FINAL TECHNICAL REPORT

Paleoseismic Feasibility Study of the Green Valley Fault,

San Francisco Bay Area, California

by

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ABSTRACT

Understanding the timing of large paleoearthquakes and the"Iong-term"aseismic creep rate of the Green Valley fault is critical for assessing seismic hazards and calculating probabilities of large earthquakes in the populated San Francisco Bay area. The Concord-Green Valley fault (CGVF) system is part of the eastern San Andreas fault system, and traverses the densely populated 1-680 and 1-80 corridor. The CGVF is composed of at least two major fault segments from south to north: Concord fault (16-to 24-km long) and Green Valley fault (GVF) (29-to 43-km-long). Recent paleoseismic studies on the CGVF provide new insight into the seismic behavior of the fault system. The Concord fault appears to have a geologic slip rate (3.4±0.3 mm/yr) similar to the average "long-term" (I 8-year record) creep rate for the fault. The presence of ductile creep deformation along the central part of the Concord fault has led some researchers to suggest that the Concord fault may not produce significant large magnitude (Mw>6) earthquakes. Based on the occurrence of a M5.4 earthquake in 1955 on the central part of the Concord fault, it appears that the Concord fault is seismogenic and is at least partly locked at depth. We do not know if moderate magnitude earthquakes are typical of this part of the CGVF, and/or large magnitude earthquakes are typical of the northern part of the CGVF system. Paleoseismic studies at Lopes Ranch on the southern GVF suggest that multiple surface-rupturing events have occurred within the last 2,700 years. In addition, preliminary results at Lopes Ranch suggest a minimum slip rate of 3.8 to 4.8 mm./yr (over the last 300 years), similar to the 14-year average creep rate of 4.9 mm/yr for the GVF. Neither the Concord nor the GVF have produced a large magnitude earthquake since 1776, when the written record began in the Bay Area.

We conducted field and air-photo reconnaissance of parts of the northern and southern Green Valley fault, and identified six potential sites that could provide information on the timing of past earthquakes and slip rate on the fault. Our approach was to progressively assess the viability of several potential sites, and then target sites that would yield the best-constrained data on earthquake history. Through this program of increasingly focused studies, we performed initial mapping and subsurface exploration. At Wildhorse Ranch Site No. 1, our favored paleoseismic research site, we were not granted access for detailed subsurface investigation. Wildhorse Ranch Site Nos. 2, 3 and 4 were further explored, but did not hold, in our judgement as much potential as Wildhorse Ranch Site No. 1. We conclude that several large depressions are present at the Wildhorse Ranch sites, however the fault location is not well constrained, thus potentially requiring extensive trenching prior to detailed studies for event chronology data. Along the southern Green Valley fault we identified two potential paleoseismic sites that may yield good information on earthquake timing and slip rate: Red Top Road and Lopes Ranch Creek site. The current owner of the Red Top Road site will not grant access for subsurface trenching. The Lopes Ranch Creek site provides a well constrained location of

the main fault trace, and rightlaterally separates an unnamed partly buried paleochannel about 30 rn across the fault. We conclude that this site shows significant potential for successfully yielding paleoseismic and slip rate data. This site also is favorable because the landowner has **granted permission in the past to** conduct a detailed paleoseismic investigation.