Landslides (2006) 3: 73–78
DOI: 10.1007/s10346-005-0011-2
Received: 17 March 2005
Accepted: 4 July 2005

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The 2005 La Conchita, California, landslide

Introduction

On 10 January 2005, a landslide struck the community of La Conchita in Ventura County, California, destroying 13 houses, rendering an additional 23 houses uninhabitable, and killing 10 people. This was neither the first destructive landslide to damage this community, nor is it likely to be the last. This report describes observations from my brief field visit soon after the slide, describes the La Conchita area and its landslide history, and discusses continuing landslide hazards in the La Conchita area.

Setting of La Conchita

La Conchita is located on the southern California coastline midway between Ventura and Santa Barbara (Fig. 1). The 11-ha community was first established in 1924 when subdivision created about 200 lots that mostly contain single-family residences. La Conchita lies on a narrow coastal strip about 250-m wide between the shoreline and a 180-m high bluff having a slope of about 35°; above the top of the bluff is a gently rising terrace surface covered by avocado and citrus orchards (Fig. 2).

The bluff above La Conchita consists of poorly indurated marine sediment of the Monterey and Pico Formations. The upper part of the slope consists of interlayered siliceous shale, siltstone, and sandstone of the Middle to Upper Miocene Monterey Formation. The lower part of the slope is siltstone, sandstone, and mudstone of the Pliocene Pico Formation (O'Tousa 1995). Rock of both formations is very weakly cemented and has been regionally associated with extensive landslide activity (Morton 1971; Harp and Jibson 1995, 1996; Parise and Jibson 2000). The two formations are in fault contact along the active Red Mountain fault, which extends across the slope face.

Landslide history

The bluff above La Conchita has produced a variety of landslides over an extended period of time. Historical accounts dating back to 1865 have reported landslides in the area around La Conchita as being a regular occurrence (Hemphill 2001). The Southern Pacific rail line that extends along the coastal strip was inundated by landslide debris in 1889 and again in 1909, when a train was also buried (Hemphill 2001). Since that time, landslides have frequently

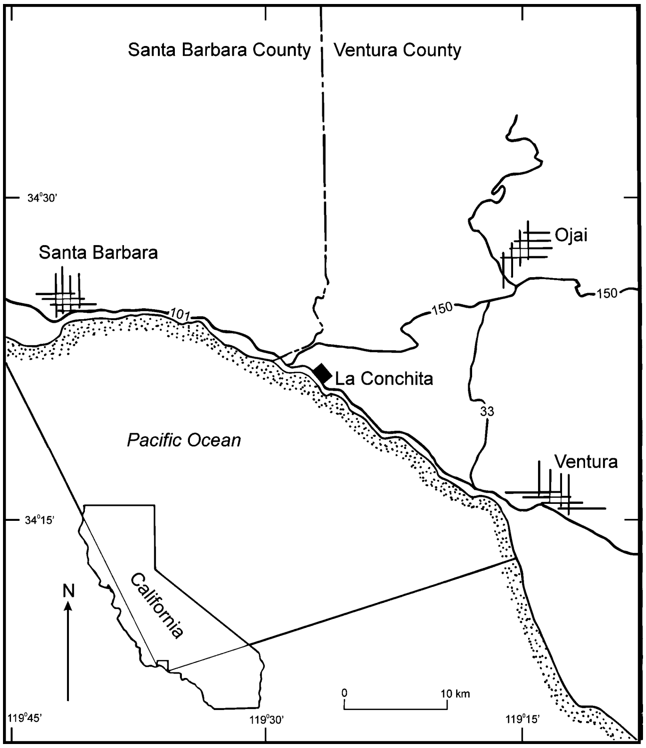

Fig. 1 Location map showing the La Conchita area (after O'Tousa 1995)

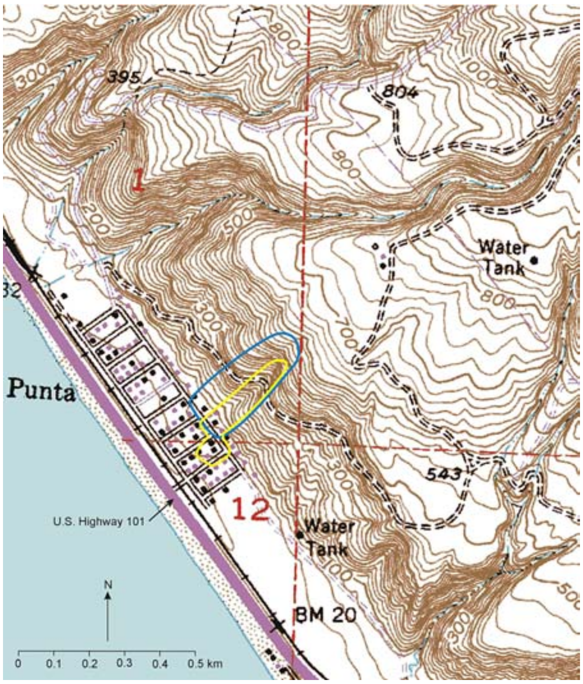

Fig. 2 Topographic map showing the La Conchita area. Approximate outlines of 1995 (*blue*) and 2005 (*yellow*) landslides are shown. Base from U.S. Geological Survey Pitas Point 7.5′ quadrangle, contour interval 20 ft (6.1 m), datum mean sea level; map center is at UTM 11 275256E 3805431N

Fig. 3 Oblique false-color infrared photo of La Conchita taken in 2002. The arcuate bench near the top of the bluff in the center of the photo is the main scarp of an ancient landslide that involved the entire bluff. The 1995 landslide is visible in the right center of the photo. Other landslides of various ages and sizes are visible on the slopes. Photo courtesy of Robert A. Larsen, GeoArchives Photography

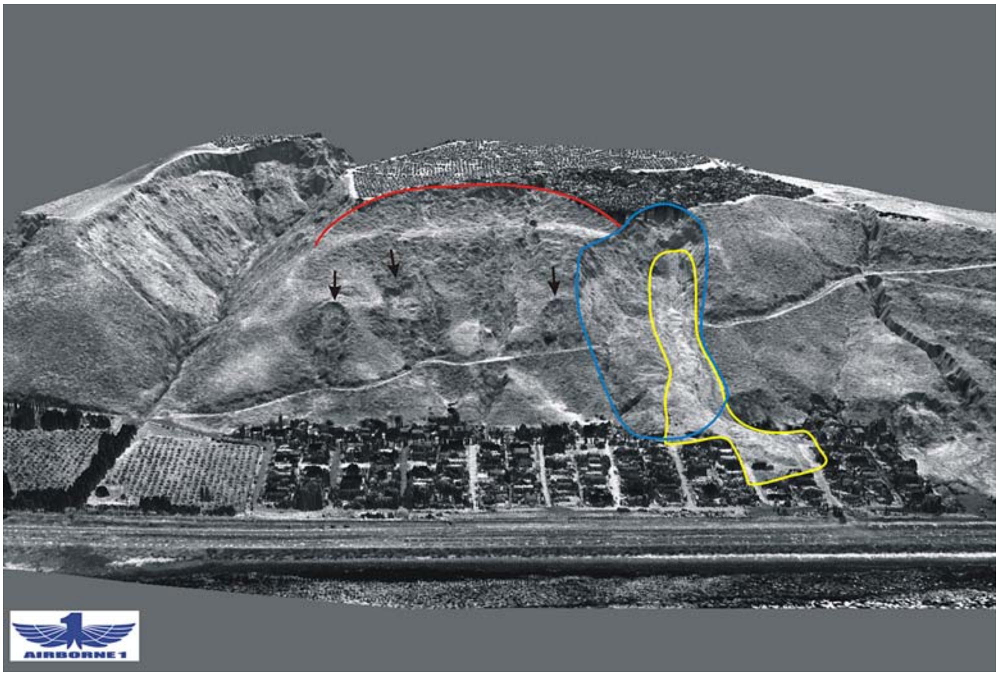

Fig. 4 Oblique LIDAR image of La Conchita after the 2005 landslide. Outline of 1995 (*blue*) and 2005 (*yellow*) landslides shown; arrows show examples of other landslides in the area; red line outlines main scarp of an ancient landslide that involved the entire bluff. The deep canyon on the left produced major debris flows in both 1995 and 2005. Image courtesy of Airborne 1 Corporation, El Segundo, CA

inundated roads, railroads, cultivated land, and, in 1995, the La Conchita community (O'Tousa 1995). Figures 3 and 4 show false-color infrared and LIDAR images, respectively, of the bluff above La Conchita and the surrounding area, and several sizes, types, and ages of landslides are visible. The ravines that incise the bluff have produced debris flows both recently and in the past. The arcuate bench at the top of the bluff is the head of a very large pre-historic landslide that affected the entire bluff. Several smaller, more recent slumps and earth flows are also visible, as is the 1995 slump-earth flow described below.

Fig. 5 View of the La Conchita landslide taken 14 January 2005. The light-colored, exposed rock in the upper part of the photo is the main scarp of the 1995 slide. The southeast part of the 1995 deposit (*right side of photo*) remobilized in 2005. At the bottom center of photo, a wall built after the 1995 slide is visible; the 2005 slide overtopped and tilted forward parts of the wall

Fig. 6 View from the main scarp down the length of the 2005 La Conchita landslide. Water visible in the center of the photo was issuing from the base of the main scarp when the photo was taken (14 January 2005). The 2005 landslide remobilized about 15% of the 1995 deposit and followed the left margin (*looking downslope*) of the 1995 slide. The vegetated ridge in the left part of the photo is intact material that did not fail in 1995 or 2005; the material in the right part of the photo is 1995 deposit that is still in place

The 1995 La Conchita landslide, a complex slump-earth flow, destroyed or severely damaged nine houses. The 1995 slide was 120-m wide, 330 m long, and covered approximately 4 ha. The depth was estimated at greater than 30 m, and the volume was estimated at 1.3 million m^3 (O'Tousa 1995; Robert Anderson, RJR Engineering, 2005, personal communication). The landslide occurred in March, near the end of a rainy season in which seasonal rainfall was about twice the normal amount (Jibson 2005).

2005 La Conchita landslide

The 2005 La Conchita landslide occurred at about 12:30 PM on 10 January. Little or no newly failed material was involved in the landslide; rather, it consisted of a remobilization of the southeastern portion of the 1995 landslide deposit, involving about 200,000 m^3 (James O'Tousa, RJR Engineering, personal communication, 2005). The landslide area was approximately 350-m long and 80–100-m wide. The landslide entered the La Conchita neighborhood, destroying

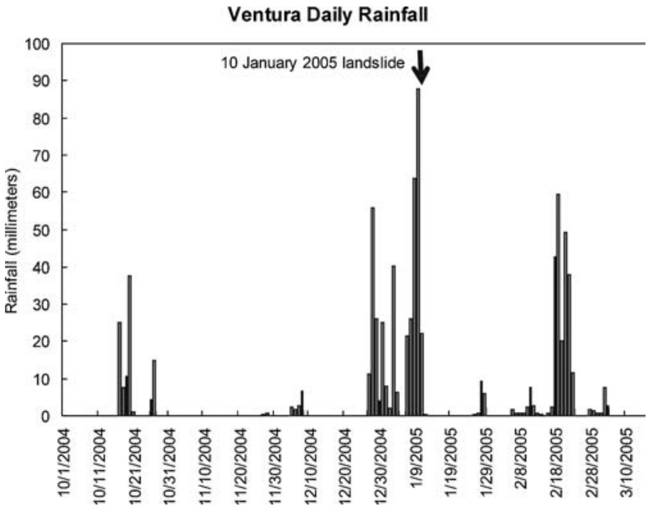

Fig. 7 Daily rainfall at Ventura (20 km southeast of La Conchita) from 1 October 2004 through 15 March 2005 (data from Wofford 2005). The 2005 landslide occurred at the culmination of the heaviest rainfall of the season

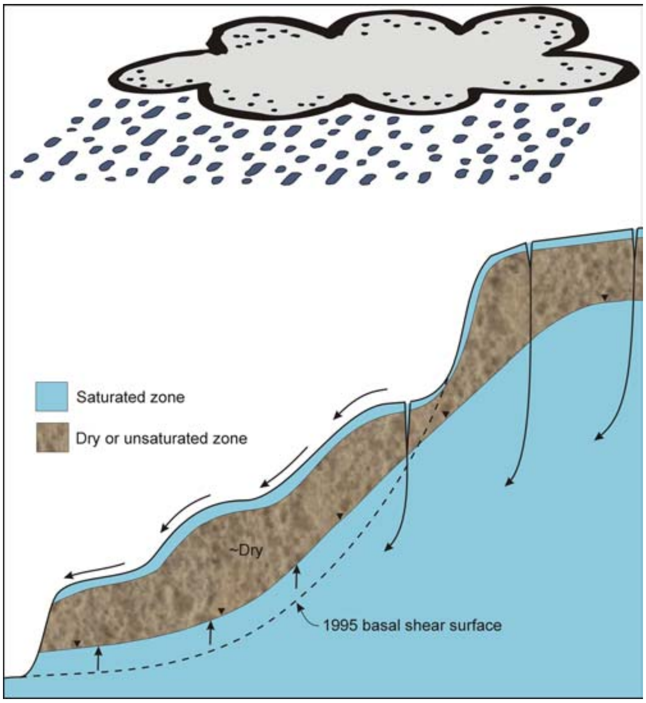

Fig. 8 Conceptual diagram showing surface- and ground-water flow paths (*black arrows*) at La Conchita. Most of the landslide material was dry, which suggests that most of the rainfall drained off the surface of the 1995 landslide deposit and only saturated a thin surface layer. Recharge from areas farther upslope likely caused the basal ground-water levels to rise and trigger the 2005 landslide

13 houses and severely damaging 23 others (Figs. 5 and 6). There were 10 confirmed fatalities.

Earlier that morning, debris flows from canyons northwest of La Conchita reached Highway 101. Law enforcement officers and media representatives were in the area, which facilitated capturing a video (KCAL-TV in Los Angeles) of the moving landslide. The video indicates that the landslide material mobilized simultaneously and nearly instantaneously into a highly fluid, rapidly moving debris flow. I estimate from viewing the video that high on the slope the landslide was moving perhaps 10 m/s. The developed part of the slope where the houses were impacted has a flatter slope, and so the flow probably slowed to no more than 5 m/s in the neighborhood. This slower rate is also suggested by eyewitnesses who stated that some residents were able to outrun the advancing flow, which would not have been possible at the higher upslope velocity.

The 2005 landslide occurred at the end of a 15-day period that produced record and near-record amounts of rainfall in many areas of southern California. At Ventura (20 km southeast of La Conchita) seasonal antecedent rainfall from 1 October 2004 through 10 January 2005 totaled 493 mm as compared to the mean value of 122 mm. From 27 December 2004 through 10 January 2005, Ventura received 378 mm of rainfall, only slightly less than its mean annual total of 390 mm (Wofford 2005; National Oceanic and Atmospheric Administration 1994, 1995). Although rainfall intensities were not extreme, moderate-to high-intensity rainfall persisted for more than 2 weeks, and the landslide occurred at the culmination of this 15-day high-rainfall period (Fig. 7).

Inspection of the site within a few hours of the landslide indicated that much of the deposit consisted of fairly dry material (James O'Tousa, RJR Engineering, personal communication, 2005). Also, the video shows dust in the air as the landslide flowed downslope. Thus, it appears that the landslide mobilized on a saturated layer deep in the 1995 deposit but that much of the material above this saturated zone was dry or nearly so. The video shows relatively intact vegetation being rafted on the surface of the rapidly flowing mass, which indicates that much of the landslide mass was simply being carried on the fluidized layer at depth, which presumably was much more saturated.

Such a failure scenario, involving a significant amount of dry material that fully mobilized on a saturated layer, indicates that most of the rain that fell on the surface of the 1995 deposit did not infiltrate but drained off the surface. The rising ground-water level within the 1995 deposit would thus have resulted from deeper recharge from rainfall infiltration upslope (Fig. 8). Vegetation patterns visible prior to the 2005 landslide show that drainage on and within the 1995 landslide deposit concentrated water in the part of the mass that failed in 2005. At the time of our visit (14 January 2005) water still came out from the base of the main landslide scarp and ponded at several locations on the 2005 deposit.

The 2005 landslide pushed many of the houses off their foundations and into each other at the toe of the landslide (Fig. 9). A wall built after the 1995 landslide to keep minor-landslide debris off the road was tilted forward and overtopped in places by debris from the 2005 landslide (Fig. 10). This indicates that the landslide material, although it flowed rapidly, was quite viscous and pushed structures in front of it rather than either flowing around them or filling them with mud, as sometimes occurs with fully saturated debris and mud flows. This apparently resulted from a highly hazardous situation involving a two-phased landslide mechanism: (1) a saturated, highly fluid layer at depth on which the landslide mobilized that (2) carried a thick layer of drier, much more viscous material that effectively acted as a battering ram.

Comparison of 1995 and 2005 landslides

The movement of the same landslide mass in 1995 and 2005 by two very different mechanisms and with markedly different results is difficult to explain. The 1995 landslide was a deep, coherent

Fig. 9 The 2005 landslide moved as a rapid debris flow, but it was quite viscous and pushed houses in its path rather than flowing around or through them. Debris on the roof of the house is from an adjacent house that was pushed downslope by the landslide

Fig. 10 Steel-and-timber wall built after the 1995 landslide was overtopped and tilted forward in places by the 2005 landslide

slump-earth flow that deformed plastically and moved slowly enough that people could get out of its way. The 2005 landslide was a shallower remobilization of the very same material into a rapid, highly fluid debris flow that buried 10 people. Although it is not uncommon for subsidiary debris flows to occur from the toes or scarps of existing landslides (Morton and Campbell 1989), that is not what happened in 2005: this was a wholesale remobilization of a significant portion of the 1995 deposit. How and why the same material failed twice in 10 years by fundamentally different mechanisms certainly will be the object of future research, and it is much too complex to analyze in detail at this time. A few things can be said, however.

The timing of the two landslides with respect to the triggering storms is of primary interest. In 1995, after a very wet January, the landslide did not move until more than a month later, during which very little rain fell. The deep mode of failure in 1995 is consistent with this delay: deeper landslides commonly are triggered by deep infiltration of rainfall, which can take weeks or months to occur (for example see, Morton and Campbell 1989). The 2005 landslide occurred at the culmination of an extremely wet 2-week period (Fig. 7). This also is consistent with the shallower, fluid mode of failure: shallow, rapid debris flows most commonly occur during periods of prolonged, intense rainfall with little or no lag time (Campbell 1975; Keefer et al. 1987; Jibson 1989).

However, this still leaves some troubling questions unanswered. Why did the landslide material not mobilize into a rapid debris flow in 1995? What about the remaining 1995 deposit? Since only about 15% of the 1995 deposit remobilized in 2005, could the remainder also mobilize into a rapid debris flow, or is it more likely to remobilize as a deep slump-earth flow? Or will it remain metastable? Currently we have insufficient data and understanding of the failure mechanisms of this landslide to adequately answer these questions, but it is clear that the hazard from renewed landslide movement is considerable.

Continuing hazards at La Conchita

Of primary interest to the general public and various governmental entities is the current state of hazard at La Conchita. While this preliminary report does not represent a detailed evaluation of those hazards, a few reasonable observations can be made.

1. Historical accounts and geologic evidence show that landsliding of a variety of types and scales has been occurring at and near La Conchita for many thousands of years and, on a relatively frequent basis, up until the present. There is no reason to believe this pattern of landsliding will stop.
2. When significant rainfall occurs in the future, several landslide scenarios are possible: (a) The remainder of the 1995 landslide could remobilize as a deep slump-earth flow similar to that in 1995. This mode of movement would most likely be relatively slow (compared to 2005) but still could pose serious hazards to property and, perhaps, life. (b) The 1995 (and possibly the 2005) deposit could mobilize into a rapid debris flow such as occurred on 10 January 2005. (c) Subsidiary landslides could be triggered from parts of the 1995 and 2005 deposits or scarps. (d) Slumps and (or) earth flows on adjacent hillsides could mobilize. (e) Intense rainfall could trigger rapid debris flows from various nearby slopes, particularly the ravines.
3. The landslide scenarios sketched above could potentially impact any part of the La Conchita community. Future landslide activity could move into the same areas that have been recently damaged or could mobilize in other directions that could damage any or all of the developed area.

Conclusion

The La Conchita area has experienced, and will likely continue to experience, a rather bewildering variety of landslide hazards. Different landslide scenarios are more or less likely to occur as a result of different specific rainfall conditions, and no part of the community can be considered safe from landslides. Unfortunately, we currently lack the understanding to accurately forecast what might happen in each possible rainfall scenario. Prudence would certainly dictate, however, that we anticipate renewed landslide activity during or after future periods of prolonged and (or) intense rainfall. Future earthquakes, of course, could also trigger landsliding in the area (Harp and Jibson 1995, 1996).

Acknowledgments

James O'Tousa of RJR Engineering provided access to the site and shared his considerable knowledge of the 1995 and 2005 landslides. Robert Anderson of RJR Engineering also provided many valuable observations about the two landslide events. Edwin Harp and Robert Schuster of the U.S. Geological Survey reviewed this paper

References

Campbell RH (1975) Soil slips, debris flows, and rainstorms in the Santa Monica Mountains and vicinity, southern California. US Geological Survey, Professional Paper 851

Harp EL, Jibson RW (1995) Inventory of landslides triggered by the 1994 Northridge, California earthquake. US Geological Survey, Open-File Report 95-213

Harp EL, Jibson RW (1996) Landslides triggered by the 1994 Northridge, California, earthquake. Seismol Soc Am Bull 86(1B):S319–S332

Hemphill JJ (2001) Assessing landslide hazard over a 130-year period for La Conchita, California. In: Proceedings of the Association of Pacific Coast Geographers Annual Meeting. Santa Barbara, CA, 12–15 September 2001

Jibson RW (1989) Debris flows in southern Puerto Rico. In: Schultz AP, Jibson RW (eds) Landslide Processes in Eastern North America and Puerto Rico. Geological Society of America Special Paper 236, pp. 29–55

Jibson RW (2005) Landslide Hazards at La Conchita, California. US Geological Survey. Open-File Report 2005-1067

Keefer DK, Wilson RC, Mark RK, Brabb EE, Brown WM, Ellen SD, Harp EL, Wieczorek GF, Alger CS, Zatkin RS (1987) Real-time landslide warning during heavy rainfall. Science 238:921–925

Morton DM (1971) Seismically triggered landslides above San Fernando Valley. Calif Geol 24:4–5

Morton DM, Campbell RH (1989) Cyclic landsliding at Wrightwood, southern California. In: Sadler PM, Morton DM (eds) Landslides in a semi-arid environment with emphasis on the Inland Valleys of Southern California, Vol 2. Inland Geological Society, Riverside, CA, pp 174–182

National Oceanic and Atmospheric Administration (1994) Climatological data annual summary—California 1994, Vol 98(13). National Climatic Data Center, Asheville, NC

National Oceanic and Atmospheric Administration (1995) Climatological data annual summary—California 1995, National Climatic Data Center, Vol 99(13). Asheville, NC

O'Tousa J (1995) La Conchita landslide, Ventura County, California. Assoc Eng Geol AEG News 38(4):22–24

Parise M, Jibson RW (2000) A seismic landslide susceptibility rating of geologic units based on analysis of characteristics of landslides triggered by the 17 January, 1994 Northridge, California earthquake. Eng Geol 58:251–270

Wofford M (2005) Ventura, California weather conditions. http://www.venturaweather.com/daily.htm, last visited 15 March 2005

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