TETRA TECH

TRANSMITTAL

TO:	Jim Well, Ducks Unlimited
FROM:	Mike Harvey, Ph.D., P.G.
SUBJECT:	M&T/ Llano Seco Fish Screen Facility Short-Term/Long-Term Protection Project (Project No. US-CA-62-2)
	Survey Report 1 (Subtask 13.2)
Cc:	
DATE:	March 18, 2010

Introduction

The M&T/Llano Seco project reach of the Sacramento River was last surveyed bathymetrically in December 2005 by Mussetter Engineering, Inc. (MEI). The reach between the head of the gravel bar and just downstream of the M&T pumps was again surveyed by MEI in May 2006, and the bathymetry from this survey was merged into the 2005 survey to better represent the in-channel topography of the reach for inclusion into the Physical Model of the reach that was developed and executed by Colorado State University (CSU). In 2007, Ducks Unlimited (DU) conducted a pre-dredging survey of the gravel bar prior to removal in Fall 2007 of approximately 100,000 tons of material from the gravel bar from within a constructed containment berm. The 2007 dredged material and the approximately 200,000 tons of material dredged in 2001 were stockpiled (300,000 tons) on 10 acres of the M&T Ranch on the south side of Big Chico Creek between the creek and the Phelan Levee.

Survey Objectives

Resurvey of the M&T/Llano Seco reach of the Sacramento River is required to meet two objectives:

1. Provide up-to-date bathymetry of the river to permit reformulation of the physical model of the river to evaluate two pump relocation long-term alternatives, and

2. Quantify physical changes in the river in the vicinity of the gravel bar and the pump intakes to inform the requirements for future dredging which is likely to be required prior to implementation of a long-term solution.

2010 Bathymetric Survey

The bathymetric survey of the M&T/Llano Seco reach of the Sacramento River (RM 190 – RM 194) was conducted by Tetra Tech-MEI between January 11 and 15, 2010, when the flows in the Sacramento River at the Hamilton City gage ranged from 7,000 to 13,500 cfs (**Figure 1**).

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Following the survey, flows peaked on the Sacramento River at 76,000 and 73,000 cfs on January 21 and 26, 2010, respectively, which were the highest flows experienced since the 2006 bathymetric survey was completed (**Figure 2**). For reference purposes, the gravel bar is inundated at a flow of about 35,000 cfs. The bathymetric survey was conducted using a Trimble 4800 series RTK-GPS system that was linked to an Innerspace 445 survey-grade fathometer with an 8-degree sonar transducer (0.1-foot resolution) mounted on Tetra Tech-MEI's survey boat. The horizontal datum for the survey is referenced to the State Plane Coordinate System, North American Datum of 1983 (NAD83) (California, Zone 2) and the vertical datum is the North American Vertical Datum of 1988 (NAVD88). Following the survey, the data were reduced to develop a Digital Terrain Model (DTM) of the channel and a 2-foot contour map using ArcGIS software.

Comparison of 2005/2006 and 2010 Surveys

The DTMs developed from the 2005/2006 and 2010 bathymetric surveys were compared in the ArcGIS software and an isopach map of the differences was developed (**Figure 3**). Between Sta 1037+00 and about Sta 1060+00 the left bank of the river has eroded and retreated and is represented on Figure 3 as about 20 to 25 feet of degradation. For the bulk of the reach between Sta 1020+00 and Sta 1150+00 there has been little change in the bed topography (-5 to+5 ft). However, degradation of between 5 and 10 feet is shown on Figure 3 between Sta 1110+00 and Sta 1124+00 and this represents the bar dredging that was completed in Fall 2007. Lack of high flows since the 2007 dredging has resulted in little or no deposition on the gravel bar, and in fact at the time of the survey, the constructed containment berm was still in place. In contrast, between Sta 1097+00 and about Sta 1105+00 there has been between 5 and 15 feet of aggradation. This region of aggradation is downstream of the gravel bar and is in the center-left portion of the channel opposite the M&T pumps. Some aggradation has also occurred along the left (east) side of the channel in the vicinity of the relocated City of Chico wastewater outfall (about Sta 1085+00).

Significance of Topographic Changes

Dredging of the gravel bar in 2001 and 2007 was used as a short-term solution to the sedimentation problems at the M&T/Llano Seco pump inlets and fish screens. Between 1995 and 2001, the gravel bar located on the east bank of the river upstream of the pumping plant, migrated about 1,700 feet downstream. Two-dimensional (2-D) hydrodynamic and sediment-transport modeling of three spur dike alternatives emplaced on the west bank of the river (MEI, 2008) indicated that all of the alternatives would prevent further downstream migration of the gravel bar. However, erosion of approximately 330 feet of the west bank of the river between 1996 and 2006 that increased the effective width of the river has in fact permitted the bar to migrate about 1,000 feet further downstream between 2006 and 2010 as is shown on Figure 3, in spite of the fact that there have been few high flows in the river (Figure 2). Interim stabilization of the toe of the west bank in Fall 2007 has prevented further westward migration of the river, but has not prevented downstream bar migration to the point where the focus of deposition is now opposite the pump inlets.

Given the current sedimentation patterns in the river, the "dryland" bar dredging methods that have been used in the previous short-term dredging projects (2001, 2007) will not be useable for future dredging that will be required until a long-term solution can be implemented. Methods

that could possibly be used include a floating dredge or a long-boom dragline operated from the east bank.

References

Mussetter Engineering, Inc., 2008. Phase II two-dimensional modeling to evaluate the potential river training works at M&T Pumping Station, Sacramento River, RM 192.5, California. Prepared for Ducks Unlimited, Rancho Cordova, California, October.

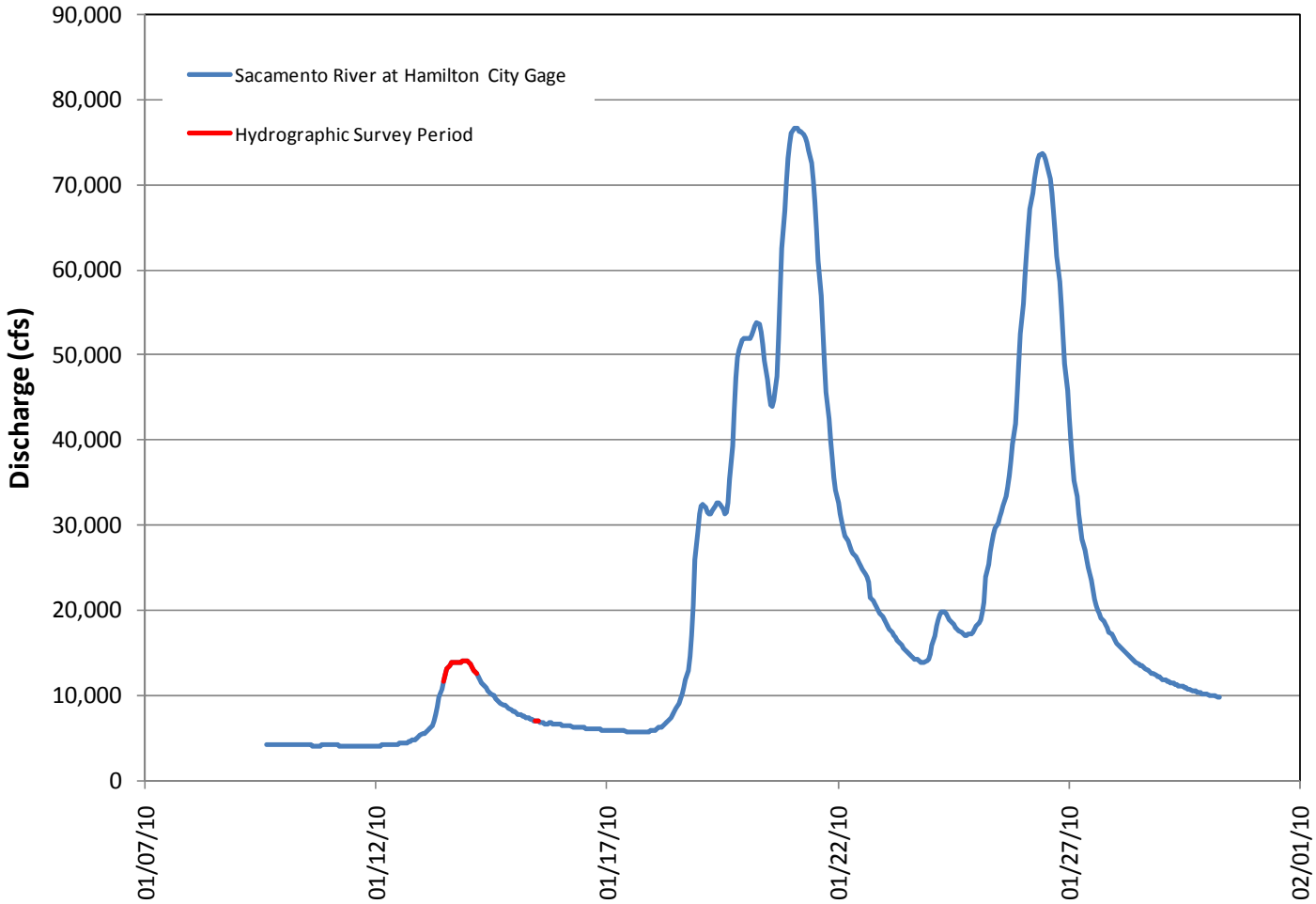

Figure 1. Hamilton City gage flows during and after the January 2010 bathymetric survey.

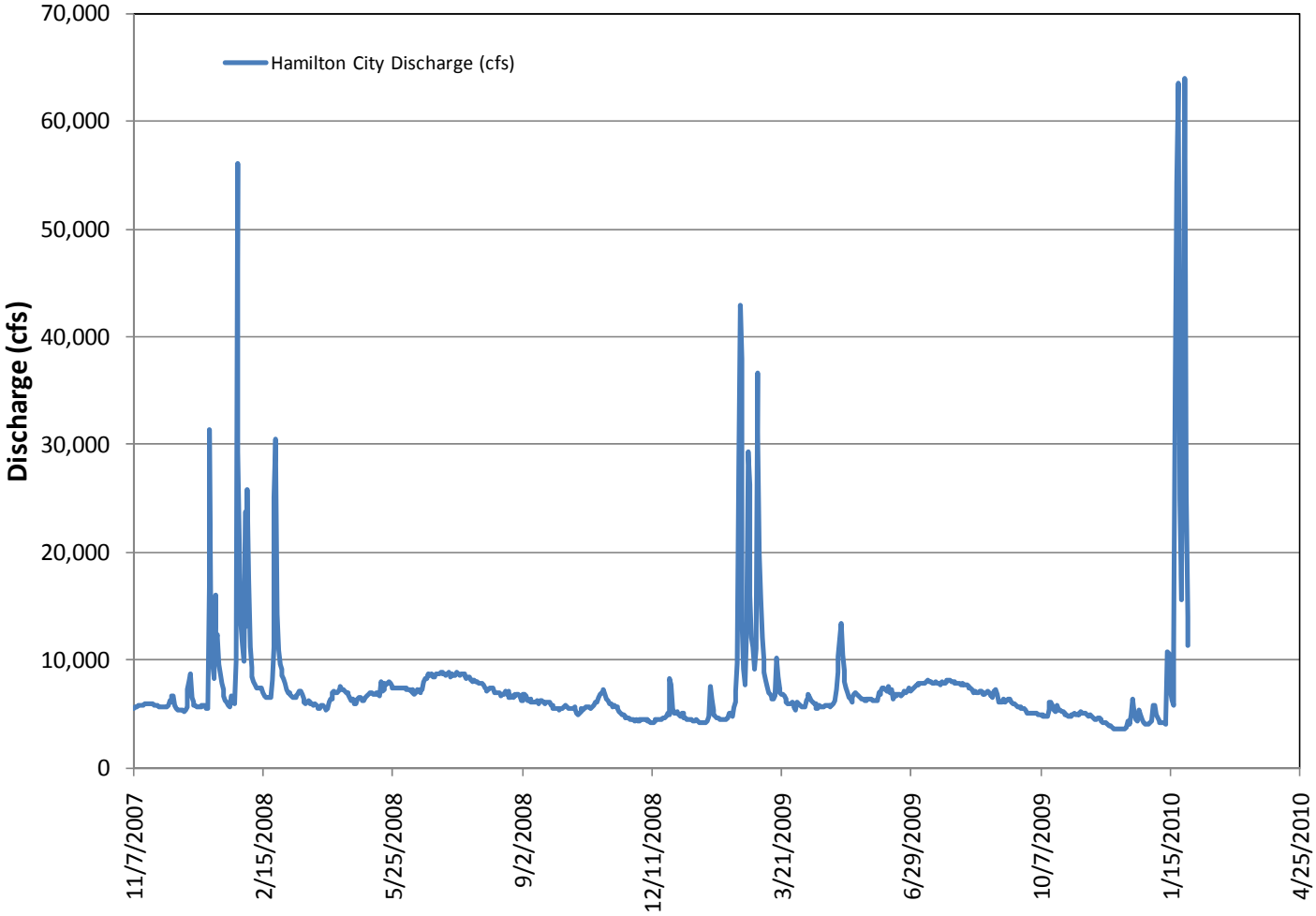

Figure 2. Hamilton City gage flows between November 2007 and January 2010.

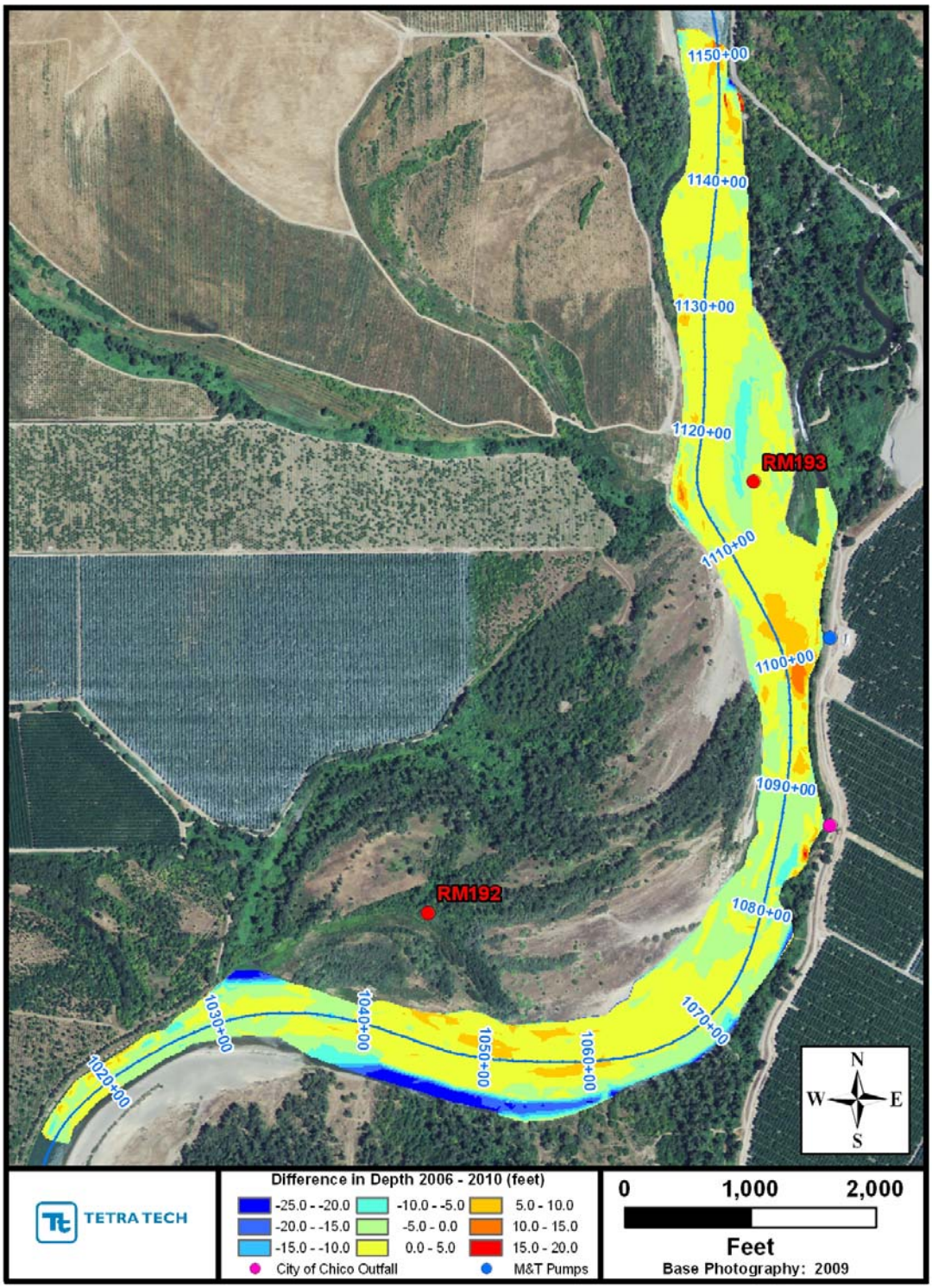

Figure 3. Isopach map of differences in channel topography between 2005/2006 and 2010 surveys.