

EXHIBIT F

Post El Nino Channel Surveys Memo
(SDSU)

Channel surveys at HMP sites

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Summary

The fieldwork performed prior to 2015 is designed to document HMP performance, but is based on intensive monitoring of discharge, sediment transport, and channel geometry at a single location. Channel response to urbanization and climate variability may be spatially heterogeneous, with large changes in only very small sub-reaches. In addition, the unprecedented El Nino event and forecasted heavy precipitation for 2015-2016 provided a potential opportunity to examine storm-induced channel change, which has not been possible to document during previous years of the HMP projects due to record-setting drought.

In this study, channel cross sections were measured at 4-9 different locations at each of 7 HMP sites in fall 2016 and at 5 HMP sites spring 2016 to:

- 1) document spatial variability in cross section geometry and longitudinal profile in order to put the long-term monitored cross sections in the context of the longer reach;
- 2) provide a baseline for monitoring channel changes due to development and HMP programs;
- 3) quantify changes in cross sections during the projected record El Nino year, including documentation of the spatial variability of the response.

The cross sections showed significant spatial variability over each reach, both in form and change. In urban reaches (e.g. Saratoga), the channel widened and deepened with distance upstream of hardpoints, which stabilize the channel.

Resurveyed cross sections in stable channels showed very small errors (< 5 cm) compared with the initial survey, suggesting that the techniques used here will document future channel change with high precision. Most cross sections showed little or no change between 2015 and 2016, due in part to unusually low rainfall for the El Nino year. Changes were observed in 1 or 2 cross sections for several sites: erosion of up to 1 m of channel bank was observed at a single cross section in the urbanized site (Saratoga), development site (Otay), and reference site (Sycamore). Shifts in upstream-cross sections of up to 3 m were observed at two development sites (Ramona, Deer Valley), though all other cross sections were stable. The lateral shifts of a cross section without corroborating visual evidence of channel change (Deer Valley, Ramona), may have been due to GPS error but should be revisited following subsequent events to confirm.

The cross sections and resurveys 1) provide a valuable baseline for monitoring change in channel condition during development, which will assess the effectiveness of HMP activities on channel stabilization and 2) suggest that the channels are continuing to change, but with significant spatial heterogeneity, suggesting that reach-scale assessment of change will be necessary to capture HMP effectiveness.

Methods

Channel cross sections were measured at 7 HMP sites in fall 2015 using either differential GPS (DGPS) (N=6) or Total station surveys (N=1), with 4-9 cross sections at each site (Table 1). Data points were recorded at changes in topography and at every 20-60cm along the bed and banks. Longitudinal profiles were also generated by surveying up and downstream of each cross section. Several sites (N=5) were resurveyed in spring 2016 following rainfall events. The data collected using the DGPS was post-processed to increase the accuracy. Base station data was downloaded from AZGPS and used to differentially correct the data in the Pathfinder software. The data was only accepted if the accuracy, following post-processing, was found to have 0-5cm accuracy. The DGPS achieved 0-5cm accuracy for 100% of points.

Table 1. Inventory of cross section and longitudinal surveys, including date of pre- and post-wet season surveys, and total precipitation between the two surveys.						
Site Name (ID)	Survey Method	Survey - 1		Survey - 2		Precip (in)
		Date	N XS	Date	N XS	
Deer Valley (RM-1)	DGPS	11/2/15	7	1/8/16	6	5.93
Sycamore (RM-2)	DGPS	10/24/15	8	3/31/16	5	9.89
Otay (DH-1)	DGPS	11/14/15	5	2/13/16	5	8.31
MDS (DH-3)	DGPS	12/9/15	6	Pending	-	-
Ramona (RH-1)	DGPS	11/11/15	8	1/18/16	6	9.26
School House (RH-2)	DGPS	12/9/15	5	Pending	-	-
Saratoga (UH-1)	Total St	10/7/15	9	3/31/16	4	6.06

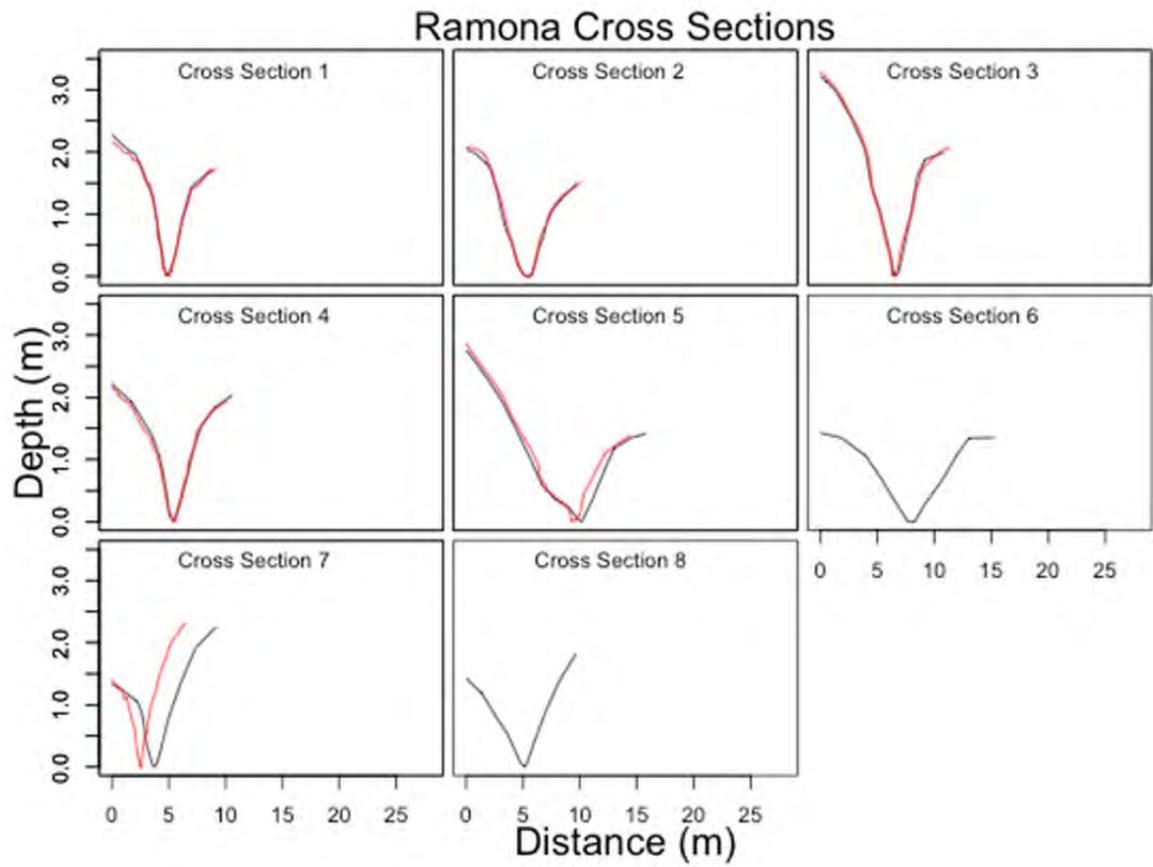


Figure 1: Ramona cross sections. Cross section 1 is the downstream-most cross section, and increasing section numbers correspond to increasing distance upstream from Cross Section 1. Red line represents resurvey (2016) and black is original survey (2015).

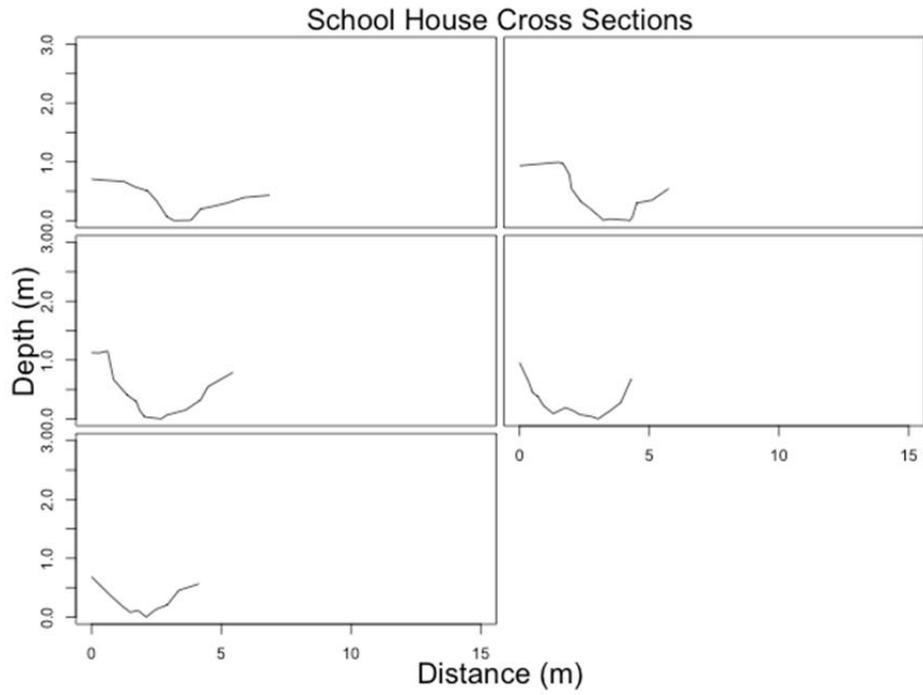


Figure 2: School House cross sections. Cross section 1 (upper left corner) is the downstream-most cross section, and increasing section numbers correspond to increasing distance upstream from Cross Section 1.

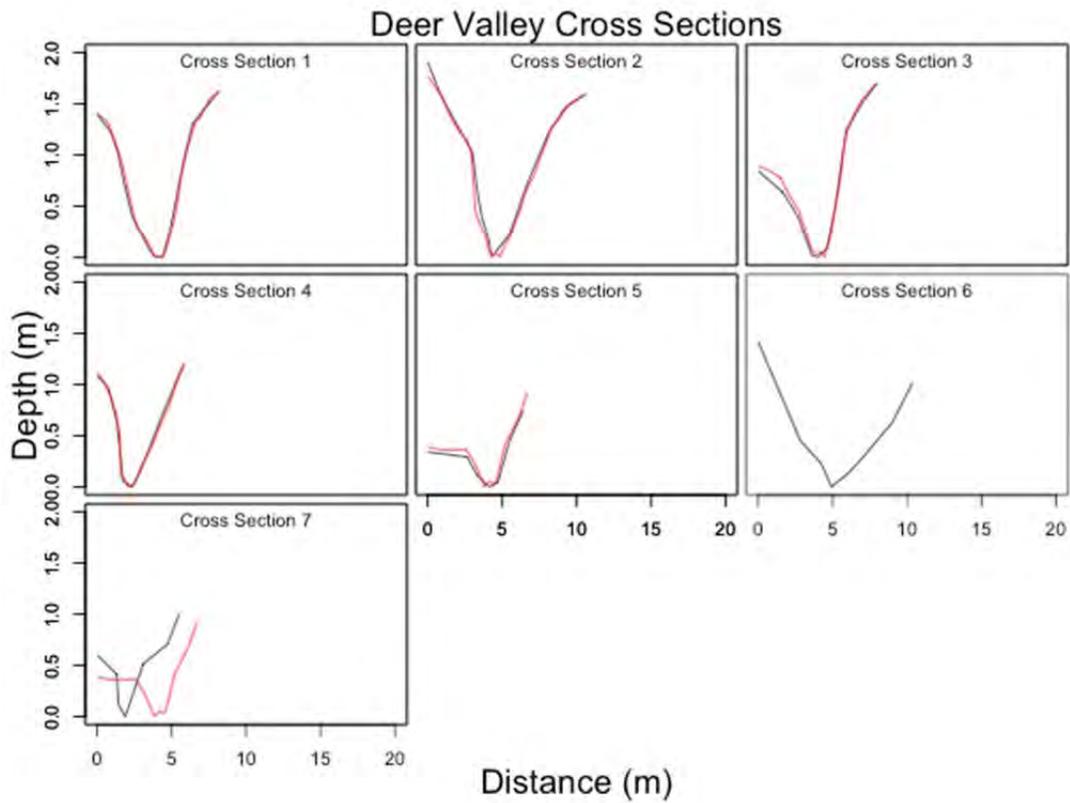


Figure 3: Deer Valley cross sections. Cross section 1 is the downstream-most cross section, and increasing section numbers correspond to increasing distance upstream from Cross Section 1. Red line represents resurvey (2016) and black is original survey (2015).

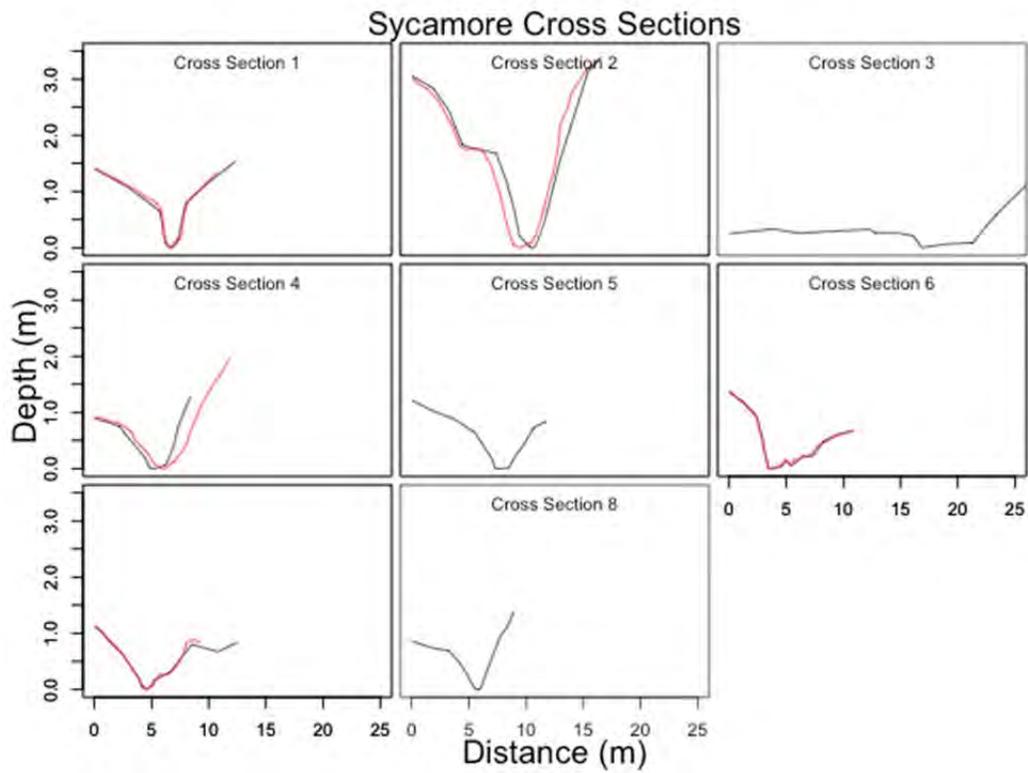


Figure 4: Sycamore cross sections. Cross section 1 is the downstream-most cross section, and increasing section numbers correspond to increasing distance upstream from Cross Section 1. Red line represents resurvey (2016) and black is original survey (2015).

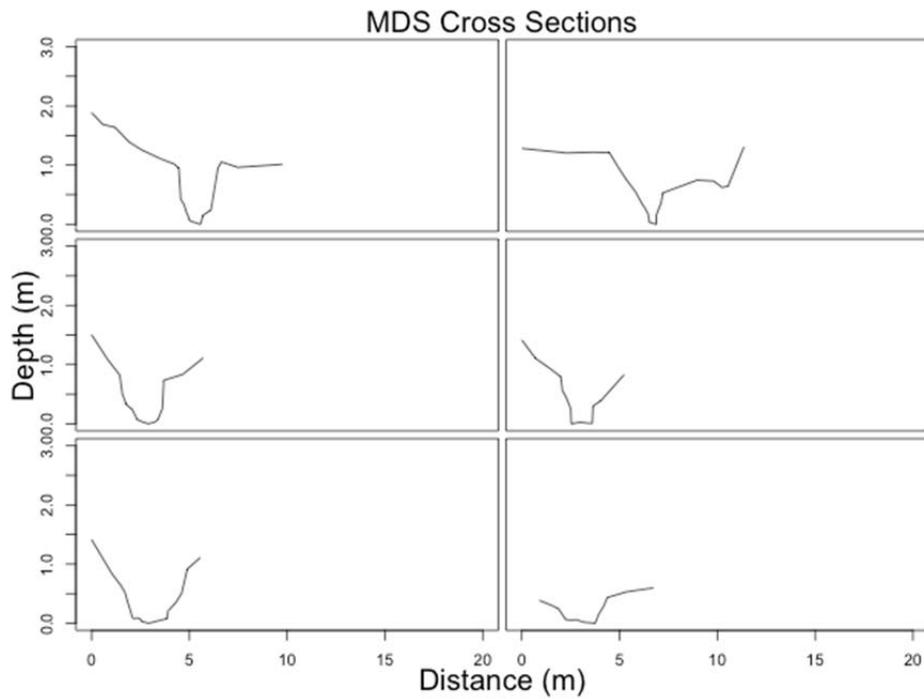


Figure 5: MDS cross sections. Cross section 1 is the downstream-most cross section, and increasing section numbers correspond to increasing distance upstream from Cross Section 1.

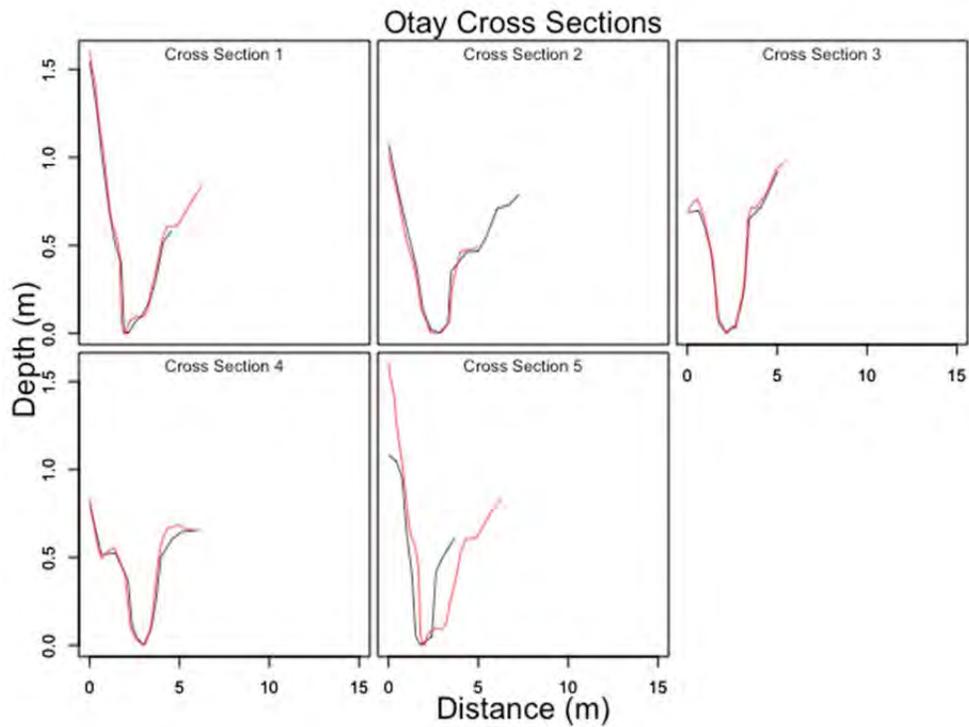


Figure 6: Otay cross sections. Cross section 1 is the downstream-most cross section, and increasing section numbers correspond to increasing distance upstream from Cross Section 1. Red line represents resurvey (2016) and black is original survey (2015).

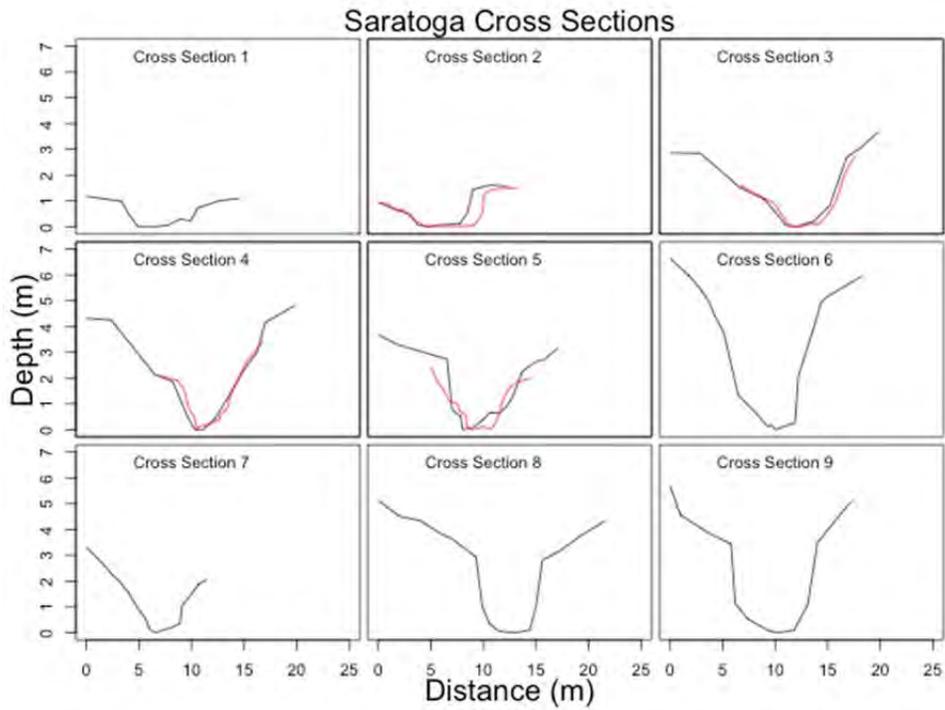


Figure 7: Saratoga cross sections. Cross section 1 is the downstream-most cross section, and increasing section numbers correspond to increasing distance upstream from Cross Section 1. Red line represents resurvey (2016) and black is original survey (2015).