Figure 5. Change in landslide topography 2005-06 (right)
This map shows the change in elevation of the landslide surface between May 2005 and July 2006. To create the map, we subtracted a digital elevation model (DEM) derived from 2006 surface elevations from a DEM derived from the 2005 surface elevations of the landslide (Wells and others, 2005). Blue areas (positive values, in feet) have subsided; red areas (negative values) are uplifted.

The headscarp graben in the upper part of the slide has subsided in excess of 20 feet (6 m), and the toe has grown by a similar amount. The subsiding graben has a well-defined rhombic shape, possibly controlled by sub parallel fractures (?) in the parent bedrock material. Other block boundaries, transverse folds, and areas of subsidence all appear to be controlled by NW-trending features, which are parallel to bedding and dominant faults in the bedrock (see Wells and others 2005 for further discussion and references).

In stable areas outside of the landslide, repeat surveys of selected monuments indicate no significant change in topography, and our difference map shows the result of subtracting the 2005 topography from itself. The resulting elevation differences (± 2 feet) reflect slight differences in the DEMs due to changes in the total data set and indicate the limit of resolution of the method. Differences around the edge of the map and in areas lacking survey points (gray dots) are not significant.

Estimate of depth to the top of the active slide plane
Measured changes in elevation and displacement over the past year can be used to estimate the depth to the slide plane, or slip surface of the active landslide (Bishop, 1999). In cross section, the area change of the landslide due to subsidence in the headscarp region (zone of depletion) should equal the area change caused by the landslide displacement in the translational zone down slope. Dividing the area by the translational displacement will give the depth to the slide slip surface, assuming that slide material is moving parallel to the cross section and that the cross sectional area of the landslide normal to the motion is not changing very much down slope. These conditions apply in the upper half of the landslide. Calculations based on area changes in a slip-parallel cross section; where displacement of 18-20 m (59-66 ft) occurred in the past year, and the depletion area is 161 m2 (Figure 5), indicate an average depth to the active slip surface of about 8 to 9 m, or 26-30 feet beneath the translational zone (before the slide narrows).

The calculated depth can be compared with measured offsets of 2005 dewatering wells that were sheared off by slide motion. Wells 10, 11, and 12 in the middle of the slide were sheared off at 24, 30, and 36 feet below the well head, whereas well 6 in the toe region was sheared off at 19 feet and well 9 near the headscarp at 21 feet below the well head (~ 7, 9, 10, 5.5, and 6 m respectively; San Mateo Co. written communication, 2006). The depth of the well-bore offset commonly coincided with a boundary between gray-brown to tan, damp to wet, sandy sticky mud with weathered sandstone and basalt fragments (probable slide debris) and underlying well-bedded, but fractured, firm, gray-green sandstone and mudstone of the Purisima Formation noted during drilling of wells 1, 6, 9, 10, and 11 in 2005. The calculated value compares favorably with observations of the base of disturbed material at 6 to 8.5 m (20-28 ft) in the three dewatering wells drilled in 1998 (wells 2, 4, and 5; J. Demouthe, in Jayko and others, 1998). The downhill motion of the sheared-off well bores in 2005-06 is probably parallel to the local slope of the slip surface at depth (Figure 5). The depth of the inferred slip calculated from the balanced cross section lies near the base of units mapped as slide debris from geotechnical well logs and is similar to that inferred from subsurface investigations by Hundemer and Upp (2006).

Although our observations and calculations of the depth to the top of the active slide plane are consistent, we note that the Scenic Drive landslide is part of an older, larger landslide complex, and that deeper, older slide planes may underlie the Scenic Drive landslide and adjacent areas (Upp, 1998; Hundemer and Upp, 2006). Our analysis does not preclude present or future movement on deeper slip surfaces, although large, deep motion in the past year is not consistent with the mass balance data.

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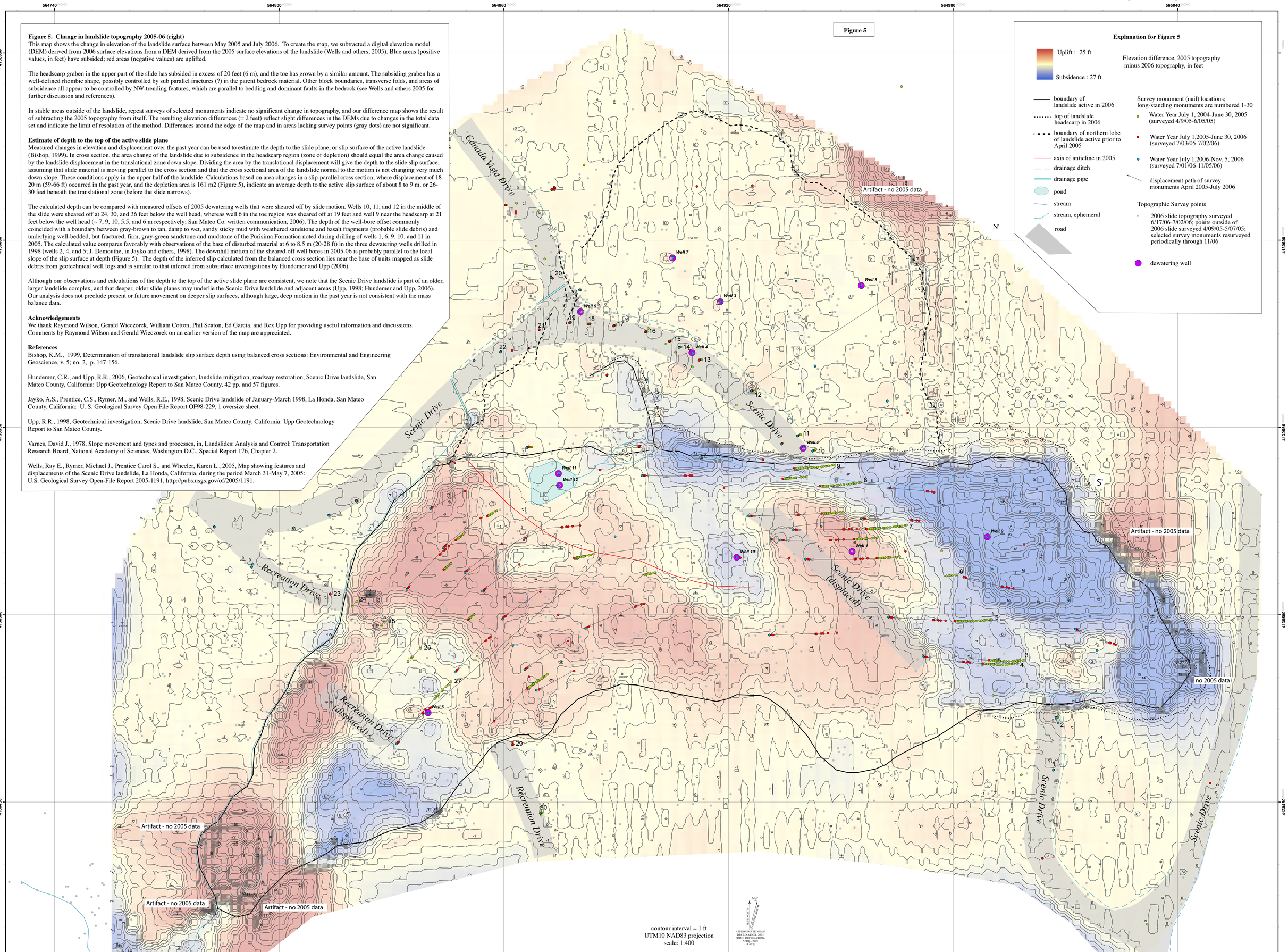
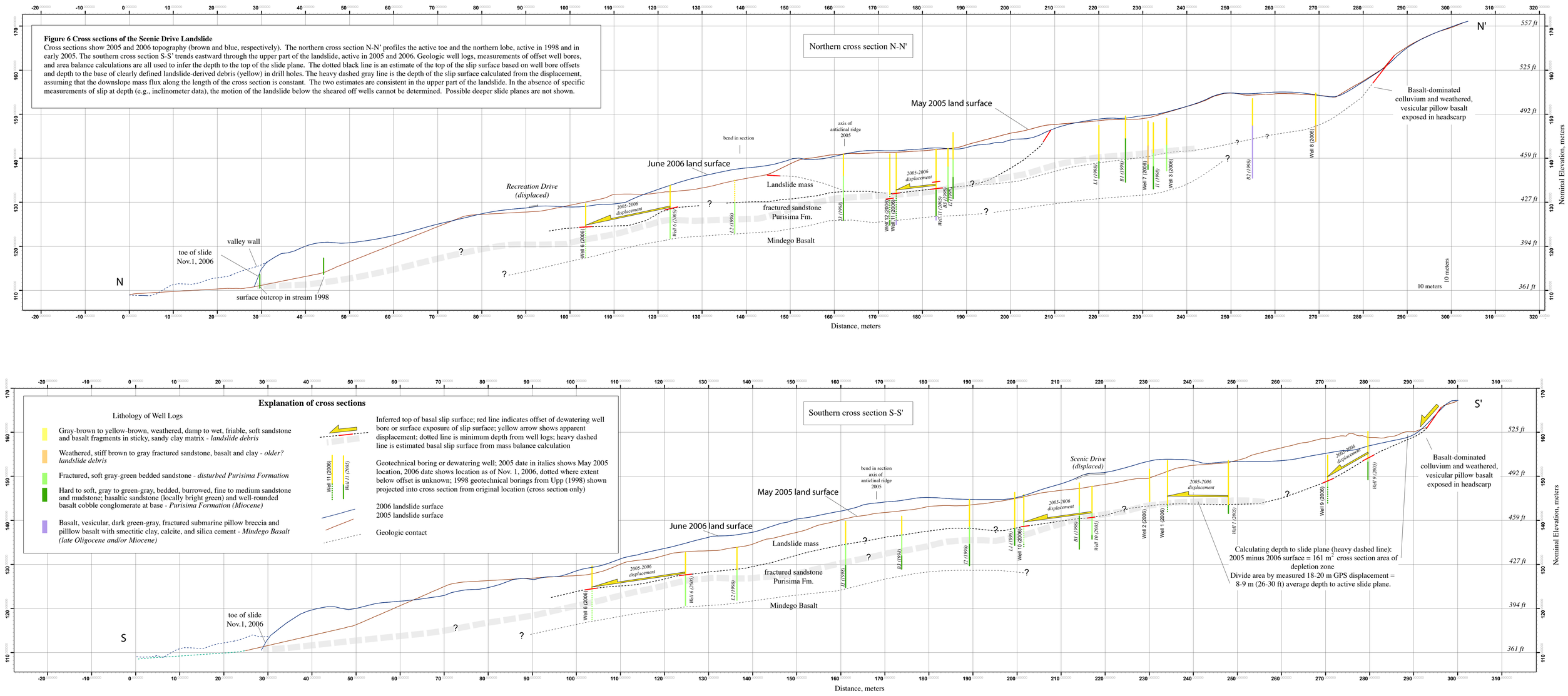


Figure 6 Cross sections of the Scenic Drive Landslide
Cross sections show 2005 and 2006 topography (brown and blue, respectively). The northern cross section N-N' profiles the active toe and the northern lobe, active in 1998 and in early 2005. The southern cross section S-S' trends eastward through the upper part of the landslide, active in 2005 and 2006. Geologic well logs, measurements of offset well bores, and area balance calculations are all used to infer the depth to the top of the slide plane. The dotted black line is an estimate of the top of the slip surface based on well bore offsets and depth to the base of clearly defined landslide-derived debris (yellow) in drill holes. The heavy dashed gray line is the depth of the slip surface calculated from the displacement, assuming that the downslope mass flux along the length of the cross section is constant. The two estimates are consistent in the upper part of the landslide. In the absence of specific measurements of slip at depth (e.g., inclinometer data), the motion of the landslide below the sheared off wells cannot be determined. Possible deeper slide planes are not shown.



Map showing Features and Displacements of the Scenic Drive Landslide, La Honda, California, During the Period March 31, 2005-November 5, 2006

by

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