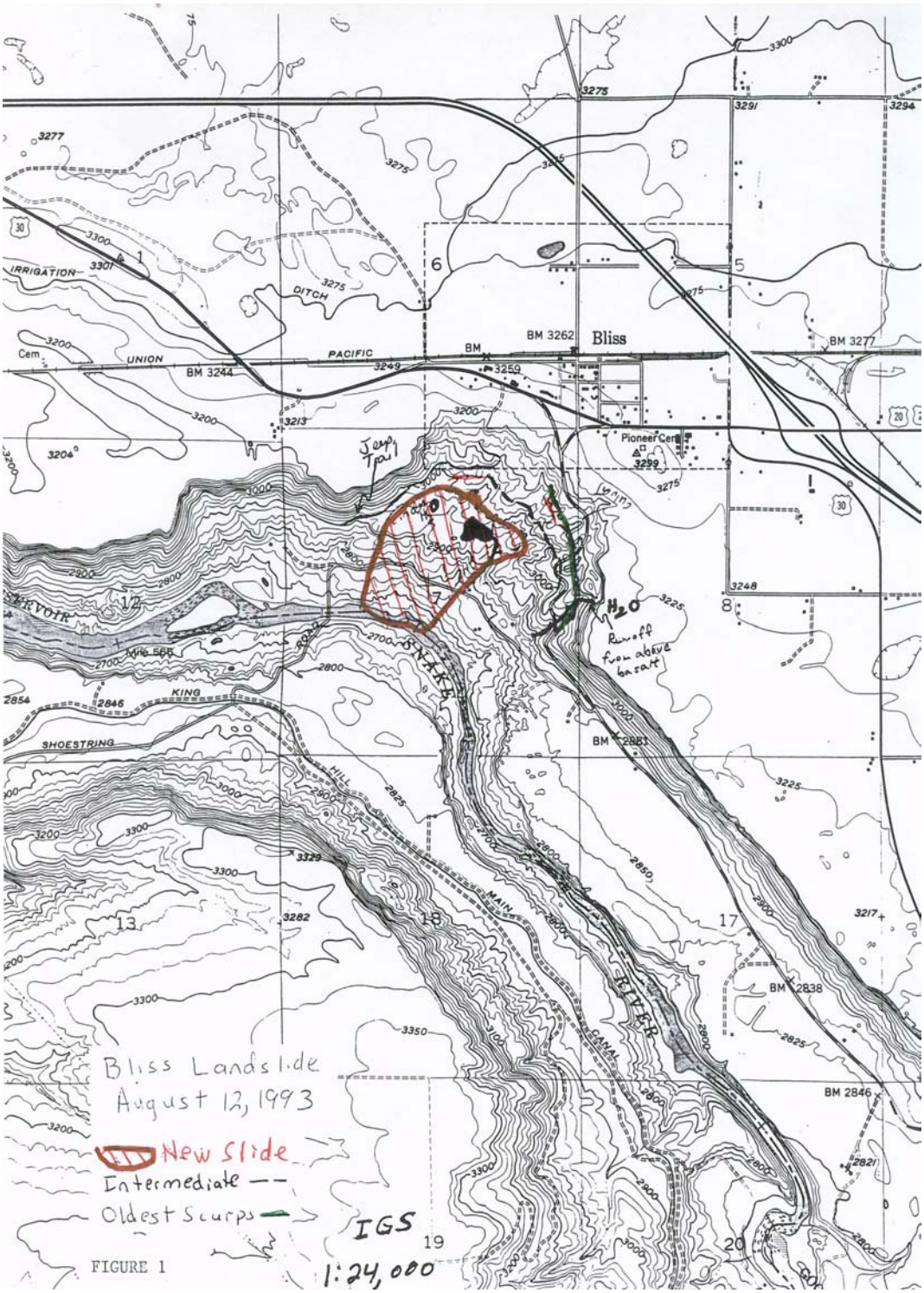

Figure 1. Topographic map with Bliss landslide.

The oldest rocks in the region are Tertiary Banbury Basalt. Resting unconformably above this are several hundred feet of Pliocene sediments of the Glenns Ferry Formation. At Bliss, these consist of lake and stream deposits, including massive siltstones, thin-bedded clays and silts, sands and silts, fine gravels, and one thin basalt flow in the upper part of the unit, which appears to be about 200-400 feet thick at Bliss. Undisturbed bedding in the sediments is horizontal. Overlying the Glenns Ferry and forming the canyon rimrock are Pleistocene-age McKinney and Madson Basalts. Thickness of the hard basalt rim averages about 30 feet.

From below Bliss and upstream to about Hagerman, this simple layer cake geology is complicated by the presence of canyon-filling pillow lavas of McKinney Basalt which dammed up the ancestral Snake River, forming a lake. This "pillow delta" consists of glassy basalt blobs in a cindery, incompetent matrix, all of which is exposed near the toe of the current slide on the south margin of the river. Deposited in the McKinney lake were bedded lacustrine clays, named the Yahoo Clay by Malde (1982). Figure 2b is a schematic geological cross-section of the Snake River Canyon at Bliss to show the relationship of the Yahoo Clay with local hydrology.

Much of the Tertiary and Quaternary units are covered by Melon Gravels, associated with the 14,500 year old Bonneville Flood, and recent and older stream alluvium and gravels. Talus and numerous old landslide deposits, including the one at Bliss, further obscure the walls of the Snake River Canyon.

LANDSLIDE GEOLOGY AND CAUSES

The Bliss landslide is a reactivation of an old Quaternary landslide zone (Qls in Figure 2) which covers most of the Bliss alcove located southwest of town. A second landslide, which a local resident said formed in the 1930's, is located across the river south of the present slide. The Bliss alcove is at a prominent bend in the river, downstream from a long straight segment. Unfortunately this helps focus the power of the Snake River on the toe of the slide. The linear river reach suggests the possibility of regional northwest-trending faults or joints cutting the Tertiary units. A major topographic alcove and three canyons filled with Madson Basalt could also be interpreted as supporting evidence for hidden NW and NNE-trending structures that fractured the Tertiary rocks.

Broken large hunks of rock on the slide surface as of August 12 are particularly clay-rich on the east and become sandier in the center of the slide. Highwalls up to 50 feet high on the southwest part of the slide expose a thick sequence of bedded, basalt gravel/cinders with claystone blocks and river rock cobbles. Polished, slickensided fault surfaces are particularly well-exposed along the sides of the slide area; the faults are both parallel to bedding and cut across bedding at all angles.

Wet clays swell and become very slippery. The interbedded clays and silts of the Glenns Ferry Formation are notorious for hosting numerous landslide deposits all along the Snake River Canyon. Fractured basalt rimrock, porous pillow basalts, sandy layers of the Glenns Ferry, and bedded porous basalt cinders are sufficiently permeable to transport surface and groundwater into the Glenns Ferry Formation. In addition, the Yahoo Clay acts as a confining unit, creating a barrier to groundwater movement out of the canyon walls (Covington and Weaver, 1989). This creates a confined aquifer condition that can produce excess water pressures in the Glenns Ferry sediments below the Yahoo Clay or clay-rich Quaternary landslides (Figure 2b).

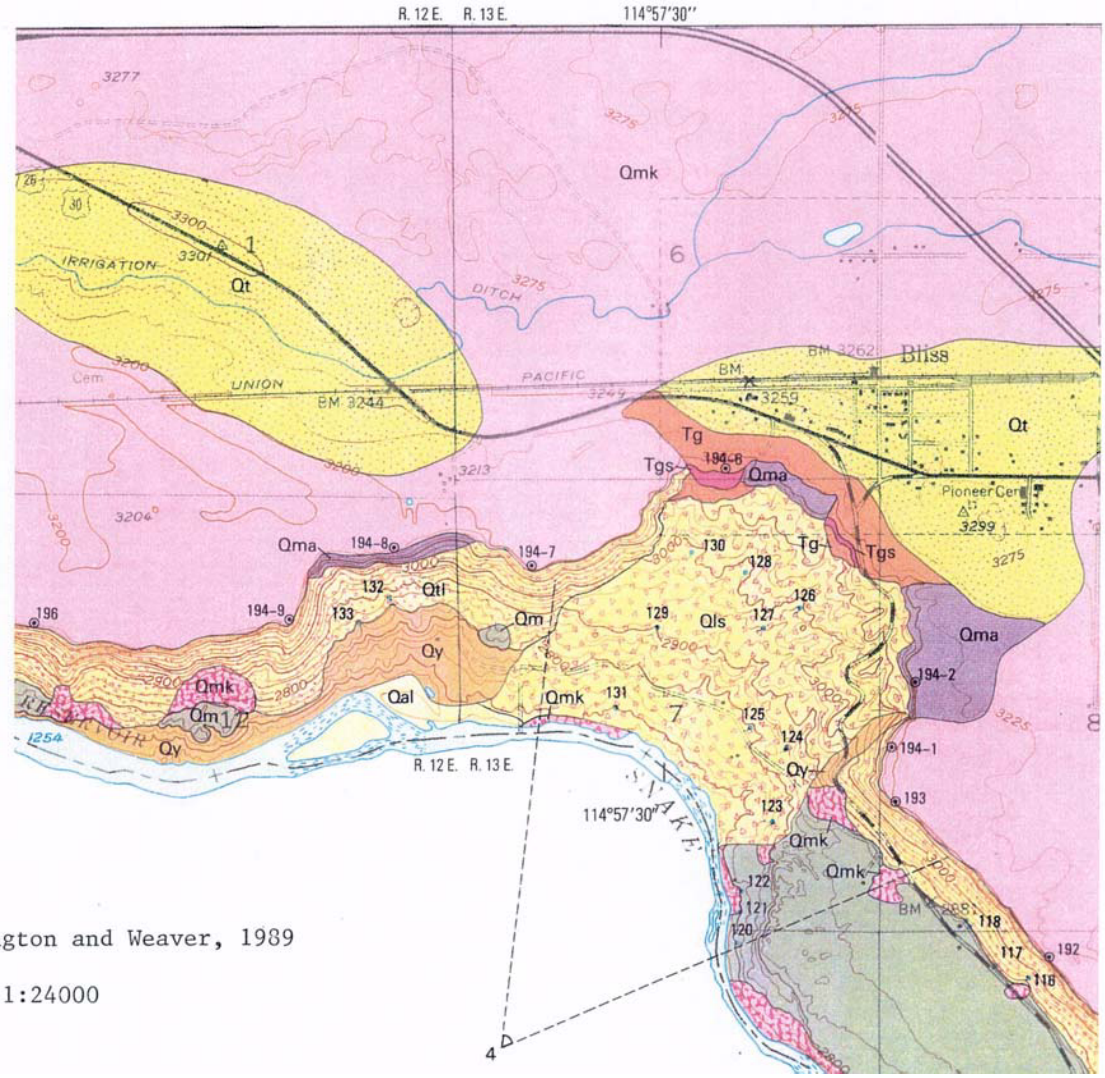

FIGURE 2

Covington and Weaver, 1989

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Figure 2. Geologic map of Bliss area from Covington and Weaver

DESCRIPTION OF MAP UNITS

Qal — **Stream alluvium (Holocene)**—Unconsolidated clay, silt, and sand along Snake River

Qtl — **Talus (Holocene)**—Unconsolidated deposits of unsorted, generally angular material of various sizes along canyon walls

Qls — **Landslide deposit (Holocene)**—Hummocky, unconsolidated deposits of blocky material in a matrix of silt or sand that occur locally along canyon walls

Qoa — **Older alluvium (Pleistocene)**—Unconsolidated pebble and cobble gravels in low terraces along Snake River

Qm — **Melon Gravel (Pleistocene)**—Unconsolidated pebbles, cobbles, and boulders of locally derived basalt in a matrix of basaltic sand deposited in sheets and bars along Snake River canyon floor as a result of catastrophic overflow of Lake Bonneville

Qcg — **Crowsnest Gravel (Pleistocene)**—Unconsolidated terrace deposits composed mostly of pebbles of silicic volcanic rocks

Qy — **Yahoo Clay (Pleistocene)**—Lacustrine clay deposited in Snake River canyon behind a dam of McKinney Basalt

Qmk — **McKinney Basalt (Pleistocene)**—Flows of gray, olivine-rich, pahoehoe basalt from vent at McKinney Butte, located 9 mi north of Bliss. Pillow lava facies shown by pattern. Cascade facies, where lava flowed over canyon wall, occurs between profile-control locations 188–1 through 191

Qwg — **Wendell Grade Basalt (Pleistocene)**—Flows of gray, olivine-rich, pahoehoe basalt from vent at Notch Butte, located 25 mi east of Hagerman. Cascade facies, where lava flowed over canyon wall, shown by pattern occurs between profile-control locations 181–1 through 181–5

Qss — **Sand Springs Basalt (Pleistocene)**—Flows of dark-gray, olivine-rich, pahoehoe basalt from vent at butte 4526, located 23 mi northeast of Twin Falls

Qtt — **Thousand Springs Basalt (Pleistocene)**—Flows of dark-gray, olivine basalt, from vent at Flat Top Butte, located 12 mi north of Twin Falls. Canyon-filling deposits occur near Magic Springs, located 5 mi south of Hagerman

Qtm — **Malad Basalt (Pleistocene)**—Flows of gray, olivine basalt, from vent at Gooding Butte, located 10 mi east of Bliss. Canyon-filling deposits discontinuously exposed in north canyon wall along Billingsley Creek and Snake River downstream to Malad canyon. Pillow lava facies shown by pattern

Qma — **Madson Basalt (Pleistocene)**—Flows of gray, olivine basalt, from an unidentified source vent east of Bliss. Canyon-fillng deposits occur in Malad canyon at spring locations 53

Qt — **Tuana Gravel (Pleistocene)**—Unconsolidated to poorly consolidated pebble and cobble gravel of silicic volcanic rocks interbedded with massive brown and gray sand and silt

Glenns Ferry Formation (Pliocene)

Tg — **Lake and stream deposits**—Massive siltstone, flaggy sandstone, carbonaceous shale, and fine-pebble gravel characterized by abrupt lateral facies changes

Tgs — **Shoestring Road lava flow**—Flows of dark-gray, olivine basalt from vent located 3 mi south of Bliss

Banbury Basalt (Miocene)

Tbu — **Basalt of upper part**—Flows of dark-gray and dark-brown olivine basalt

Tbs — **Sedimentary deposits of middle part**—Brown to olive sand and pebble gravel, locally includes light-colored silt, clay and diatomite

Figure 2a. Explanation for geologic map.

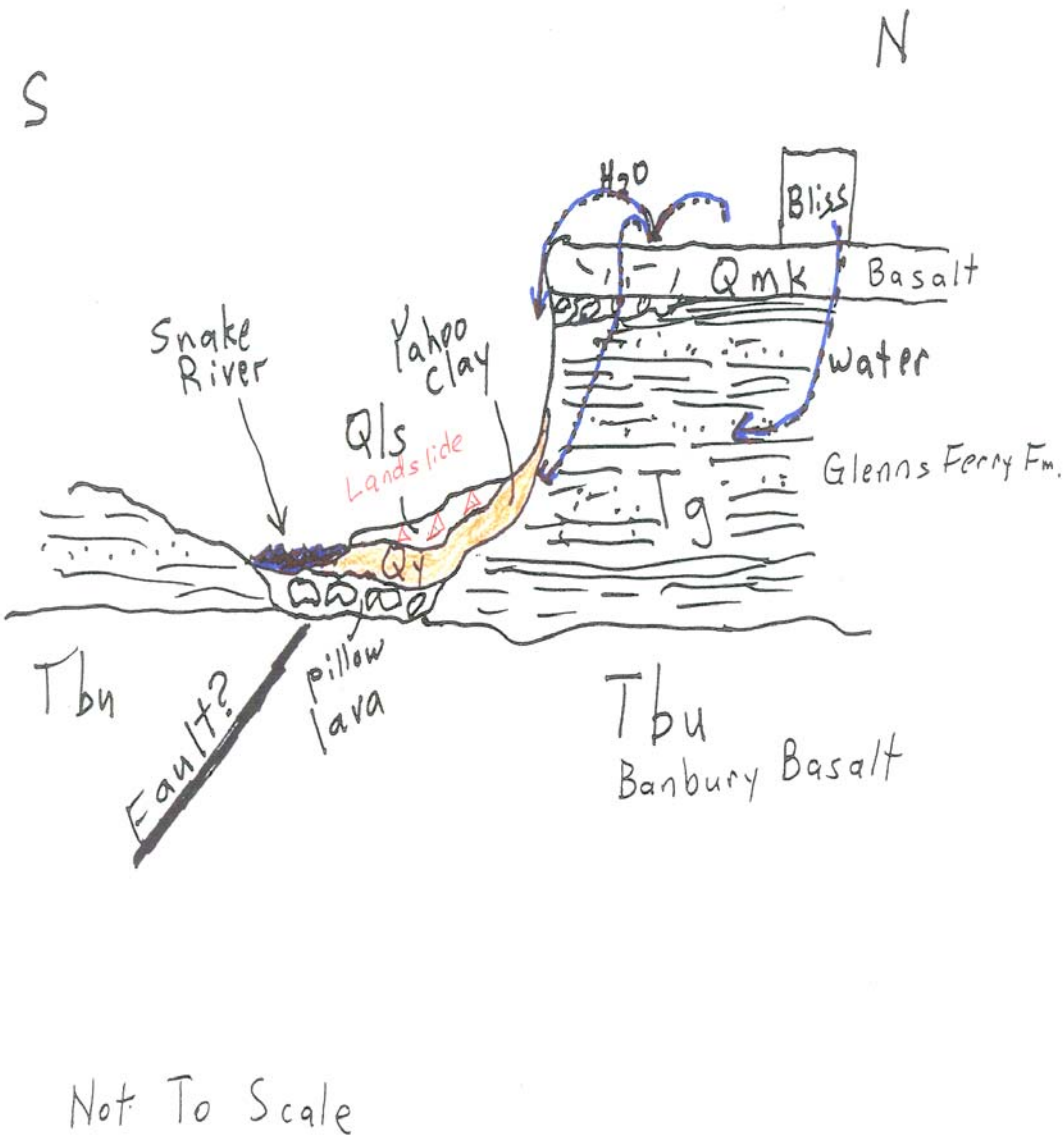

Figure 2b: Schematic cross-section of canyon at Bliss, showing geology and hydrogeology.

Several factors, rather than a single cause, combined to generate the landslide(s). These include the geology, a wet year after several drought years, a heavy rain the day before, and several local sources applying surface runoff and groundwater to the preexisting landslide zone. A few ponds and springs are still present on the slide surface, and several have been uplifted and drained in the last two weeks. Abundant water is still available to these clay-rich rocks, and another slide is possible.

LANDSLIDE STRUCTURES AND MOVEMENT HISTORY

Each of the three visits to Bliss revealed new movements, some catastrophic in nature and some due to creep or slow deformation. Classic landslide features, including rotational slumps, hummocky topography, arcuate highwall scarps with sag ponds, toe humps, tension cracks, tension gashes, grabens, compressional folds and thrusts, and spectacular strike-slip fault planes on the sides of the slide, are present. Figures 3a, b; 4a, b, c, d; 5a, b, c, d, and e show some of these features on my three visits.

New offsets of a few inches are now noticeable on past, unvegetated landslide scarps (Fig. 5b, 5c) within a few hundred feet of old Highway 30 which crosses two major old scarps. At the uppermost scarp, the steep highway surface has been patched repeatedly and cracks cut the most recent generation of asphalt.

New cracks continue to appear in the Sheep Trail dirt road on the west side of the slide. Fifty-foot high scarps (cliffs) are located within 100 feet of the Sheep Trail road and tourists were seen standing at the edge of the scarps. Such steep walls are inherently unstable and could slab off at any time, particularly after a heavy rain.

The river channel through the toe of the slide appears to have stabilized some between the August 6 and August 12 visits, judging from the color of the river water. However, erosion of material from the toe of the slide into the river will continue. As support material is removed from the bottom of the slide, it will continue to grow headward. As of August 12 it appeared that most new fractures were above the northwest part of the slide, closer to the modified Sheep Trail (the original one cracked off over two weeks ago) than to Highway 30. The center portion of the slide “blowout” appeared to have deflated and tilted northward in a series of rotational slumps. This creates a flatter, more stable slope gradient below a steeper part still headward. More recent information says that this steeper part is the site of new large cracks (J. Garth, personal communication).

Another catastrophic failure is quite possible and probably unpredictable. It is a geologic certainty that small-scale slides, creep and highwall erosion will continue for months.

SAFETY RECOMMENDATIONS

There is not much we can do to tame Mother Nature here, but the following actions are recommended:

1. Do NOT build another road across the slide. It is still very unstable and at present may not even stand the weight of a bulldozer.

2. An alternate access road around the margin of the landslide west of the Sheep Trail may cut into more incompetent Glenns Ferry Formation rocks and could easily slide,

especially if inadequate dewatering and engineering structures are not in place.

3. Close or at least discourage sightseer or heavy truck traffic on the existing Sheep Trial. A “Travel at your own risk” sign is essential.

4. Monitor with survey stakes and instrumentation the cracks and old scarps along old Highway 30 south along the Bliss grade from about 3,200 feet elevation to the bottom at 2,900 feet elevation. Particularly dangerous is the upper landslide scarp at about 3,070 to 3,100 feet elevation, just up from the big pullout where all the sightseers park. Monitoring should be done at least three times a week and the road closed if an increase in movement rate or cracking is noted.

5. Several point sources of surface water discharging onto the slide area were noted. While it may not be politically or economically justifiable to stop agricultural irrigation of the lands on the rim near Bliss, it is cheap and practical to divert surface and underground drainage away from the slide. Irrigation sprinklers a few hundred feet from the north edge of slide should be turned off if possible. Flowing water was seen in a ditch/creek that goes eastward over the rim in the NE¼ NW¼ sec. 7, and in a culvert/gully that crosses under old Hwy. 30 near the midpoint of the secs. 7 and 8 boundary. A currently dry culvert with a very deep gully below it crosses old Hwy. 30 in the NW¼ sec. 8, about 2,000 feet below the junction with Highway 20. It is recommended that the water discharges be terminated as soon as possible.

SUMMARY CONCLUSIONS

The geology and hydrogeology of the Bliss alcove are responsible for the continued development of landslides in that area. The slide is continuing to grow; dewatering may help slow that growth. It is very difficult, if not impossible, to stop a large landslide and equally hard to predict when a major movement will take place. The Bliss landslide has inconvenienced people living on the south side of the river, but the slide has to date caused no injuries and little property damage. Potential danger does exist from having continual traffic on the two roads bordering the slide. The aim of any action on the state or county’s part should be to decrease the danger and the easiest way to do this is to keep people off of it.

REFERENCES

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Malde, H.E., 1982, The Yahoo Clay, a lacustrine unit impounded by the McKinney Basalt in the Snake River canyon near Bliss, Idaho, *in* B. Bonnichsen and R.M. Breckenridge, eds., Cenozoic Geology of Idaho: Idaho Geological Survey Bulletin 26, p. 617-628.

Malde, H.E., and H.A. Powers, 1972, Geologic map of the Glenns Ferry-Hagerman area, west-central Snake River Plain, Idaho: U.S. Geological Survey Map I-696.

Figure 3a. Bliss landslide, looking southwest from end of asphalt road, July 27, 1993.

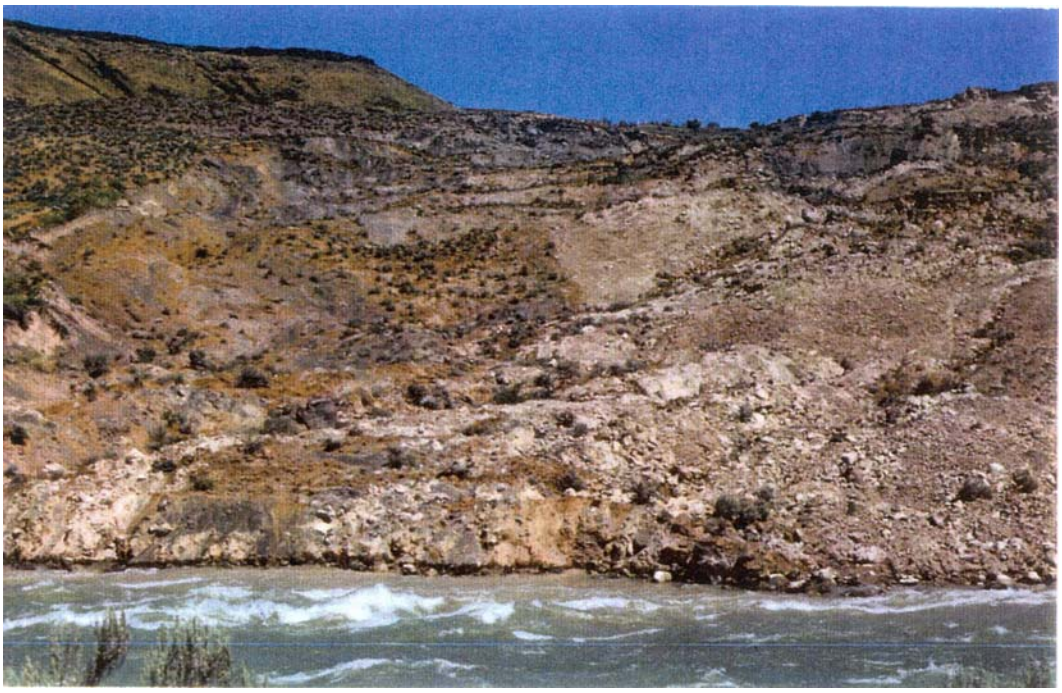

Figure 3b. Bliss landslide, looking north from south bank, Snake River, July 27, 1993.

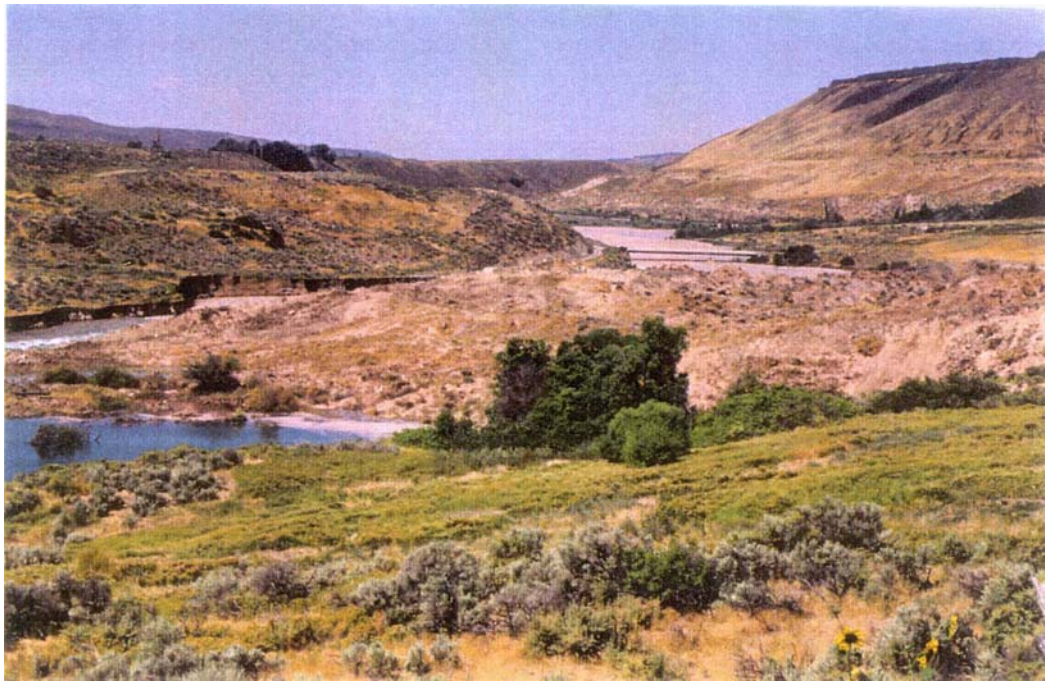

Figure 4a. Bliss landslide, looking southwest at toe of slide in river, August 6, 1993.

Figure 4b. Bliss landslide, looking north at toe from south bank. Pillow lava outcrop to right of person, August 6, 1993.

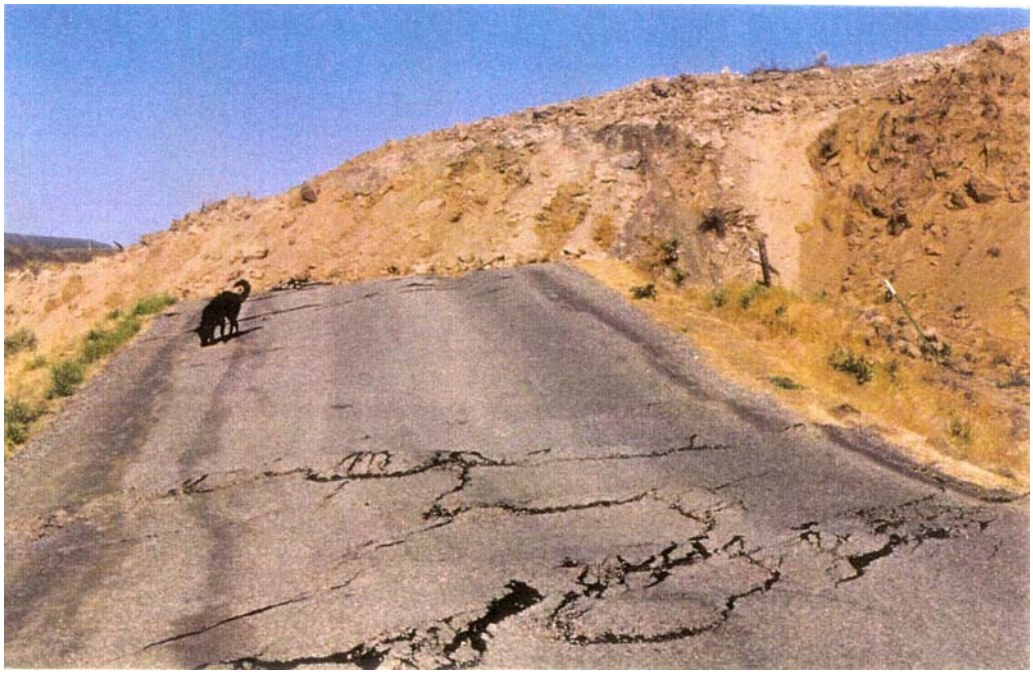

Figure 4c. Bliss landslide, from end of asphalt road, looking west, August 6, 1993.

Figure 4d. Bliss landslide, looking south at east margin of slide, August 6, 1993.

Figure 5a. Upper portion of Bliss landslide, panorama, looking west from old Highway 30, August 12, 1993. Note multiple rotated blocks and old scarps

Figure 5b. Bliss alcove, old scarp with 3 inches of new offset, looking northwest, August 12, 1993.

Figure 5c. Bliss alcove, closest new break to old Highway 30. Less than 4 inches displacement, looking northwest, August 12, 1993.

Figure 5d. Bliss landslide, fault surface on east margin of slide. Extends approximately 800 feet August 12, 1993.

Figure 5e. Bliss landslide, strike slip merging into dip-slip fault surface. East margin of landslide, August 12, 1993.