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A CASE HISTORY OF A MUD AND ROCK SLIDE ON AN EXPERIMENTAL WATERSHED

by

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On December 19, 1961, almost 3,000 feet of creekbed in experimental watershed 3 on the H. J. Andrews Experimental Forest near Blue River, Oreg., was scoured to bedrock by a tumbling, churning mass of mud, rocks, and logs. Five thousand cubic yards of this debris accumulated in two log jams in the main channel. Another 100 cubic yards of sand, silt, and gravel were washed on downstream and almost filled a small catchment basin which had collected only 57 cubic yards since 1956.

Slides like this are not uncommon in the forested mountains of western Oregon and Washington, but seldom does one occur on an experimental watershed where it can be measured. While there were no witnesses, it is possible to reconstruct what happened with some certainty. Three elements were involved: (1) a steep and unstable soil mantle evidenced by characteristic slump topography, (2) a logging road constructed across the watershed in 1959 but allowed to lie idle until logging began in 1962, and (3) a sequence of snow and rainstorms which thoroughly wet the soil.

During the early morning hours of December 19, several inches of wet snow fell on a modest snowpack remaining from previous storms. Rain followed and, together with melting snow, evidently wet the soil to a level not reached since road construction. Shortly before the storm peaked, about 30 cubic yards of material below a short section of the logging road slumped into a tributary of the main creek. This material

Figure 1.--Debris dam left in the stream channel by the slide.

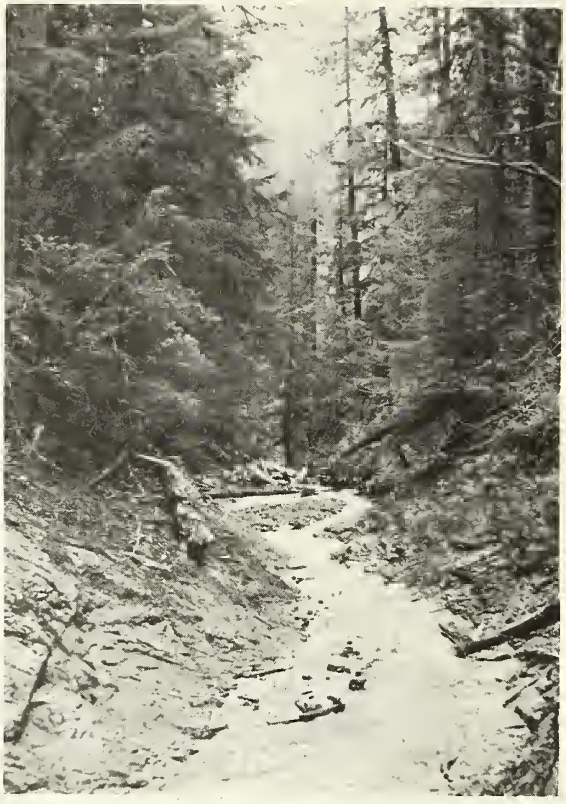
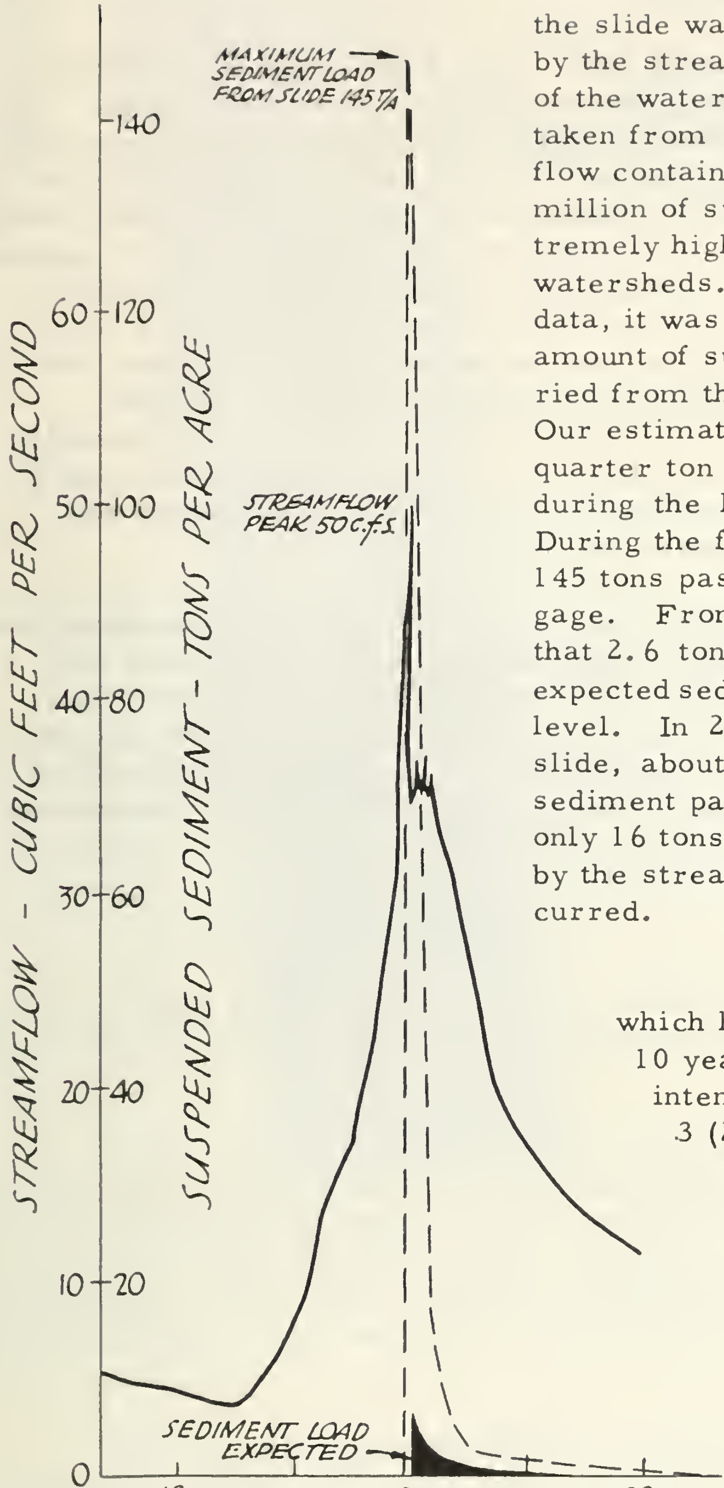


Figure 2.--Stream channel scoured to bedrock by the slide (looking downstream).

created a short-lived dam which, when breached, triggered a massive flow of mud, rock, and logs. More debris was picked up as the flow moved down the channel, plucking whole down trees from the side slopes of the drainage. For almost 3,000 feet, the channel was scoured to bedrock leaving behind isolated gravel deposits, small log jams, and two large debris dams (figs. 1 and 2). About 1 acre of mineral soil was exposed along the margin of the stream channel.

The accompanying chart traces some of the events occurring during the storm. As a result of rain on snow, streamflow rose rapidly to about 37 cubic feet per second (c.f.s.). At this stage, a surge of water, carrying silt, sand, and gravel, passed through the gage where streamflow is measured. The stream reached a peak discharge of over 50 c.f.s. and then settled down to some minor fluctuations, probably associated with the shifting and settling of the debris dams.



Much of the soil loosened by the slide was carried in suspension by the stream and moved rapidly out of the watershed. Samples of water taken from the stream near peak flow contained over 6,000 parts per million of suspended sediment--extremely high for these forested watersheds. From these and other data, it was possible to estimate the amount of suspended sediment carried from the watershed each hour. Our estimate showed that about one-quarter ton of sediment was lost during the hour before the slide. During the first hour after the slide, 145 tons passed through the stream gage. From past records we know that 2.6 tons per hour would be the expected sediment load at this water level. In 20 hours following the slide, about 260 tons of suspended sediment passed the gaging station; only 16 tons would have been carried by the stream had the slide not occurred.

This is the only slide which has occurred in the past 10 years during which we have intensively studied watershed 3 (250 acres) along with two adjacent watersheds (149 and 237 acres). There is, however, abundant evidence of old slides in deep deposits of colluvium near the mouth of the streams. The presence of old log jams indicates that slides, such as the one described, have been a natural occurrence in these watersheds during the last few decades.

The true cause of this slide is not known. From evidence on the ground, there is little doubt about the instability of the area. It. is reasonable to assume that a natural slide might have occurred even without the presence of the roadbed. The unstable condition of the ground at the head of this tributary was recognized during road reconnaissance, and a location was chosen to avoid the more active slump areas. In both design and construction, roads were "full benched," and soil removed was pushed several hundred feet to make a fill at the head of the creek. No soil was deliberately side cast over the slope on which the slide originated, although some accidentally spilled over the edge of the roadbed on a bank which sloped abruptly to the creekbed. A culvert installed at this point for draining ditch water may have been a contributing cause although the slope was protected in part with a half-culvert apron.

In spite of precautions taken in road location and construction, it appears that the presence of the road and culvert triggered this mass soil movement. Even a "full benched" road inevitably upsets the balance of forces within the soil mantle. A decision to build a road in an area of unstable topography constitutes a calculated risk no matter how well the road is designed and constructed to minimize damage.