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To: MR. TOM OSTROM, CHIEF
OFFICE OF EARTHQUAKE ENGINEERING

Date: April 3, 2013

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Cleghorn Creek Bridge
Bridge No. 54-0773L/R

From: DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES
Materials Engineering and Testing Services and Geotechnical Services
Office of Geotechnical Support – Geotechnical Instrumentation

Subject: Evaluation of Fault Rupture Potential, Cleghorn Creek Bridge, San Bernardino County

SUMMARY

Cleghorn Creek Bridge, No. 53-1776L/R, is crossed by a 1-1/2 mile long Quaternary-age fault (i.e., active in the past 2.6 million years). Although this fault may have been related to the San Andreas Fault at one time, it has probably not been active in the past 15,000 years, the criterion for an active fault for purposes of surface rupture at Caltrans. In addition the fault is short and not on trend with another fault, and therefore it is unlikely to be a significant independent seismic source.

The main trace of the San Andreas Fault is located approximately 4,000 feet south of the bridge and is the source of seismic hazard in this area. **Surface rupture does not need to be further addressed at this bridge.**

INTRODUCTION

This evaluation was prepared as part of the statewide evaluation of fault rupture potential at Caltrans bridges. Caltrans' policies regarding fault rupture at bridges are described in Memo to Designers (MTD) 20-10. Caltrans requires a fault rupture evaluation if a bridge is located within an Alquist Priolo Earthquake Fault Zone (EFZ) or within 1,000 feet of an un-zoned fault 15,000 years or younger in age. Cleghorn Creek Bridge is situated within the EFZ established in 1974 for the San Andreas Fault in the Cajon 7-1/2' Quadrangle; therefore a fault evaluation was required.

An initial estimate of potential offset was based on an analysis developed by the Division of Research and Innovation in collaboration with Geotechnical Services, using methods presented in Abrahamson (2008), Moss and Ross (2011), and Petersen,et al (2011). Both a deterministic fault displacement analysis (DFDHA) and a probabilistic fault displacement analysis (PFDHA) were

performed using magnitude, slip rate (for PFDHA), mapping and base map errors, and likelihood of secondary fault traces. If the main trace of the San Andreas Fault crosses beneath the bridge, the expected displacement at the bridge would be about 20 feet deterministically and 16 probabilistically. Mark Yashinsky and Fadel Alameddine reviewed the bridge plans and determined the bridge could not withstand the displacements without modification. Therefore additional work, documented herein, was performed to better define the faulting hazard.

Cleghorn Creek Bridge was built in 1969 and improved in 1996. The bridge consists of left and right three span bridges each 255 feet long and 68 feet wide, all supported on spread footings.

FAULT RUPTURE EVALUATION

The evaluation consisted of a review of existing data and field reconnaissance

REVIEW OF EXISTING DATA

The fault is shown as Quaternary (active in the past 2.6 million years) on the 2010 Fault Activity Map (CGS, 2010), and as having no evidence of recent activity on figure 2a described above and repeated in part here as Figure 1. However there have not been nearby studies to confirm the fault age. Bryant (1987) noted the following about the fault:

> Traces of the San Andreas and northern San Jacinto fault zones, and related faults were zoned for special studies in 1974 in the Cajon quadrangle (figure 2a). These two fault zones will not be evaluated in this FER. Re-evaluation of these faults should be accomplished if time and scheduling permit because zoning for special studies in 1974 was based on the criterion of Quaternary-active faulting. Some of these fault segments in the Cajon quadrangle may not meet the current criteria for zoning.

The fault is about 1-1/2 miles long and is not on trend with any other fault.

There is evidence for faulting in bedrock both in the 1996 LOTBs where slickensides were encountered in a deep boring excavated northeast of the structure for geophysical studies (Caltrans, 1996), and in a construction report from the 1960s where the following was noted:

> "Fault lines and slickensides were noted in several of the excavations. The reddish brown to green decomposed granitic gneiss was highly fractured. A change in color was noted at the vertical fault line in the right footing of the left bridge." Caltrans construction report by John Wheeler, no date)

Inactive faults that were once active have been observed elsewhere near the San Andreas Fault (e.g., northeast of the Devore Rd UC south of this bridge). The fault may trend anywhere beneath

the left and right bridges in a northwesterly direction, however it is unlikely to be an active fault and is also short and not likely a seismic source.

Field Reconnaissance

A field reconnaissance of the bridge vicinity was conducted on 1/10/2013 by Douglas Cook, CEG from the office of Geotechnical Design South - Branch 2, and Martha Merriam. We located the fault east of the bridge in bedrock. There was no evidence of faulting at either bridge.

POTENTIAL FOR FAULT RUPTURE

As noted above, a 1-1/2 mile-long fault crosses beneath the bridge. No specific age constraints have been developed for this fault, although the fault is likely too old to need to be considered for fault rupture. Potential for fault rupture is low because of both the length of the fault and its probable inactivity in the last 15,000 years.

RECOMMENDATIONS FOR ADDITIONAL INVESTIGATIONS

No additional work is recommended at this time. If you have any questions, please contact Martha Merriam at (916) 227-7135.

Prepared by: Date: April 3, 2013

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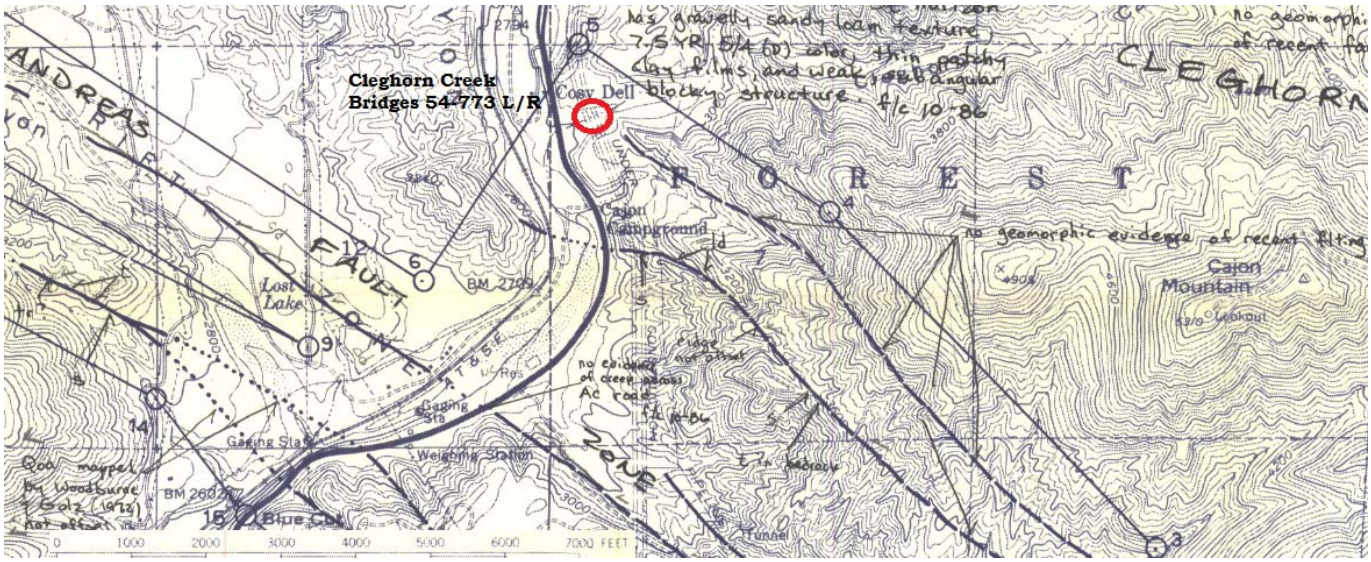

Figure 1. Part of Figure 2a of FER 187 (1987), showing 1974 fault locations. The location of Cleghorn Creek Bridge in shown in the red circle, along with the AP EFZ encompassing the nearest fault projecting to the bridge. The main trace of the San Andreas Fault Zone is located about 4,000 feet southwest of the bridge. The fault nearest the bridge is annotated, "No geomorphic evidence of recent faulting."