

tion of wave surges that can overtop the dam, (2) increased sedimentation with resulting loss of storage, and (3) dam failure.

Flood surges can be generated either by the sudden detachment of large masses of earth into the reservoir, or by the formation and subsequent failure of a landslide dam across an upstream tributary stream channel. Waves formed by such failures can overtop the dam and cause serious downstream flooding without actually causing structural failure of the dam.

Landsliding into upstream areas or reservoirs can greatly increase the amount of sediment that is deposited in the reservoir, ultimately reducing storage capacity. This increases the likelihood that the dam will be overtopped during periods of excessive runoff, causing downstream flooding. Excessive sedimentation can also damage pumps and intake valves associated with water systems and hydroelectric plants.

Actual dam failure could be caused by landsliding at or near the abutments or in the embankments of earthen dams.

In 1983 a large mass of rock detached from Slide Mountain in Nevada. The mass slid into Upper Price Lake, an irrigation reservoir, displacing most of the water which overtopped and breached the dam, flowing into Lower Price Lake. This lake's dam was also breached. The water flowed into Ophir Creek where it collected large amounts of debris and became a debris

flow. After traveling about four kilometers and dropping 600 meters in elevation, the debris flow emerged from the canyon onto the alluvial fan of Ophir Creek (total time—15 minutes). One person was killed, four injured, and numerous houses and vehicles were destroyed (Figure 17) (Watters, 1988).

Rapid changes in the water level of reservoirs can also trigger landslides. When the water level in the reservoir is lowered (rapid drawdown), the subsequent loss of support provided by the water and increased seepage pressure can initiate sliding (Figure 18). Alternatively, the increase in saturation caused by rising water can trigger landslides on slopes bordering the reservoir.

Eisbacher and Clague (1984) describe an excellent example of the potential impacts of landsliding on dam safety: the 1963 Vaiont dam disaster in Italy. The Vaiont Dam, a hydroelectric dam, was completed in 1960 to impound the Vaiont Torrent, a major tributary of the Piave River in the southern Alps of Italy. The dam is 261 m high and spans a steep narrow gorge. The southern wall of the valley behind the dam is a steep dip slope. Within two months after the reservoir was filled, a 0.7×10^6 m³ mass of rock slumped away along the submerged toe of the southern embankment. Over time, deep-seated movement of the slope occurred in response to changing levels of the reservoir. As a result of these movements,



Figure 17.
House destroyed by
1983 Slide Mountain,
Nevada landslide
(photograph by
Robert J. Watters,
University of
Nevada, Reno).