TETRA TECH

MEMORANDUM

TO: Jim Well, Ducks Unlimited

FROM: Dai Thomas, PE, and Mike Harvey, PhD., PG

SUBJECT: **May 8, 2013 Resurvey of M&T/Llano Seco Pumping Plant and City of Chico Outfall Reach of the Sacramento River**
M&T/Llano Seco Fish Screen Facility Long-term Protection Project, Phase IV, Project No. US-CA-62-6

DATE: June 11, 2013

1. INTRODUCTION

As part of an effort to reduce the risk of mortality to native anadromous salmonids, including special-status species within the Sacramento River Basin, the M&T Chico Ranch/Llano Seco Rancho fish screen and pumping facility was redesigned, upgraded, and relocated from Big Chico Creek to the Sacramento River during 1997. Since its construction, local geomorphic changes including erosion and lateral migration of the west bank of the Sacramento River and related sediment deposition at the mouth of Big Chico Creek and in the vicinity of the fish screened intakes have posed a threat to the normal operation and fish protection function of the M&T Chico Ranch/Llano Seco Rancho diversion facility.

An upriver gravel bar adjacent to the Bidwell-Sacramento River State Park is migrating toward the vicinity of the fish-screened diversion. As a result of continued sediment deposition and increased river meander, the intake screens are progressively becoming threatened by encroaching sediment, which could cause a reduction in sweeping velocities across the screens (parallel to screen). A reduction in sweeping velocities would render the screens out of compliance with the National Oceanographic and Atmospheric Administration's National Marine Fisheries Service (NMFS) and the CDFG fish screen criteria. Periodic maintenance is required to reduce the size of the gravel bar and prevent interference with the diversion facility. In 2001 and 2007, 200,000 and 100,000 tons of material, respectively, were excavated from the gravel bar as a short-term solution to limit sedimentation impacts. Additionally in 2007, 1,500 feet of short-term, rock toe and brush bank protection was installed on the west side of the Sacramento River on the U.S. Fish and Wildlife Service's (USFWS) Capay Unit of the Sacramento River National Wildlife Refuge to prevent further channel meander.

As part of the long-term monitoring program, Ducks Unlimited commissioned Tetra Tech to perform annual bathymetric surveys to monitor sedimentation along the study reach and in particular, to determine the necessity of dredging and to quantify the volume (tonnage) of material. Unlike the previous gravel removal operations that were conducted in the "dry" during 2001 and 2007, future dredging will likely require a below-water dredge operation.

Technical memorandums (Tetra Tech, 2010, 2011, 2012b) describing the bed elevation changes that occurred between 2006 and 2012 were provided to Ducks Unlimited following the 2010, 2011 and 2012 surveys. This 2013 technical memorandum was developed by updating the 2012 technical memorandum to include the May 2013 survey data and results.

2. HYDROGRAPHIC AND TOPOGRAPHIC SURVEYS

Hydrographic and topographic surveys of the M&T/Llano Seco reach of the Sacramento River between River Mile (RM) 192 and RM 193.5 have been used to monitor geomorphic changes in the reach, including aggradation of the bed as well as bank erosion and lateral migration of the river. Surveys were conducted by Mussetter Engineering Inc. (MEI) in December 2005 and May 2006 and by Tetra Tech in January 2010, June 2011 and June 2012. The horizontal datum for the surveys 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). The largest peak flow between the June 2012 and May 2013 surveys was 86,600 cfs on December 3, 2012. This peak flow event had duration of less than one day and is used as the provisional peak flow event for WY2013 (**Figure 1**). In addition, two smaller peak flow events of approximately 60,000 cfs occurred on December 22 and 24, 2012, which also had durations of less than one day.

This hydrographic survey was conducted by Tetra Tech on May 8, 2013, when the flows at the Hamilton City gage were reasonably steady at around 9,450 cfs. The survey was conducted with an Ohmex SonarMite Echosounder (±0.1-foot resolution) coupled with a Leica Viva RTK-GPS system that were mounted on Tetra Tech's survey boat.

3. SURVEY RESULTS

The initial survey of the M&T/Llano Seco reach was conducted in December 2005, but in January 2006 there was a flow of 135,000 cfs in the river (Hamilton City gage) which caused both lateral erosion of the west bank of the river and aggradation and degradation in the reach. As a result, the reach was re-surveyed in May 2006, and this survey is used as the baseline condition for the following discussion.

Figure 2 presents the changes in elevation of the bed of the river within the M&T/Llano Seco reach between the 2010 and 2006 surveys. The comparison indicates that there had been significant aggradation (4 to 10 feet) in the vicinity of the pumps which was supported by observations of the river under low-flow conditions. The location of the 2007 gravel removal is clearly visible (-4 to -6 feet) along the left (east) bank of the river upstream of the pumping plant and adjacent to Bidwell State Park. **Figure 3** presents the changes in bed elevation between the 2011 survey and the 2006 survey. It is apparent that the amount of deposition in the vicinity of the pumping plant was reduced following the high flows in early 2011 (peak flow at Hamilton City was about 102,500 cfs), but there is still some aggradation when compared to the 2006 survey. **Figure 4** presents the differences in elevation of the bed of the river between the 2010 and 2011 surveys.

Figure 5 presents the changes in bed elevation between the 2011 survey and the 2012 surveys. The data indicate that there was some additional aggradation in the vicinity of the pump intake as compared to the 2011 survey, which was likely due to the lack of significant peak flows during the 2012 spring runoff period (peak flow at Hamilton City was about 44,000 cfs).

Figure 6 presents the changes in bed elevation between the 2012 survey and the 2013 surveys. The data indicate that there was very little change in bed elevation between the 2012

and 2013 surveys with the majority of the values in the -2 to 0 or the 0- to 2-foot categories. The range of these categories has been kept consistent with the previous survey report (Tetra Tech, 2012); in general, most of the values range between -0.5 and 0.5 feet, which represents little change in bed elevation. **Figure 7** presents the differences in elevation of the bed of the river between the 2013 and 2006 surveys, and demonstrates that the site is still net aggradational.

In order to further evaluate bed elevation changes between 2006 and 2013, and to determine the volume of dredge material in the vicinity of the fish screens and pump inlets, an approximately 600- by 1,200-foot area was designated and the difference in volume between surveys was determined. Between the 2006 and 2010 surveys, about 89,000 cu.yd. (~120,000 tons) of material accumulated (**Figure 8**). Between the 2011 and 2006 surveys, the volume of material that accumulated was reduced to about 54,400 cu.yd. (~72,900 tons) (**Figure 9**). Between 2010 and 2011, there was net loss of about 34,800 cu.yd. (~47,000 tons) of material (**Figure 10**). Between the 2012 and 2006 surveys, there was a net accumulation of about 61,300 cu.yd (~82,800 tons) (**Figure 11**). From 2011 to 2012, there was slight aggradation in the delineated area and a net gain of about 6,700 cu.yd (~9,000 tons) of material (**Figure 12**).Between the 2013 and 2006 surveys, there was a net accumulation of about 66,000 cu.yd (~89,100 tons) (**Figure 13**). From 2012 to 2013, there was slight aggradation in the delineated area and a net gain of about 3,600 cu.yd (~4,860 tons) of material (**Figure 14**)

4. ANALYSIS OF CHANGES

Aggradation and degradation within the M&T/Llano Seco reach appears to be tied to the peak flow hydrology. With the exception of WY2004, the peak flows in the six years prior to 2005 were less than the bankfull (~90,000 cfs) in the M&T/Llano Seco reach and this sequence of flows appears to be responsible for the aggradation in the channel (Figure 1). In WY2006, the peak flow was about 135,000 cfs and clearly there was some degradation in the reach, especially in the vicinity of the fish screens and pump inlets (**Figure 15**). Between WY2006 and WY2010, the peak flows were again less than the bankfull and aggradation occurred in the vicinity of the fish screens and pumps (**Figure 16**). Peak flow in WY2011 was about 102,500 cfs and this flow appears to have caused degradation in the vicinity of the fish screens and pump inlets (**Figure 17**). Between 2011 and 2012, the peak flows during the spring 2012 runoff period was about 44,000 cfs (approximately half of the bankfull flow) and there was a relatively small amount of deposition in the vicinity of the fish screens and pump inlets but the general problem of deposition during low flow years was observed (**Figure 18**).

As mentioned previously, the peak flow between the 2012 and 2013 surveys was about 85,600 cfs, which is slightly less than the bankfull discharge of 90,000 cfs, and the duration of the peak flow event was less than one day. Between 2012 and 2013, there was a relatively small amount of deposition in the vicinity of the fish screens and pump inlets, but the general pattern of deposition at less than bankfull discharges was observed (**Figure 19**).

The general patterns of aggradation and degradation shown in Figures 15 through 19 are supported by comparative cross-sectional plots. The locations of the plotted cross sections are shown on **Figure 20**, with Cross Section 1 (XS1) being located at the newly relocated City of Chico wastewater outfall and diffuser, XS2 is located near the City's previous outfall, XS3 through XS5, span the fish screens and pump inlets and XS6 and XS7 are located upstream and incorporate the migrating gravel bar. XS8 represents the area that was dredged in 2007.

At the City of Chico's outfall (**Figure 21**), the cross sections indicate that there was some aggradation on the left (east) side of the channel in 2005 but the 2006, 2010 and 2011 surveys show that the local aggradation was removed. The 2012 survey shows a small amount of aggradation near the left bank in the vicinity of Sta 440 and degradation in the vicinity of Sta 450 the 2013 survey shows slight degradation along the left side of the channel from near the left bank (east) to approximately Station 430. The 2013 survey also shows no change from the location of the thalweg (~Sta 560) to Sta 890 compared to the 2012 survey.

At the location of the City's prior outfall (**Figure 22**), it is apparent that the aggradation in 2010 was removed by the flows in 2011 and that the depth of scour probably depends on the magnitude of the high flows since the bed elevation in 2006 is the lowest. The 2012 survey shows there was very little change along the cross section compared to 2011 conditions. The 2013 survey shows approximately 1.5 feet of degradation at the channel thalweg (~Sta 170) compared to the 2012 survey. The 2013 survey also shows slight aggradation along the right side of the channel from Sta 290 to Sta 450.

At the location of the fish screens and pump inlets (**Figures 23 through 25**) it is clear that during the lower peak flow years the deposition approaches the inlets and fish screens, and it is eroded during the higher-flow years. At XS3 (located slightly downstream from the fish screen), the 2013 survey shows there was approximately 1 foot of aggradation around the pump intake and up to 1.5 feet of aggradation to the right of the thalweg between Sta 245 and Sta 450 compared to 2012 (Figure 23). At the M&T intake (XS4), there was very little change in elevation compared to 2012; however, there was up to 1.5 feet of aggradation along the right side of the channel between Sta 230 and Sta 450, compared to 2012 (Figure 24). At XS5, which is located slightly upstream of the M&T pump intakes, the 2013 survey shows there was approximately 1 foot of degradation along the alignment of the intake compared to 2012; similar to XS3 and XS4, there was up to 1.5 feet of aggradation along the right side of the channel between Sta 230 and Sta 470, compared to 2012.

The same general trend is seen on the upper part of the migrating bar (**Figures 26 and 27**). Aggradation occurs during the lower peak flow years (2005, 2010, and 2012) and there is scour in the higher peak flow years (2006 and 2011). The 2013 survey shows there was aggradation of up to 2 feet near the left bank of XS6 and localized differences (aggradation and degradation) of up to 1 foot in the main channel, but in general, between Sta 290 and the right bank, the 2013 survey is very similar to the 2012 survey. At XS7, there was approximately 1 foot of aggradation downstream from the bank attached bar.

The comparative cross sections indicate that there has been up to 1 foot of aggradation on the mid-channel bar at Sta 635. The 2013 survey shows there has been little or no change in bed elevation in the channel located to the left of the mid-channel bar compared to 2012 (**Figure 28**). The 2013 show small bed changes near the right bank, with approximately 0.5 feet of degradation in the vicinity of Sta 850 and approximately 0.5 feet aggradation near the right bank (~Sta 910).

5. CONCLUSIONS

Based on the response of the system over the six surveys, it appears that there is cyclic behavior within the M&T/Llano Seco reach with the less than bankfull flows delivering sediment to the reach from upstream and causing aggradation, and the higher than bankfull flows causing scour in the vicinity of the fish screens and pump inlets. The scour is most likely due to the formation of a helical flow cell along the riprap that lines the east bank of the river in the vicinity of the fish screens and pump inlets because of downstream translation of flows that approach the riprap obliquely from upstream. Acoustic Doppler Current Profiler (ADCP) measurements collected in June 2011 indicated the presence of a weak helical flow cell at approximately 19,500 cfs (Tetra Tech, 2012a). Three-dimensional hydraulic modeling (Alden, 2012) over a range of flows from 20,000 to 134,600 cfs, showed an increase in strength of the helical flow with increasing discharge, and thereby supported the hypothesis that at higher flows, a helical cells forms and with sufficient strength to erode previously deposited material.

This hypothesis of the cyclic behavior of the system depends on the general alignment of the river being maintained. If the west bank was to erode and migrate westward, it is likely that the flow alignments would change and it is unlikely that the helical flow cell would be maintained in the vicinity of the fish screens and pump inlets, which would probably cause them to be buried. Dive reports at the fish screens tend to support the results of the comparative surveys (**Appendix A**).

6. RECOMMENDATIONS

Until a long-term solution is developed and implemented at the M&T/Llano Seco pumping plant inlets and fish screens, it is recommended that geomorphic changes in the reach continued to be monitored. Monitoring should involve deposition/erosion in the vicinity of the inlets as well as any erosion of the west bank of the river downstream of the rock toe and brush revetment. In addition, monitoring should also involve the City of Chico's recently relocated outfall and diffuser since the post-2005 survey data tend to indicate that there is potential for sedimentation in that location as well.

The 2011 peak flow event exceeded bankfull conditions and eroded the previously deposited material in the vicinity of the fish screens and pump inlets, leaving the area relatively clear of deposition. The 2012 and 2013 surveys indicated relatively little deposition in this area, and therefore, dredging is not recommended at this time.

7. REFERENCES

Alden Research Laboratory, 2012. Three-Dimensional Numerical Flow Analysis of the M&T Pumps, Chico, California. 32 p.

Tetra Tech, Inc., 2010. Survey Report 1 (Subtask 13.2) for M&T/Llano Seco Fish Screen Facility Short-term/Long-term Protection Project (Project No. US-CA-62-2). Submitted to Ducks Unlimited, Rancho Cordova, California, March 18, 6 p.

Tetra Tech, Inc., 2011. June 7-9, 2011 Resurvey of M&T/Llano Seco Pumping Plant and City of Chico Outfall Reach of the Sacramento River. Submitted to Ducks Unlimited, Rancho Cordova, California, July 11, 24 p.

Tetra Tech, Inc., 2012a. Two-dimensional Sediment-transport Modeling of the M&T/Llano Seco Pumps Reach Submitted to Ducks Unlimited, Rancho Cordova, California, May 1, 42 p.

Tetra Tech, Inc., 2012b. Evaluation of ADCP Data Collected in June 2011 at the M&T/Llano Seco Pumps Reach (DRAFT). Submitted to Ducks Unlimited, Rancho Cordova, California, June 29, 11 p.

Tetra Tech, Inc., 2012c. June 26, 2012 Resurvey of M&T/Llano Seco Pumping Plant and City of Chico Outfall Reach of the Sacramento River. Submitted to Ducks Unlimited, Rancho Cordova, California, July 16, 29 p.

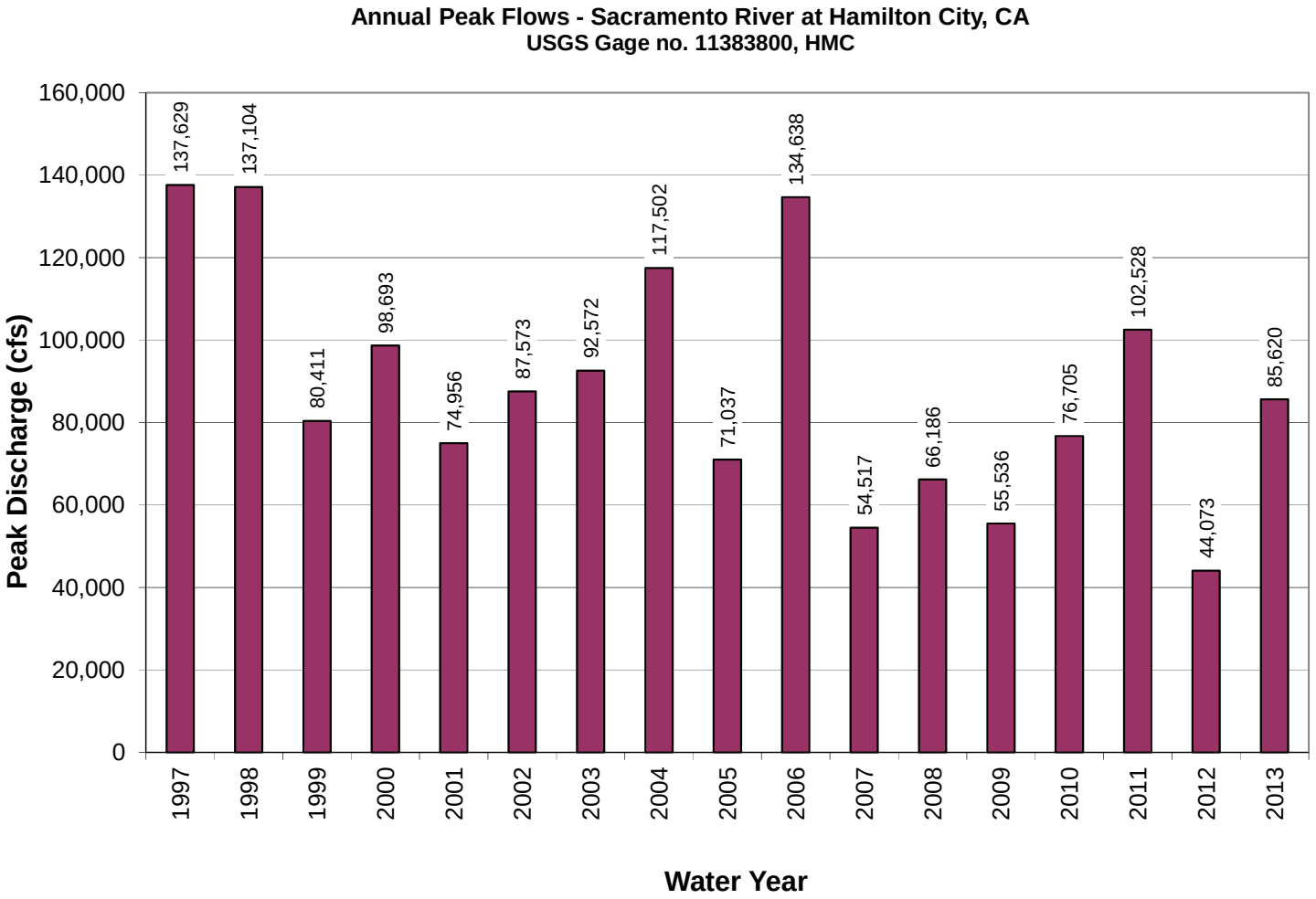


Figure 1. Peak annual flows at the Hamilton City gage between WY1997 and WY2011. Note: The peak flow for WY2013 is the peak flow to date, and is therefore provisional.

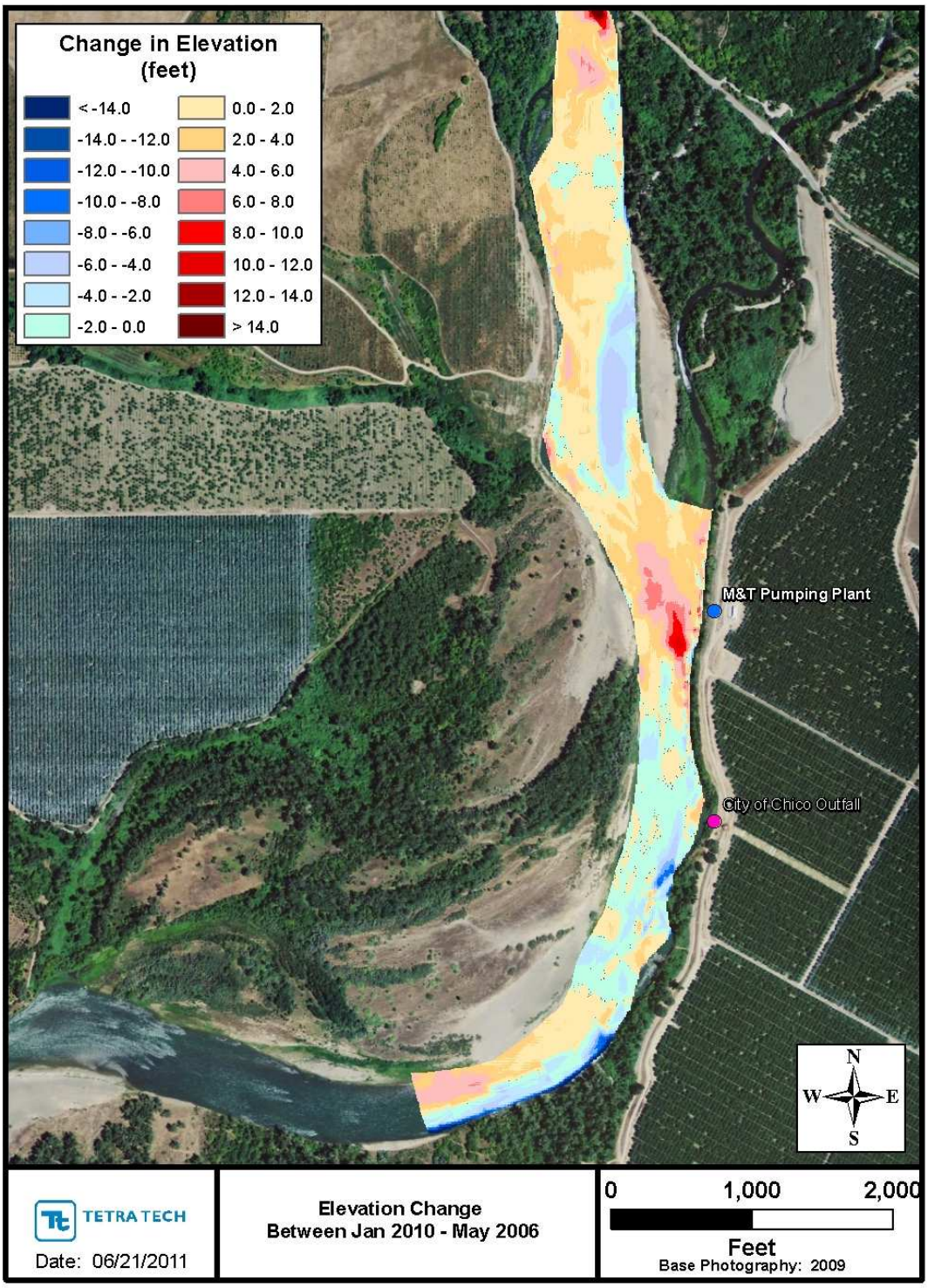


Figure 2. Elevation changes in the M&T/Llano Seco reach between the January 2010 and May 2006 surveys.

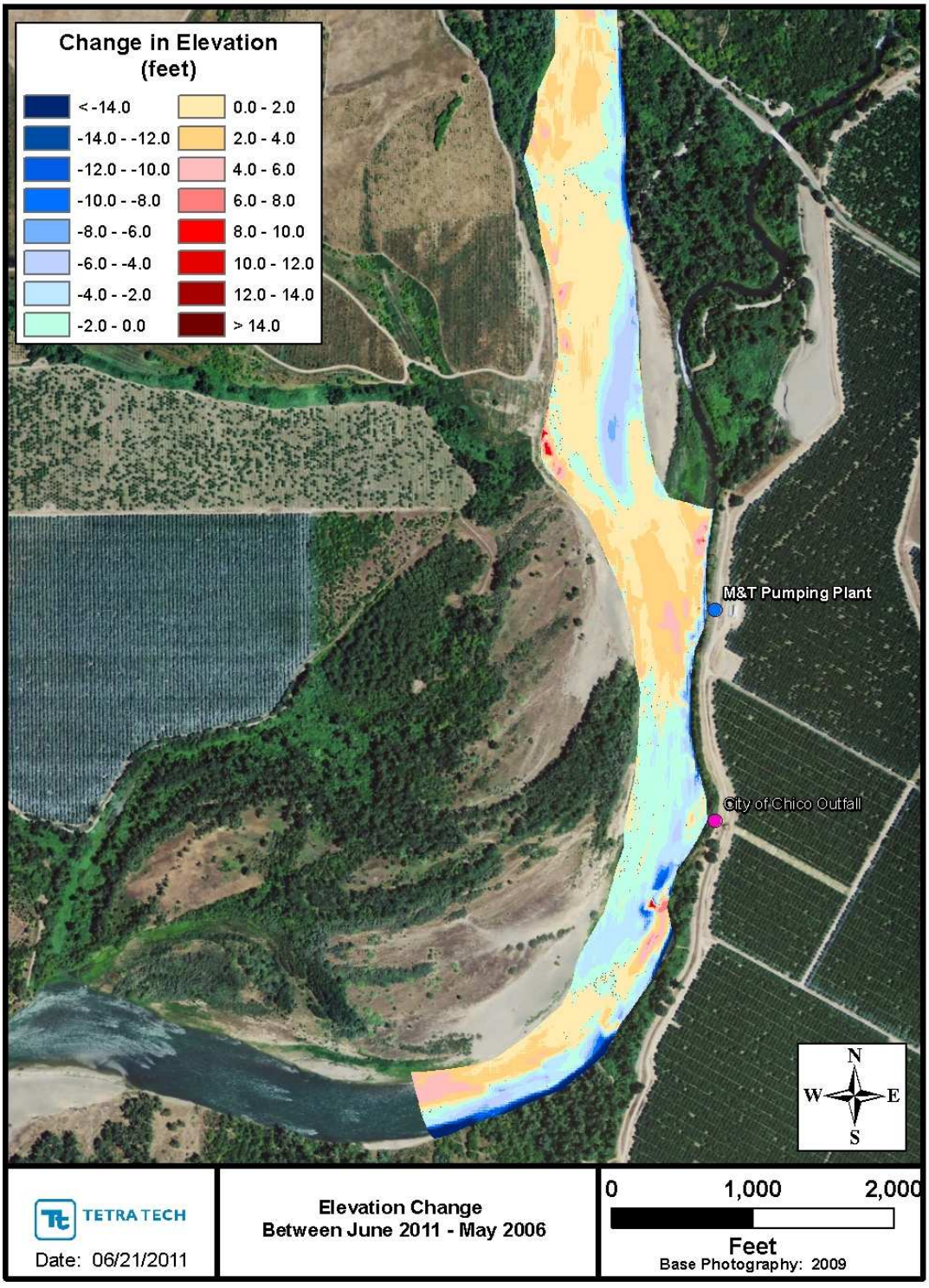


Figure 3. Elevation changes in the M&T/Llano Seco reach between the June 2011 and May 2006 surveys.

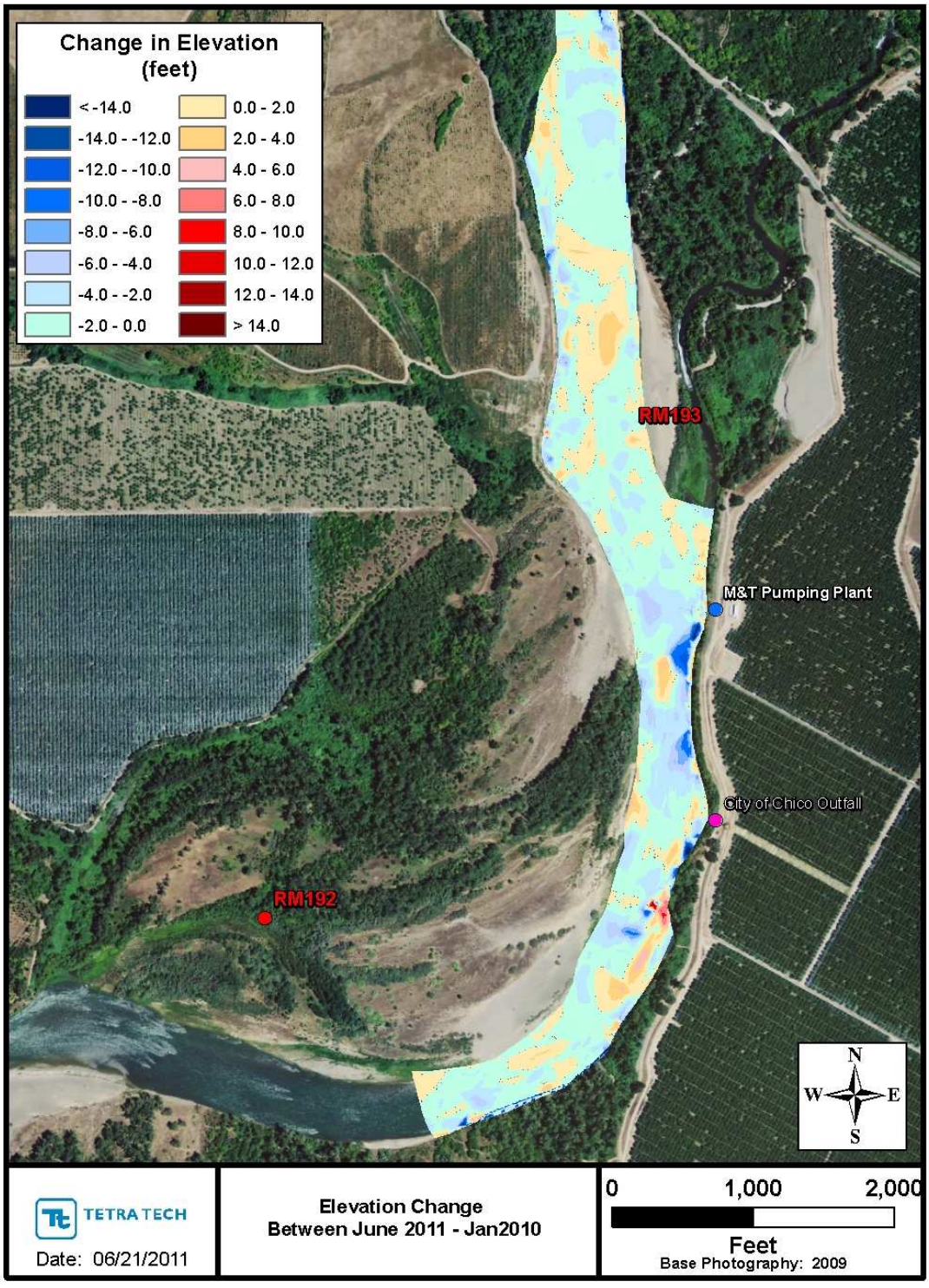


Figure 4. Elevation changes in the M&T/Llano Seco reach between the June 2011 and January 2010 surveys.

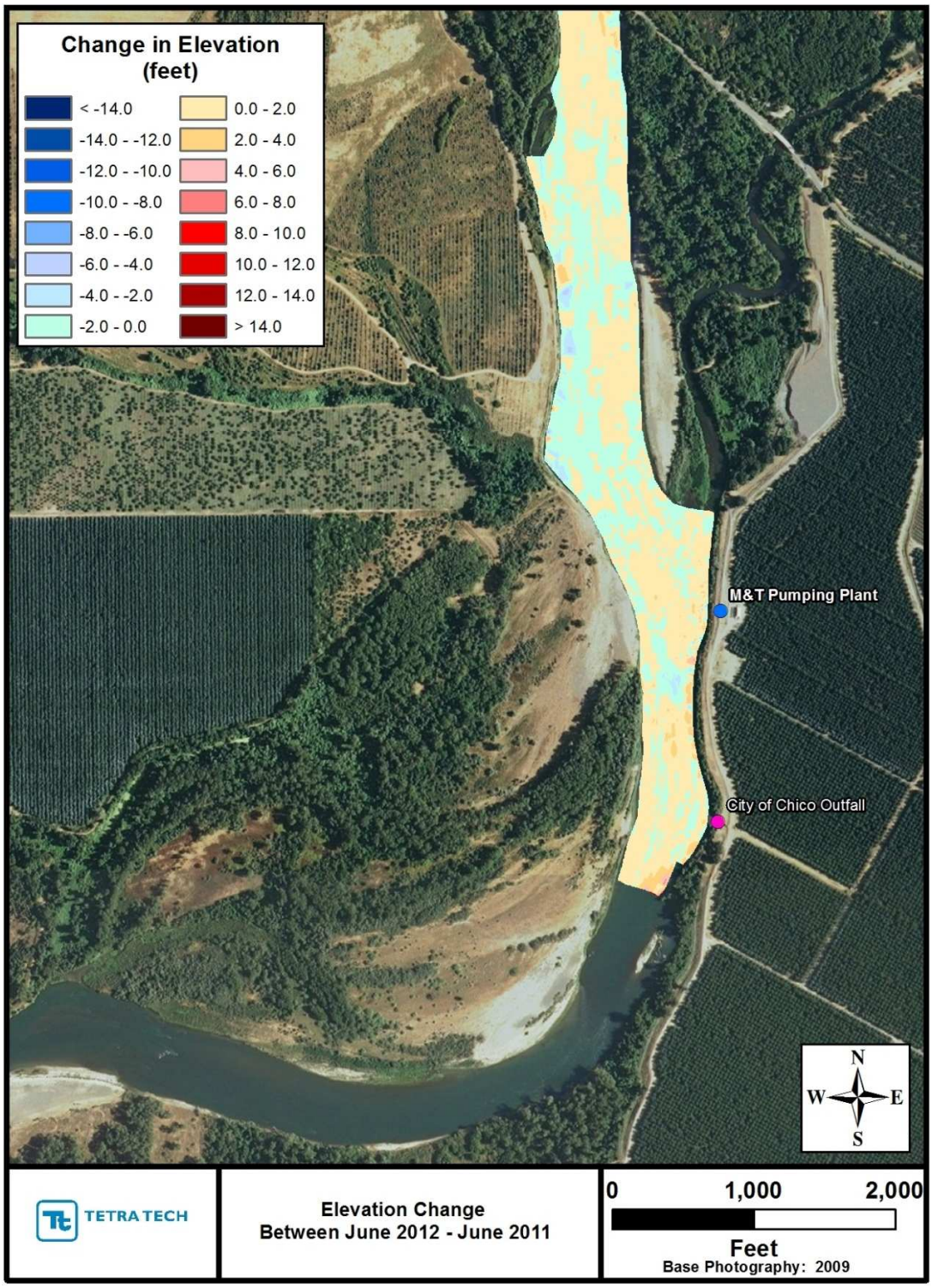


Figure 5. Elevation changes in the M&T/Llano Seco reach between the June 2012 and June 2011 surveys.

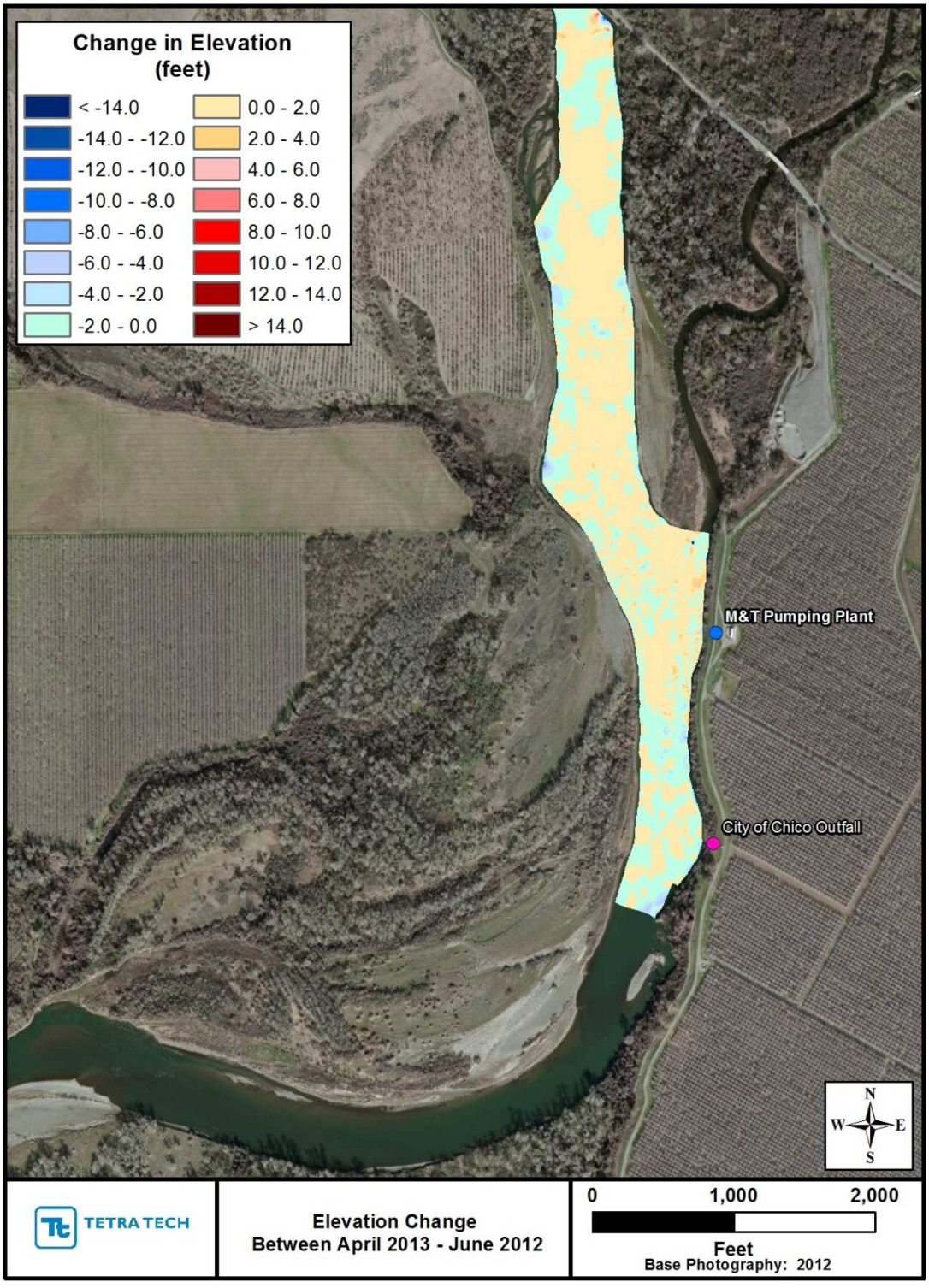


Figure 6. Elevation changes in the M&T/Llano Seco reach between the June 2012 and May 2013 surveys.

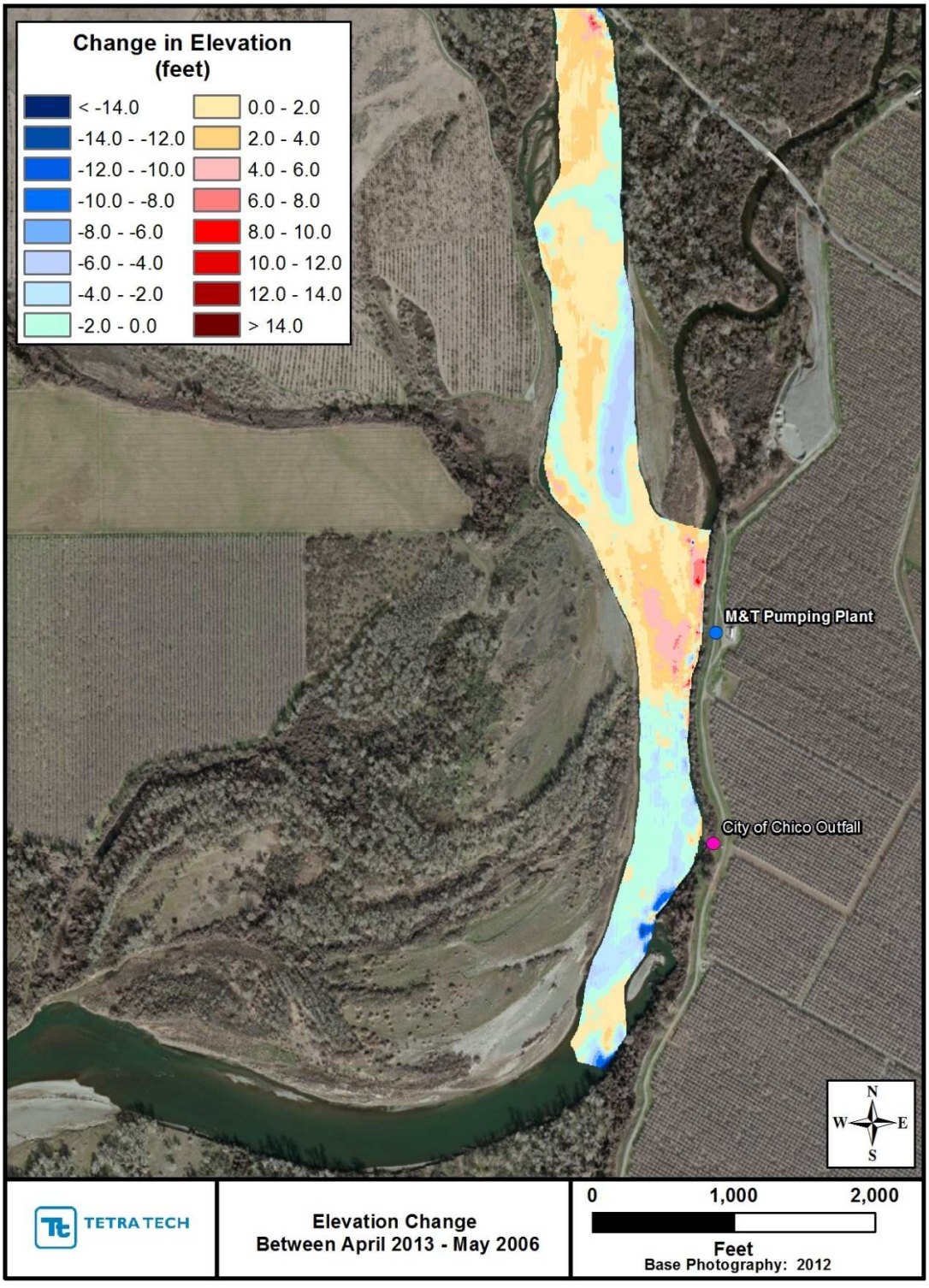


Figure 7. Elevation changes in the M&T/Llano Seco reach between the May 2013 and May 2006 surveys.

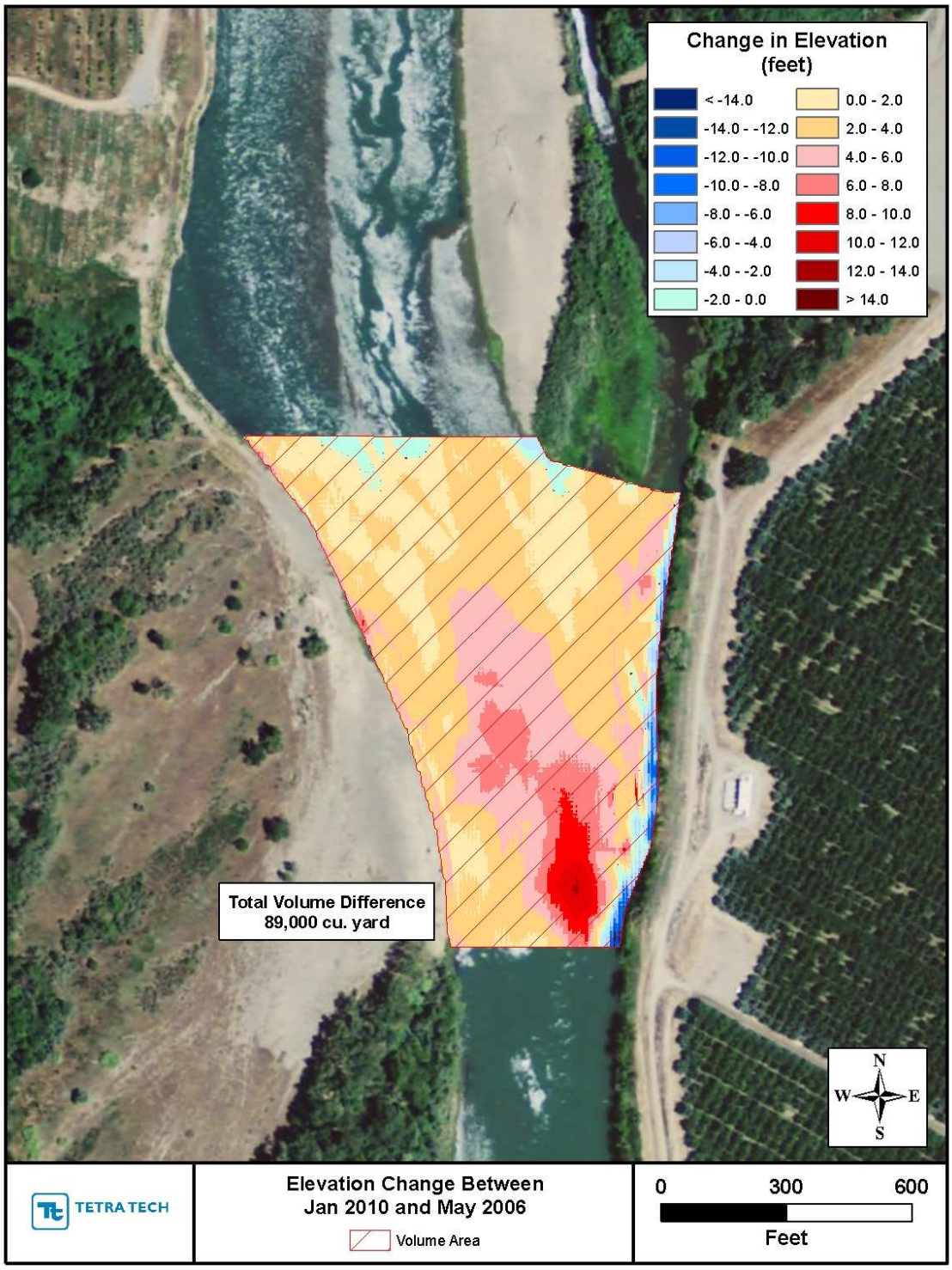


Figure 8. Volumetric calculation of the deposition in the 600- by 1,200-foot segment in the vicinity of the fish screens and pump inlets between the January 2010 and May 2006 surveys.

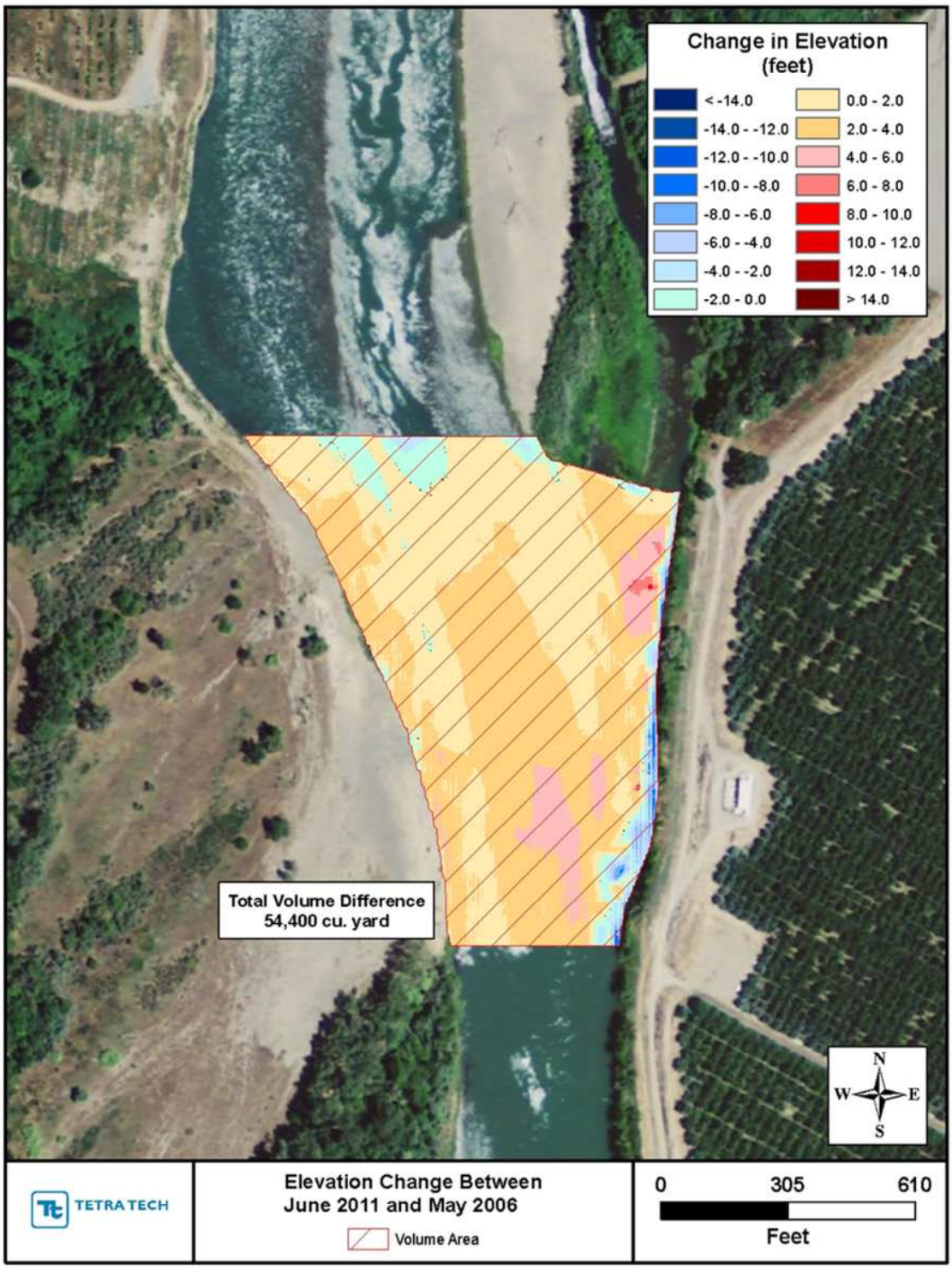


Figure 9. Volumetric calculation of the deposition in the 600 by 1,200-foot segment in the vicinity of the fish screens and pump inlets between the June 2011 and May 2006 surveys.

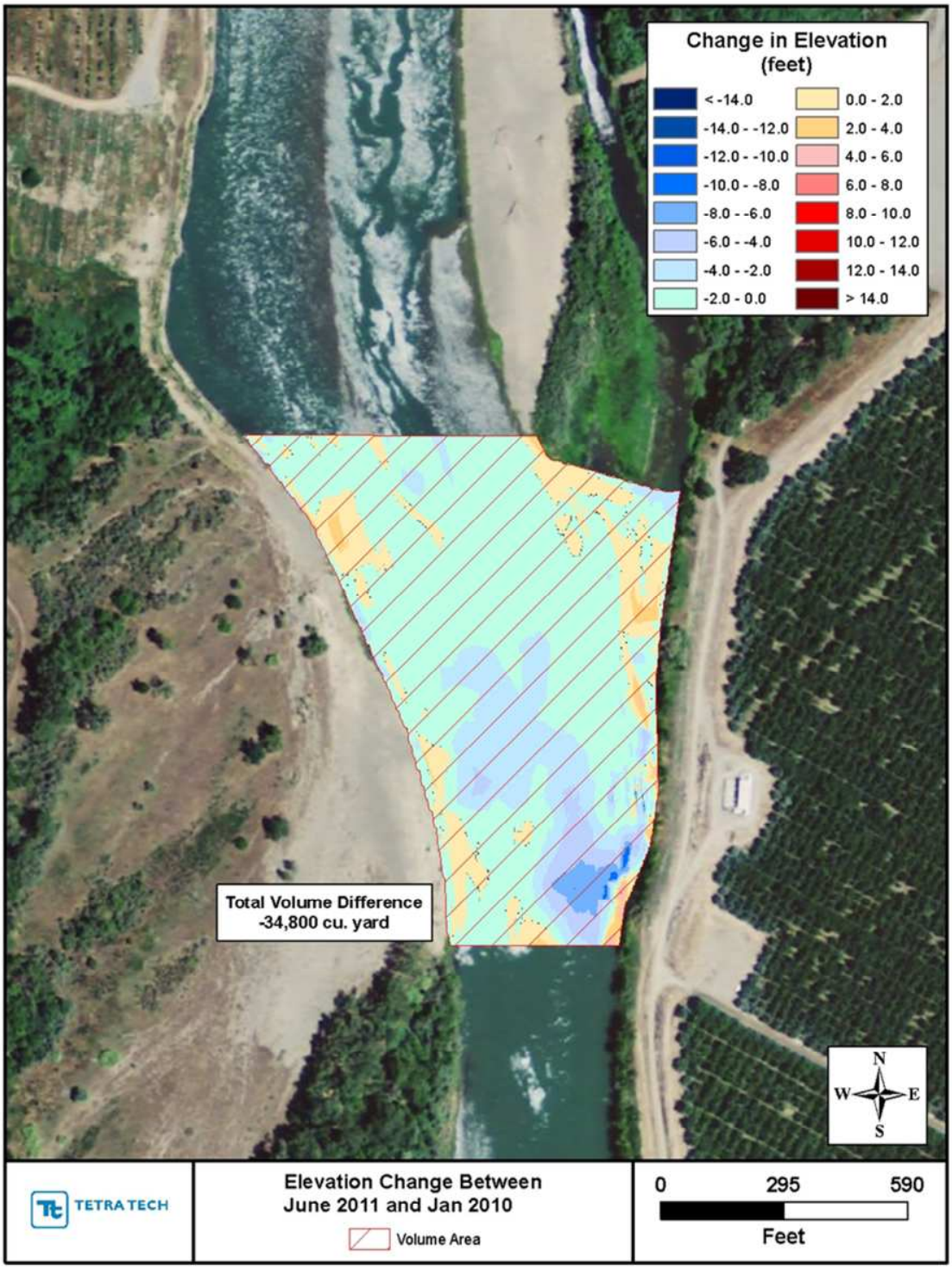


Figure 10. Volumetric calculation of the deposition in the 600- by 1,200-foot segment in the vicinity of the fish screens and pump inlets between the January 2010 and June 2011 surveys.

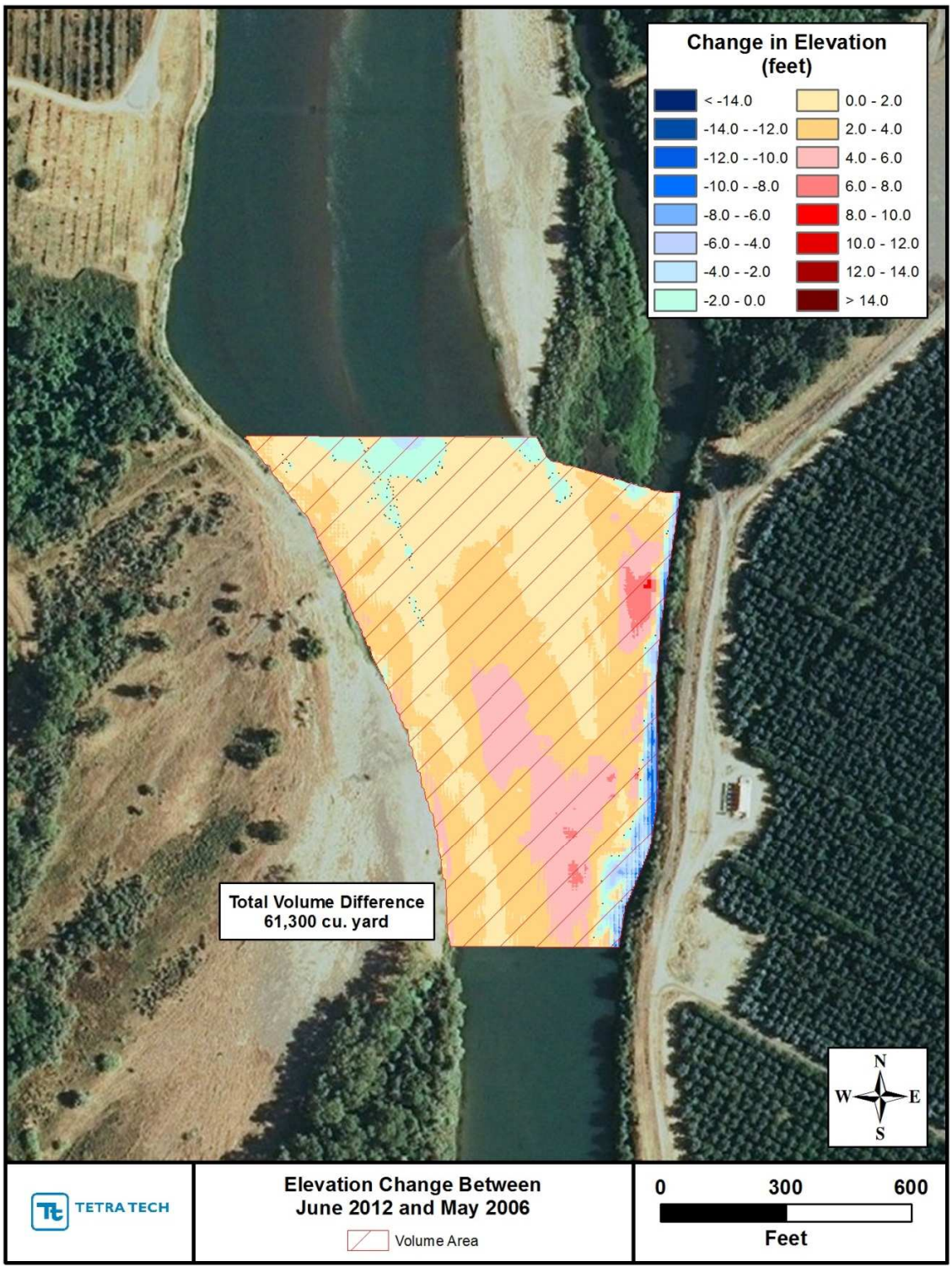


Figure 11. Volumetric calculation of the deposition in the 600- by 1,200-foot segment in the vicinity of the fish screens and pump inlets between the June 2012 and May 2006 surveys.

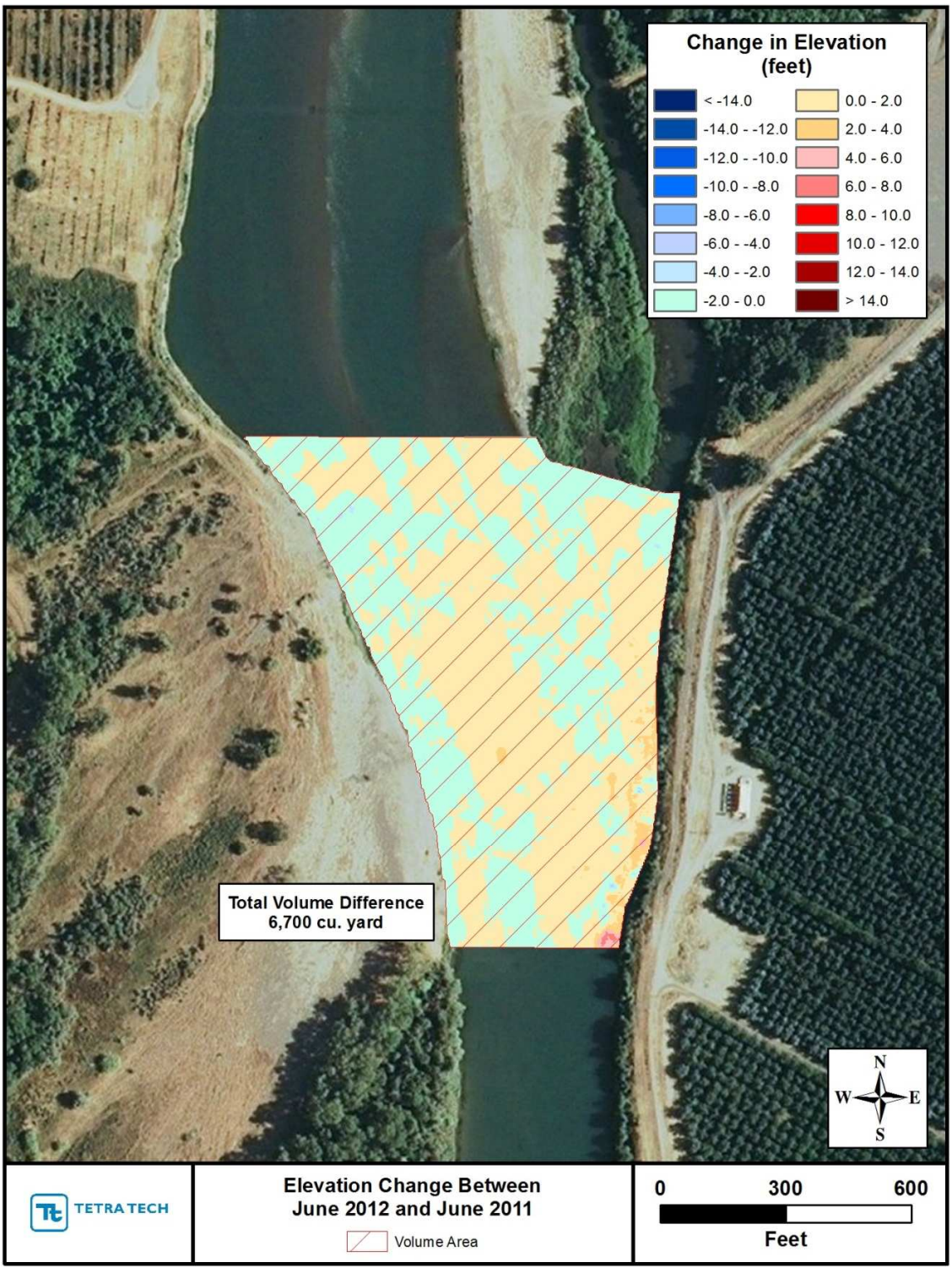


Figure 12. Volumetric calculation of the deposition in the 600- by 1,200-foot segment in the vicinity of the fish screens and pump inlets between the June 2011 and June 2012 surveys.

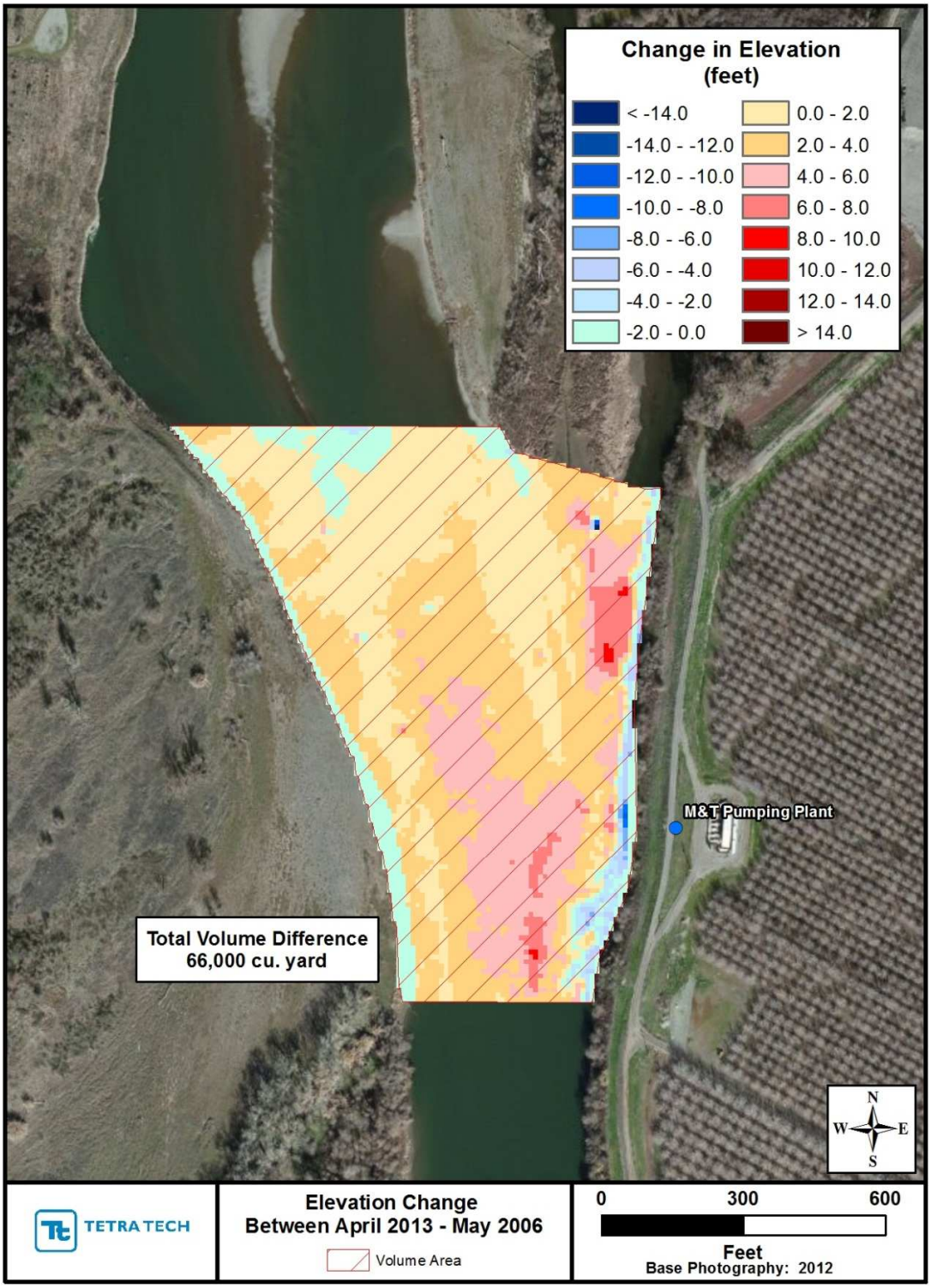


Figure 13. Volumetric calculation of the deposition in the 600 by 1,200-foot segment in the vicinity of the fish screens and pump inlets between the June 2013 and May 2006 surveys.

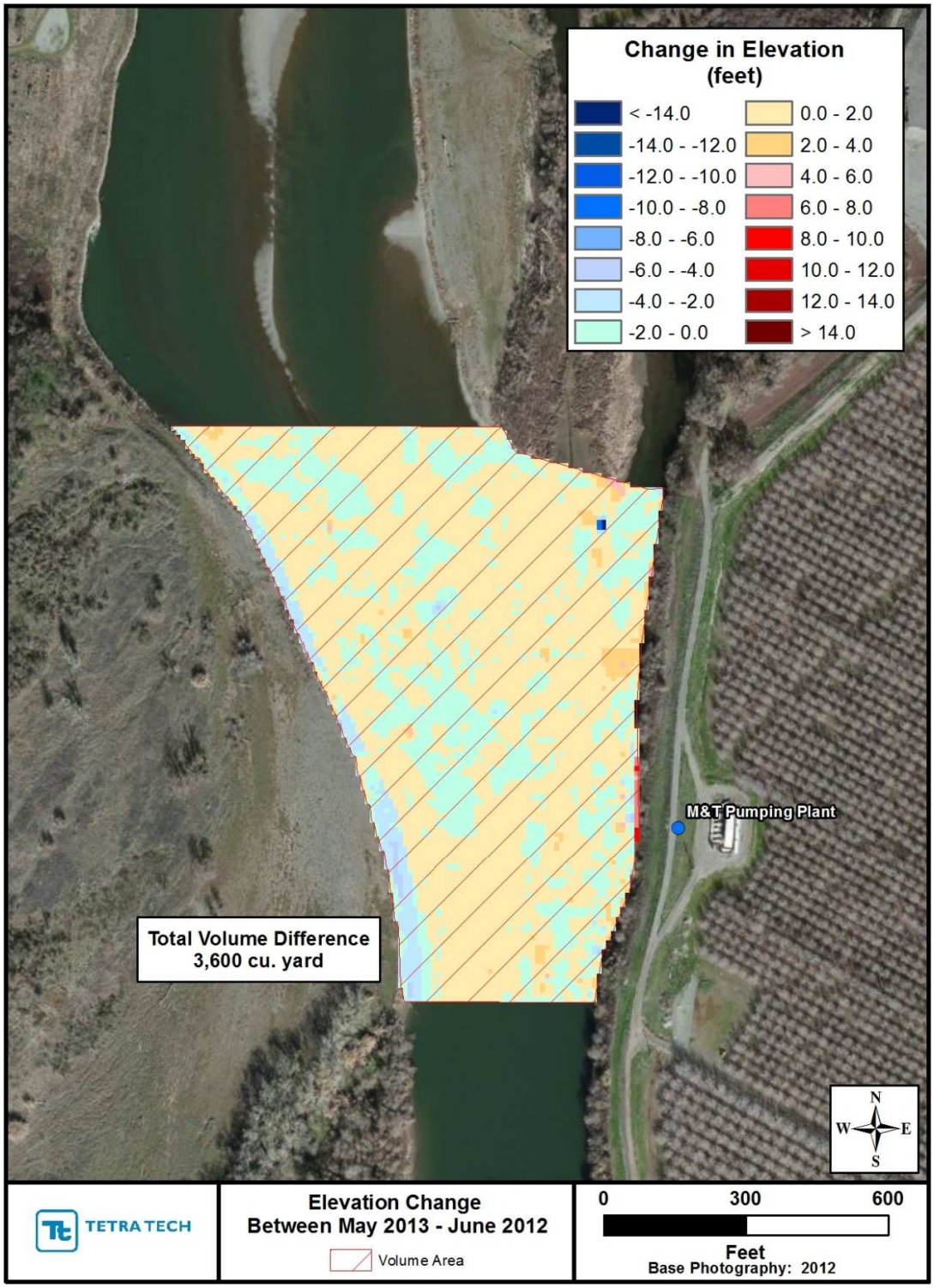


Figure 14. Volumetric calculation of the deposition in the 600- by 1,200-foot segment in the vicinity of the fish screens and pump inlets between the May 2013 and June 2012 surveys.

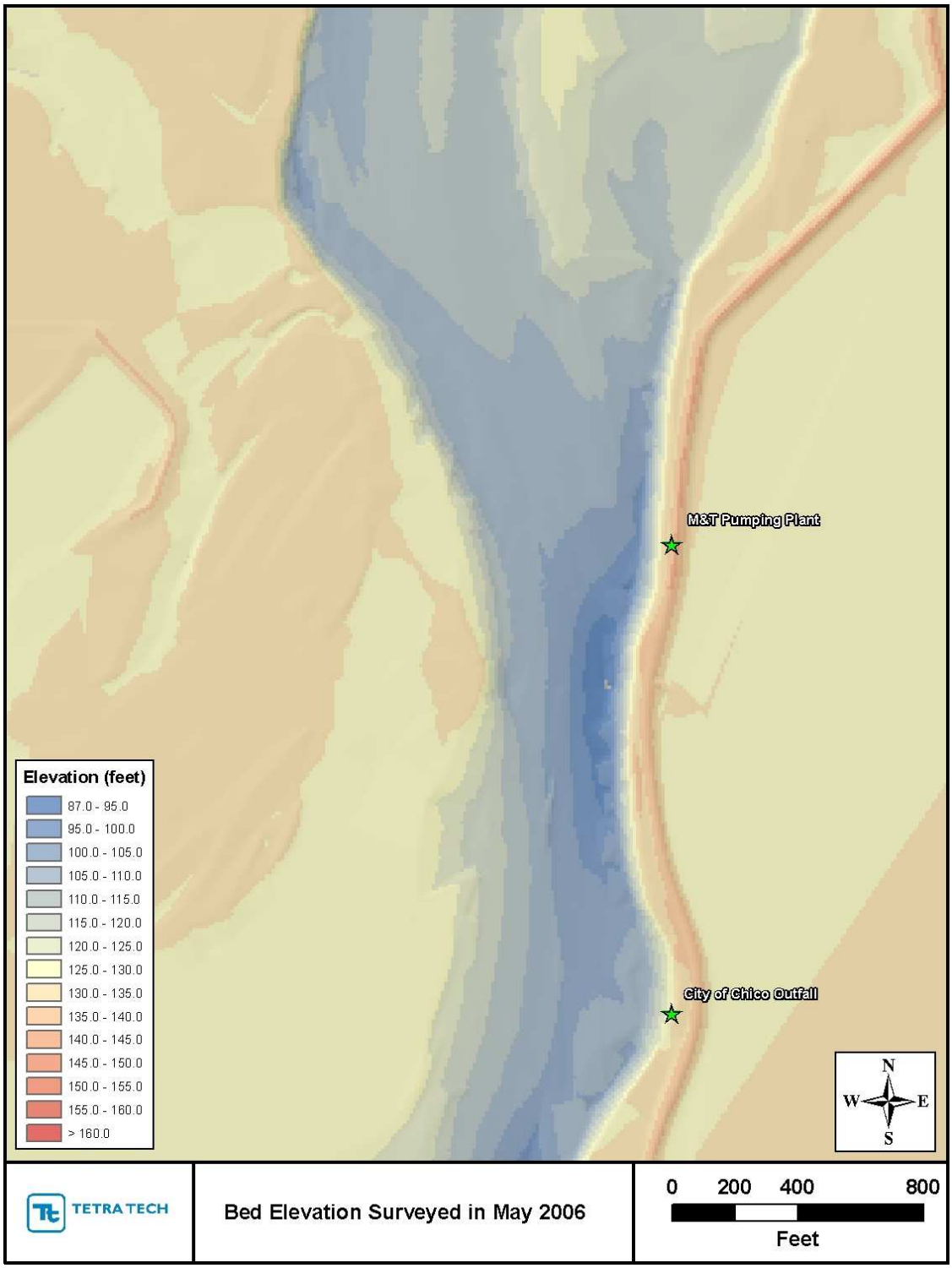


Figure 15. Color gradient plot showing the bed topography in the vicinity of the M&T/Llano Seco Pumping Plant and the relocated City of Chico Outfall in May 2006.

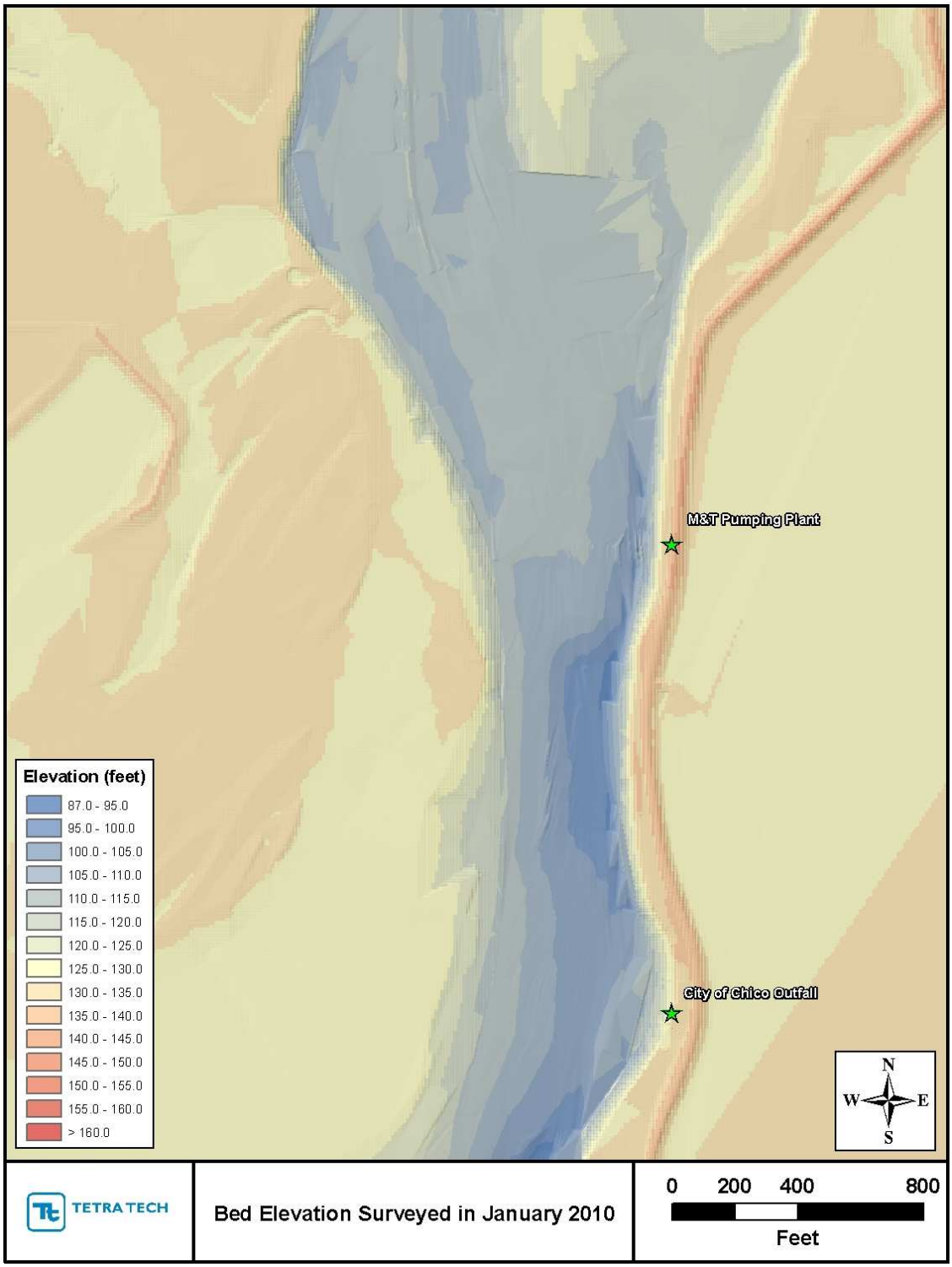


Figure 16. Color gradient plot showing the bed topography in the vicinity of the M&T/Llano Seco Pumping Plant and the relocated City of Chico Outfall in January 2010.

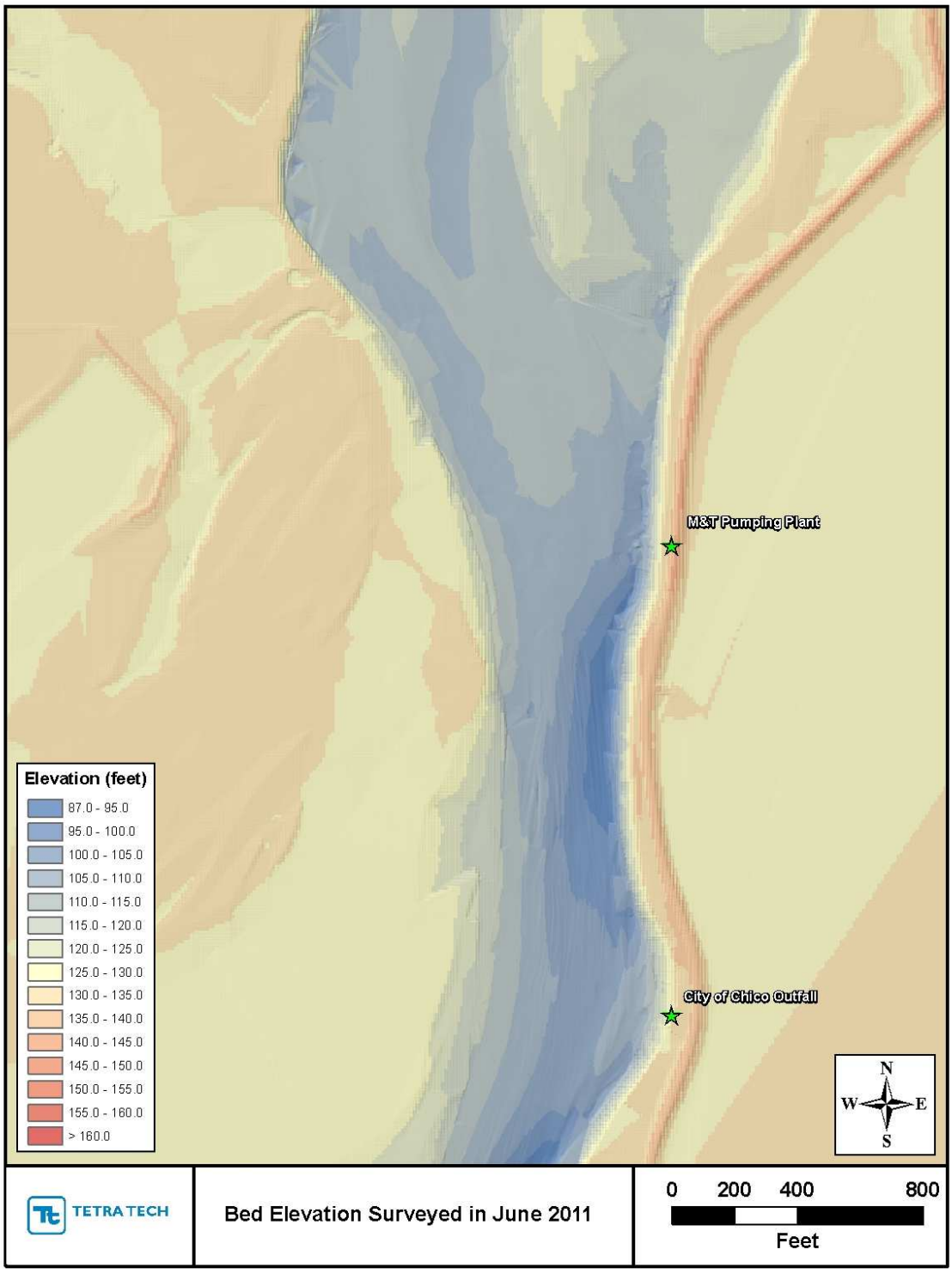


Figure 17. Color gradient plot showing the bed topography in the vicinity of the M&T/Llano Seco Pumping Plant and the relocated City of Chico Outfall in June 2011.

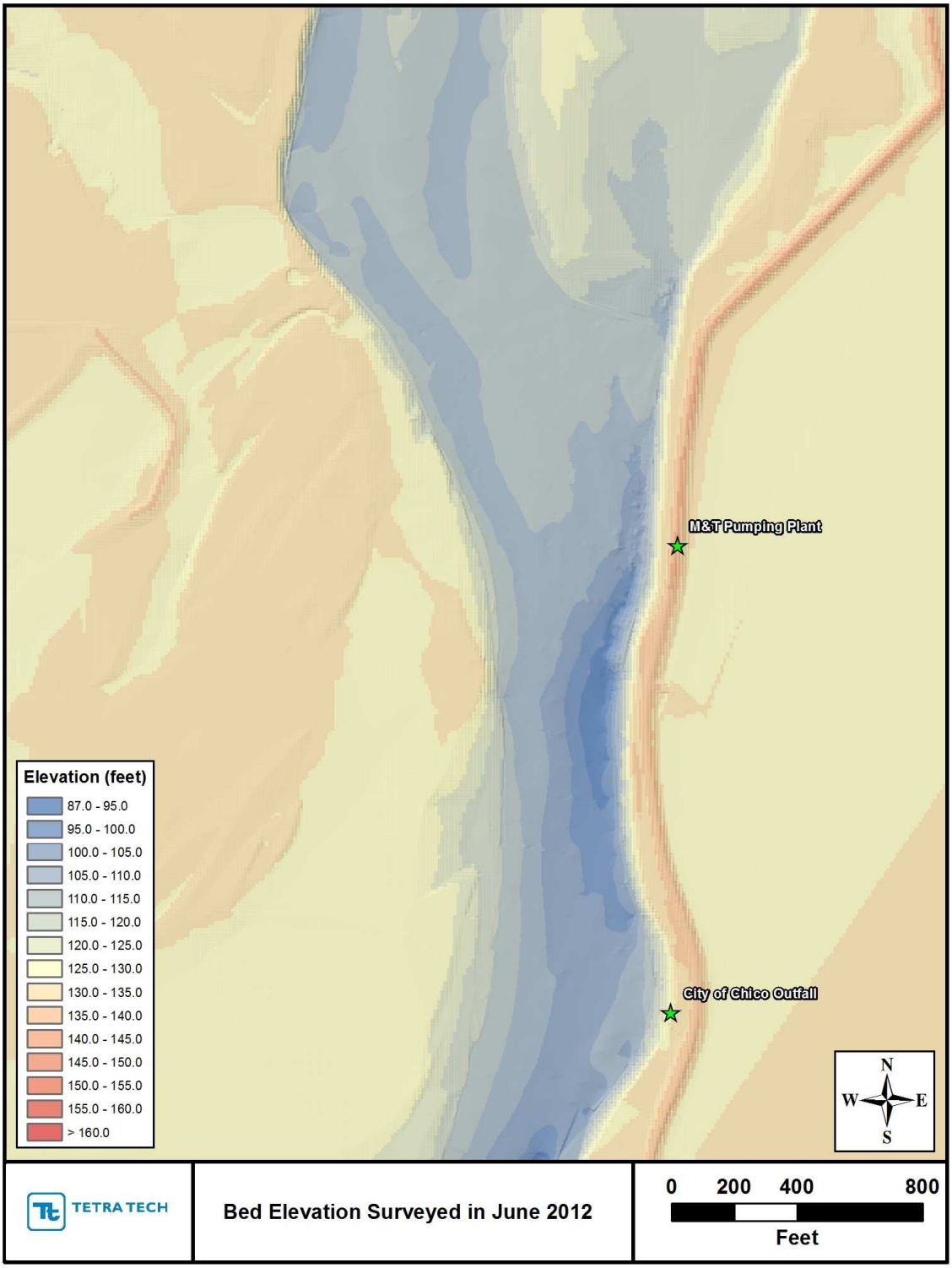


Figure 18. Color gradient plot showing the bed topography in the vicinity of the M&T/Llano Seco Pumping Plant and the relocated City of Chico Outfall in June 2012.

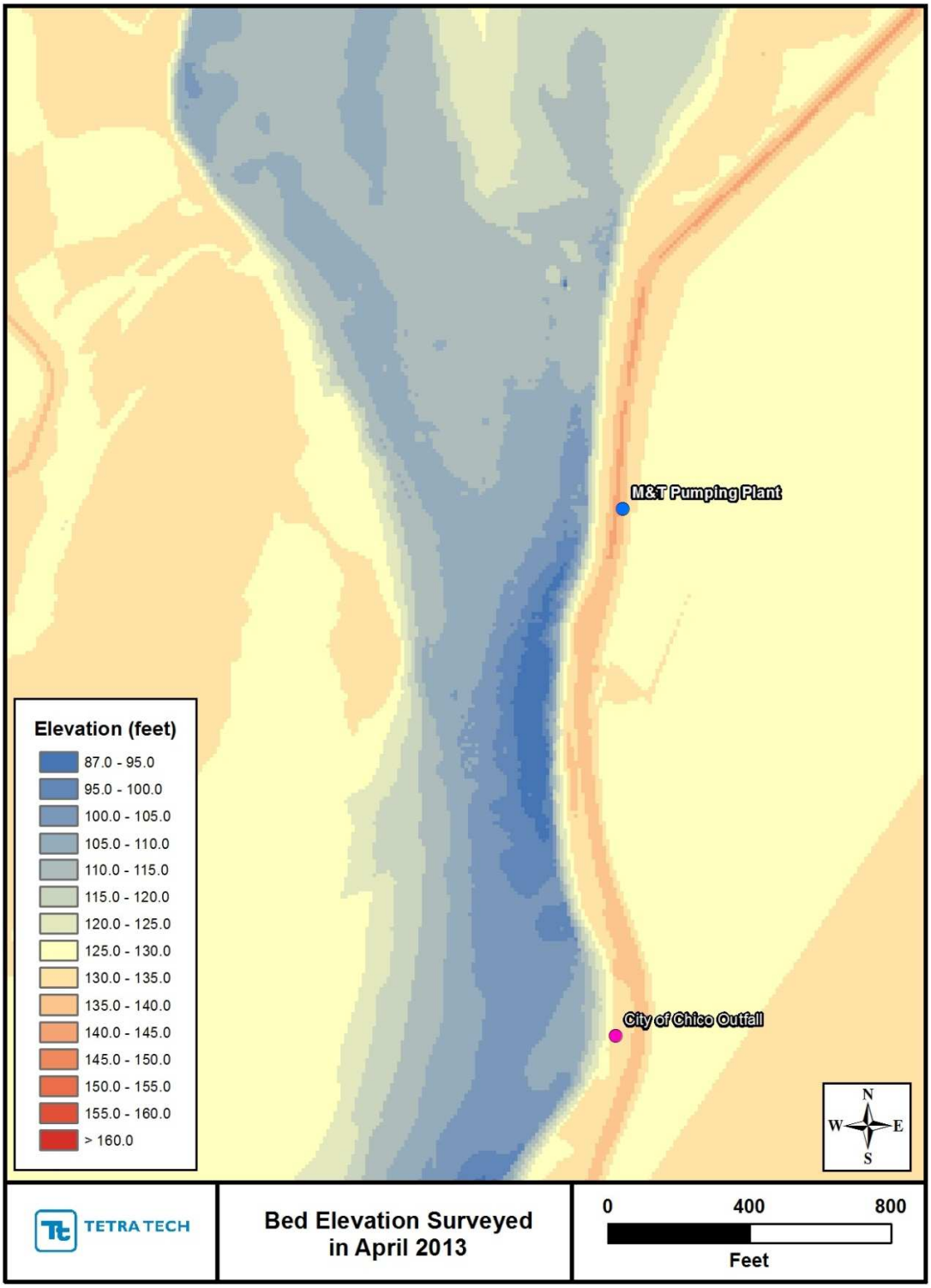


Figure 19. Color gradient plot showing the bed topography in the vicinity of the M&T/Llano Seco Pumping Plant and the relocated City of Chico Outfall in May 2013.

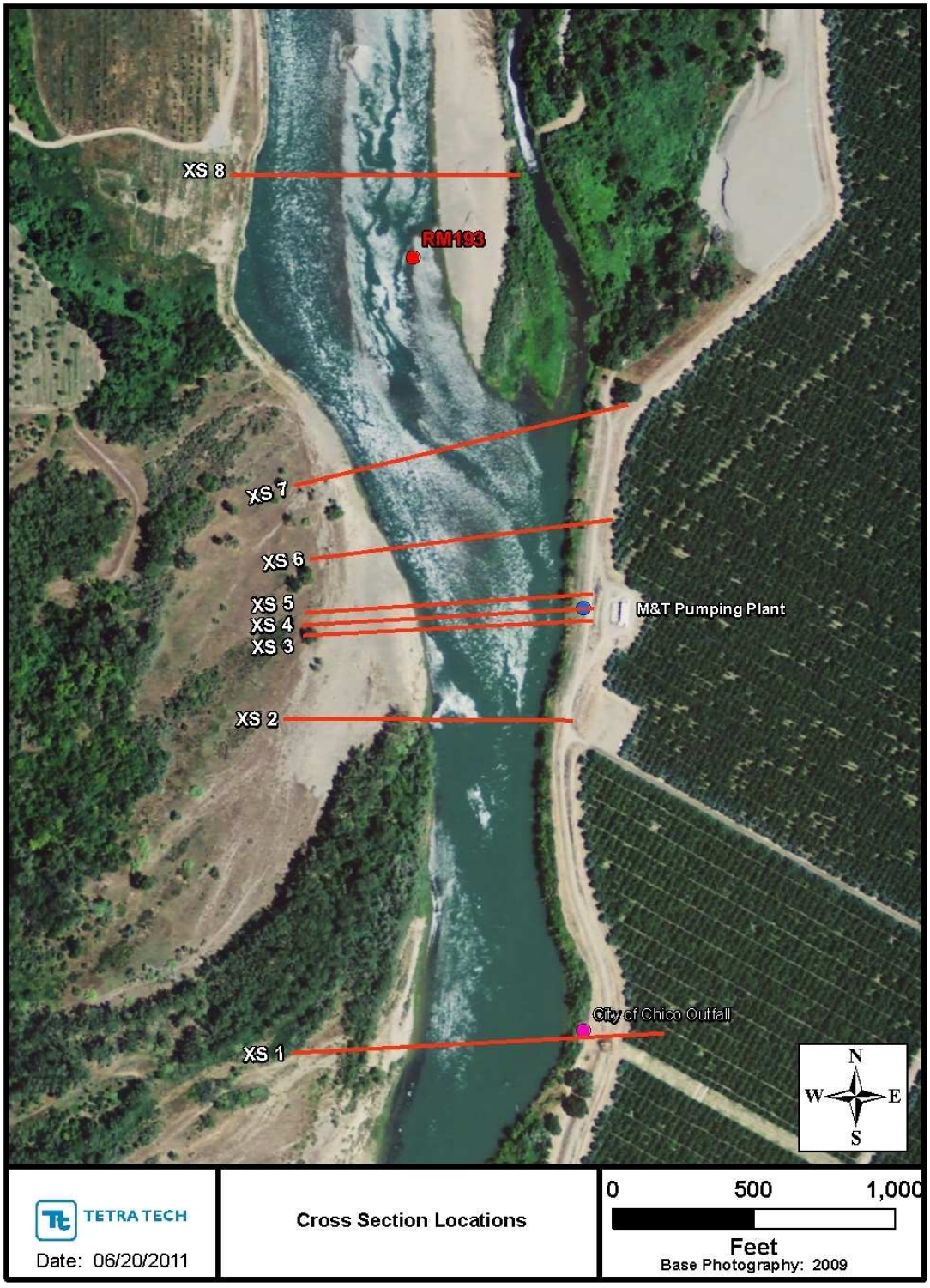


Figure 20. Locations of comparative cross sections discussed in the text.

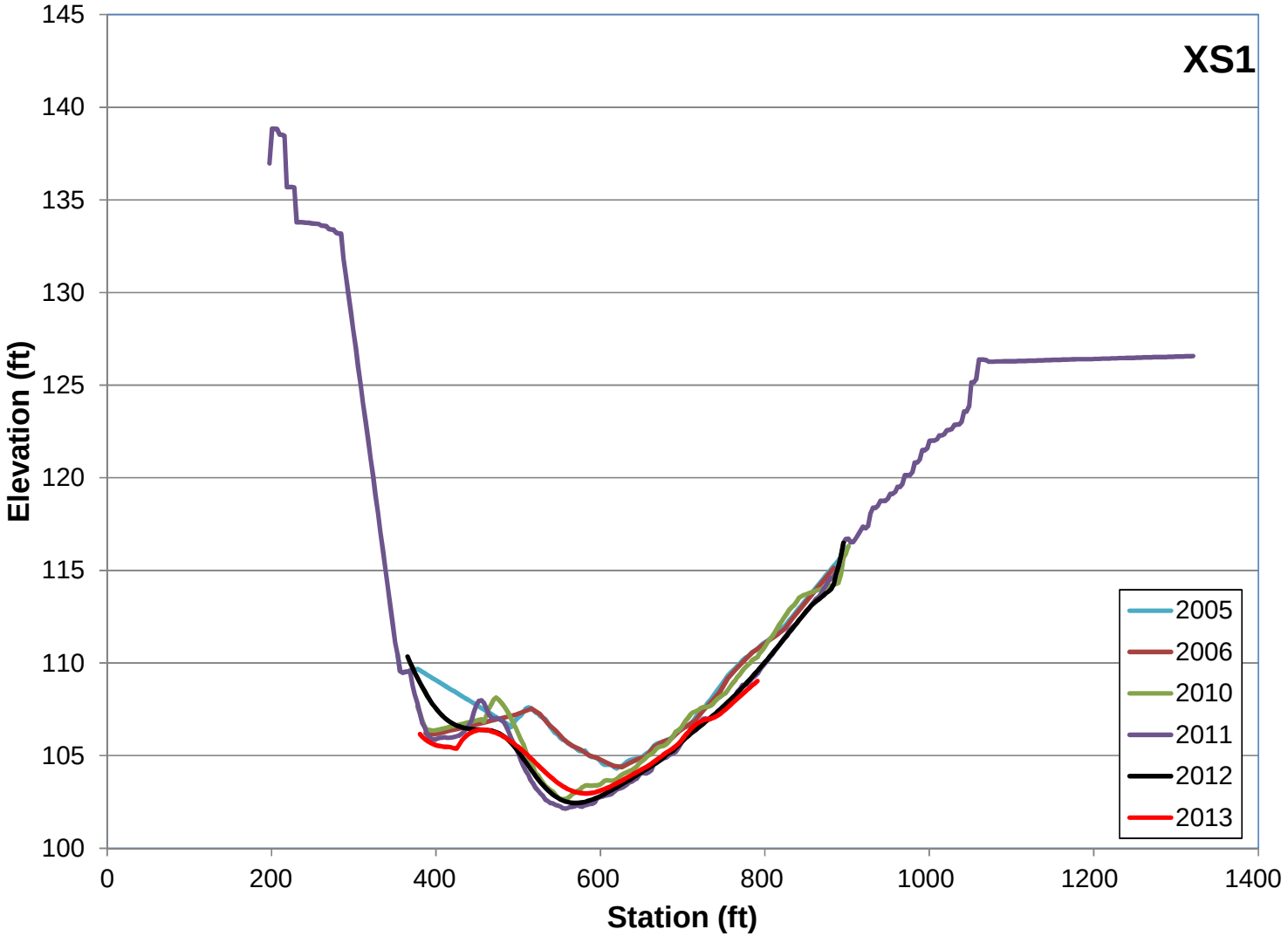


Figure 21. Comparative cross-section plots, 2005 to 2012 at the relocated City of Chico outfall.

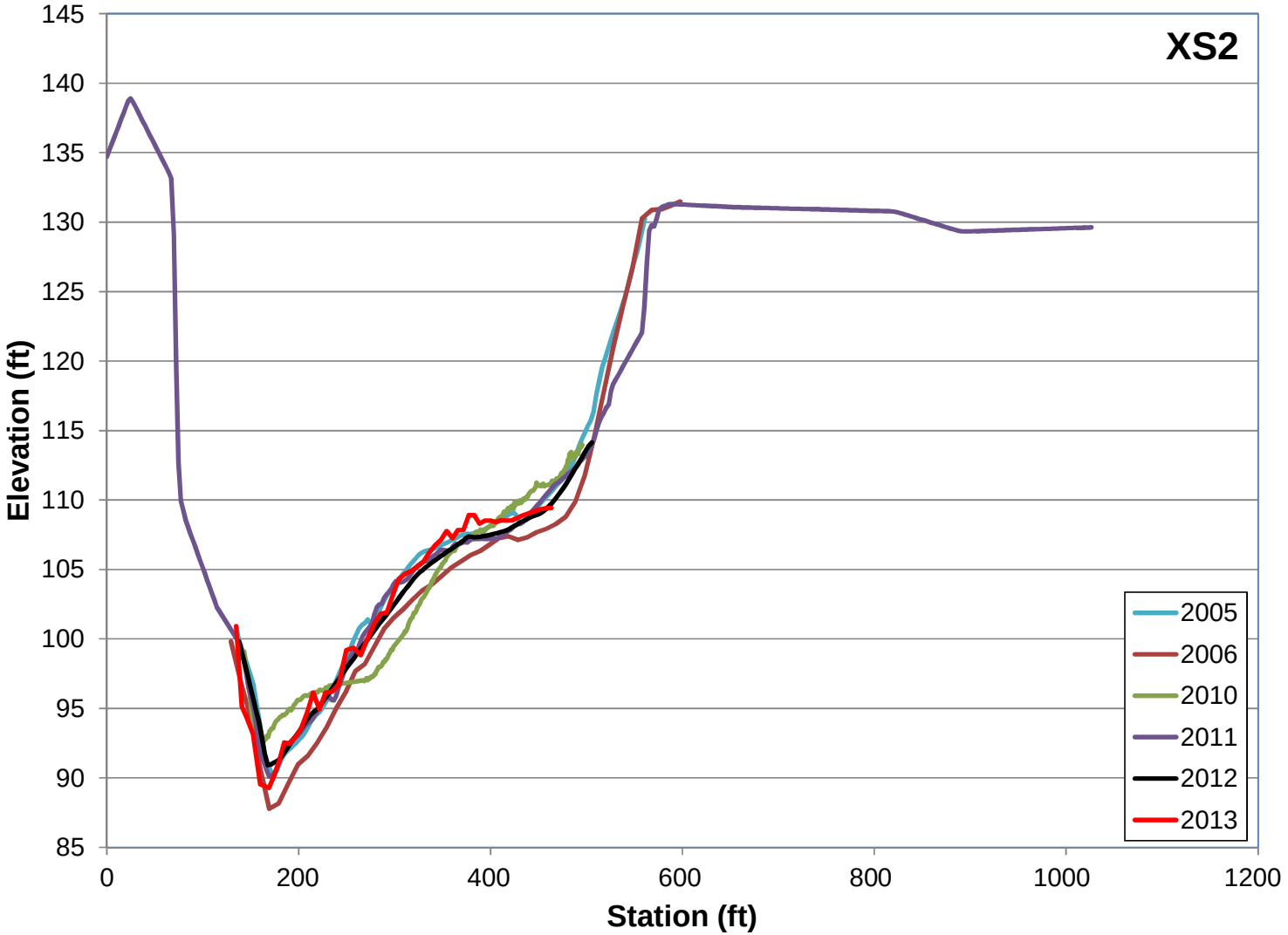


Figure 22. Comparative cross-section plots, 2005 to 2012 at the original City of Chico outfall.

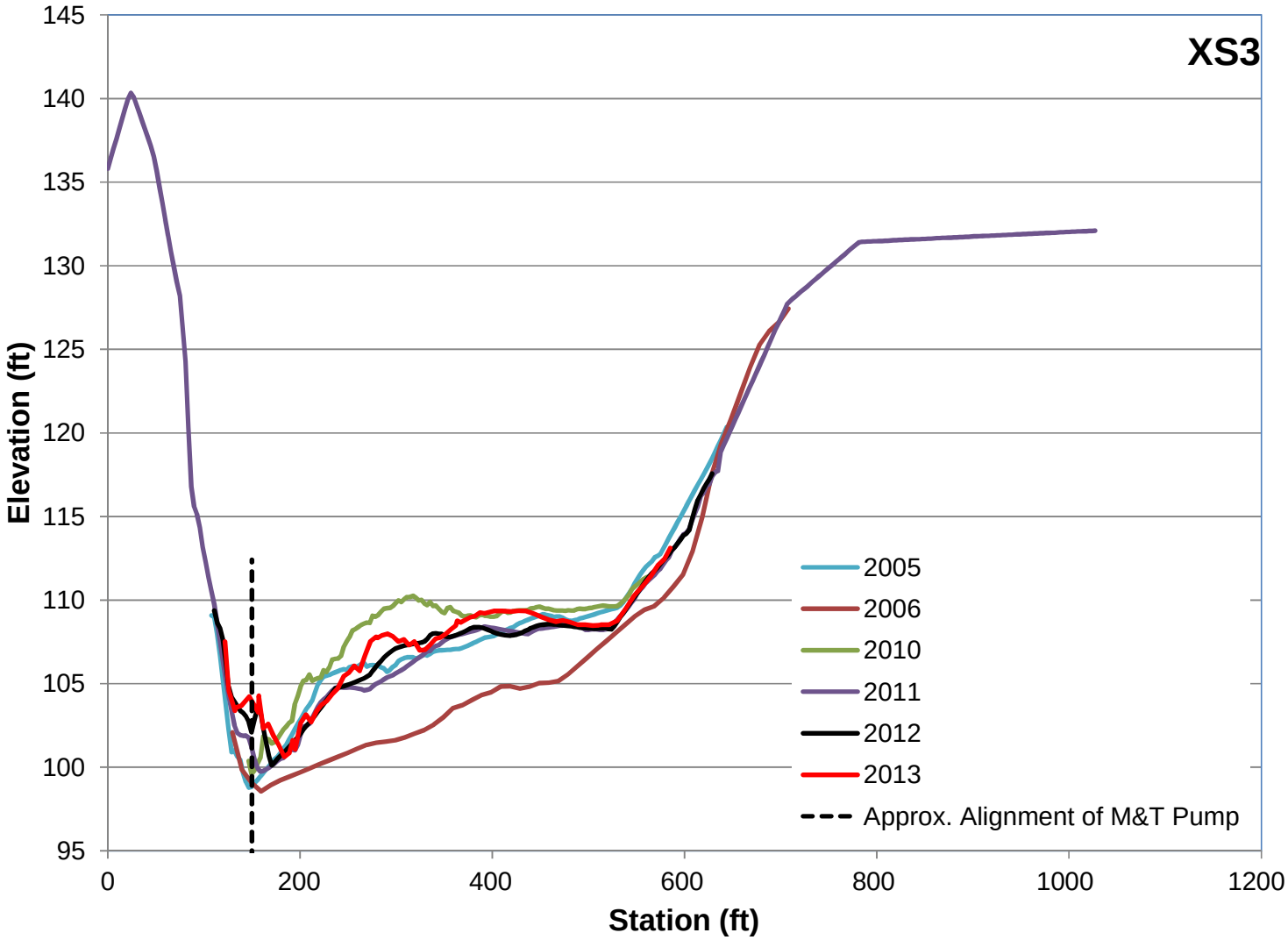


Figure 23. Comparative cross-section plots, 2005 to 2012 immediately downstream of the M&T/Llano Seco fish screens and pump inlets.

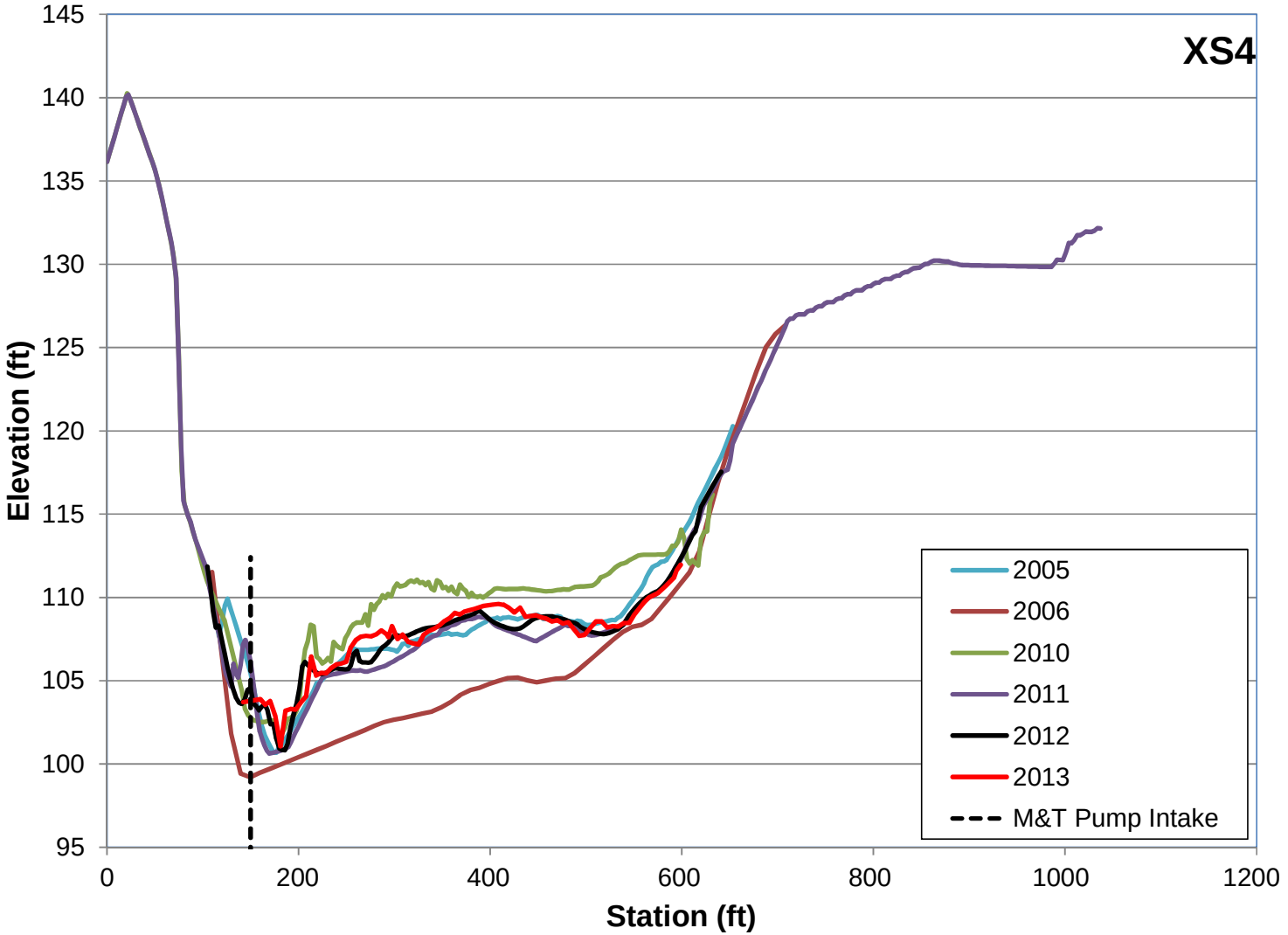


Figure 24. Comparative cross-section plots, 2005 to 2012 at the M&T/Llano Seco fish screens and pump inlets.

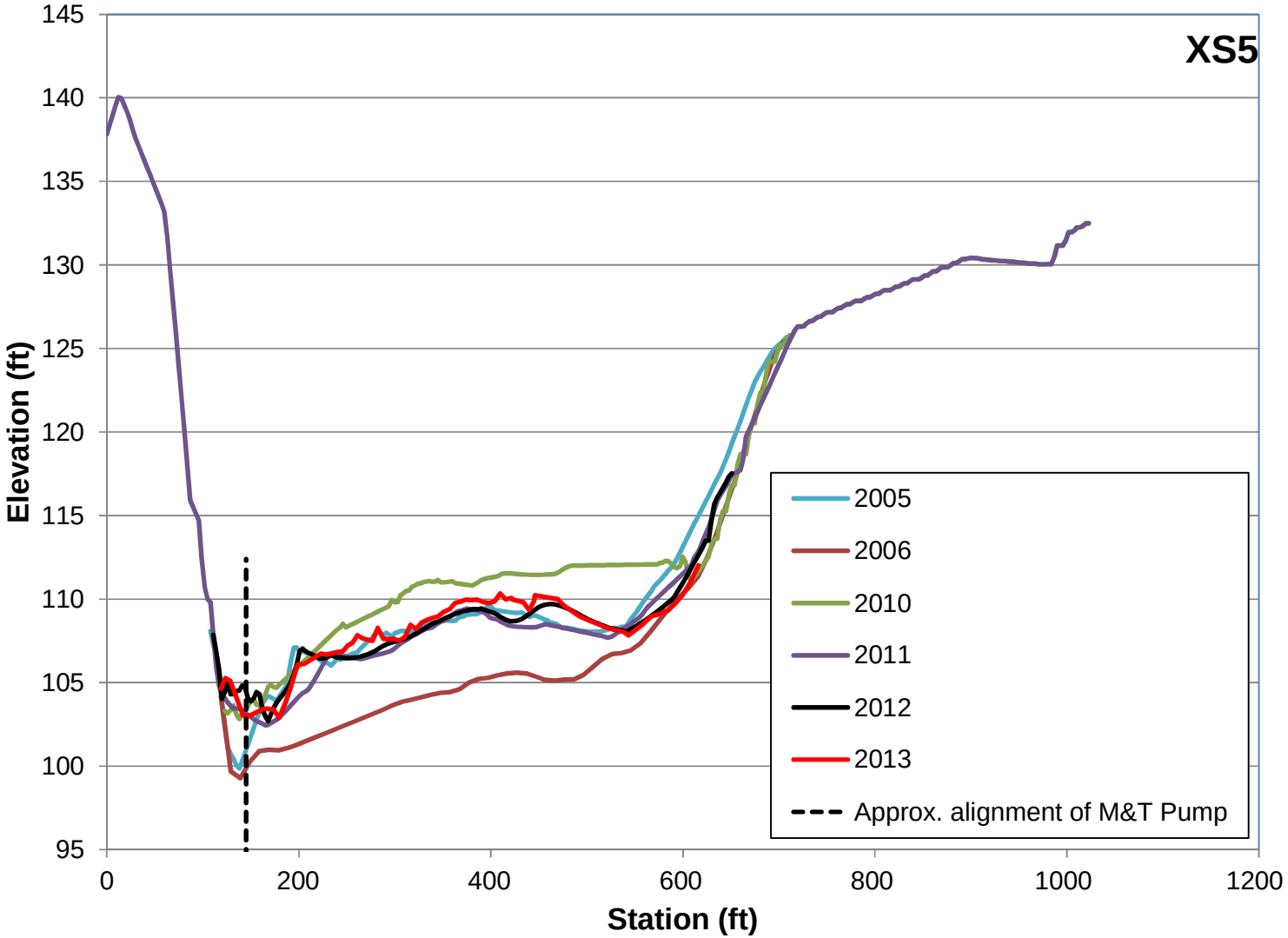


Figure 25. Comparative cross-section plots, 2005 to 2012 immediately upstream of the M&T/Llano Seco fish screens and pump inlets.

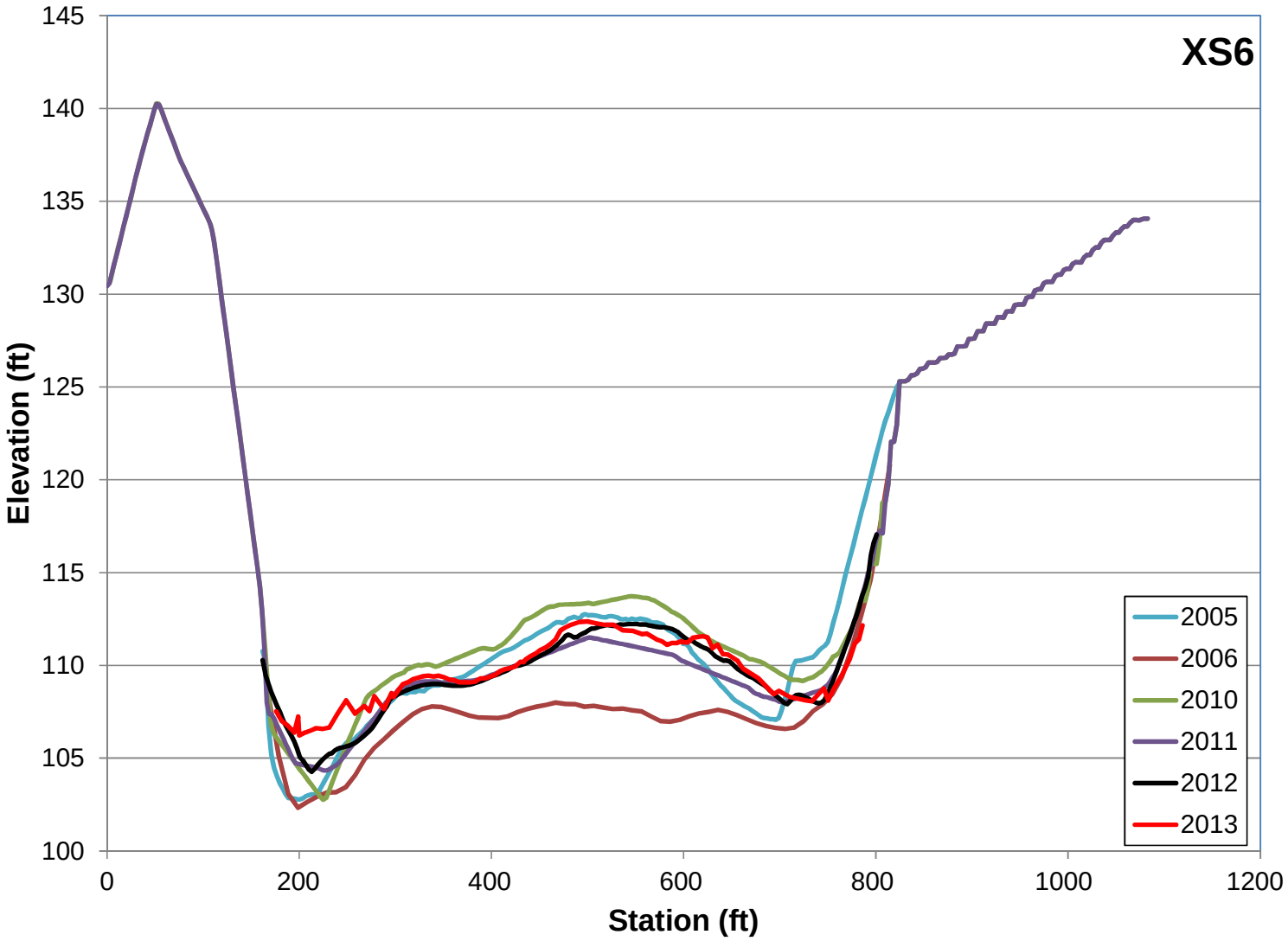


Figure 26. Comparative cross-section plots, 2005 to 2012 upstream of the M&T/Llano Seco fish screens and pump inlets on the lower part of the migrating bar.

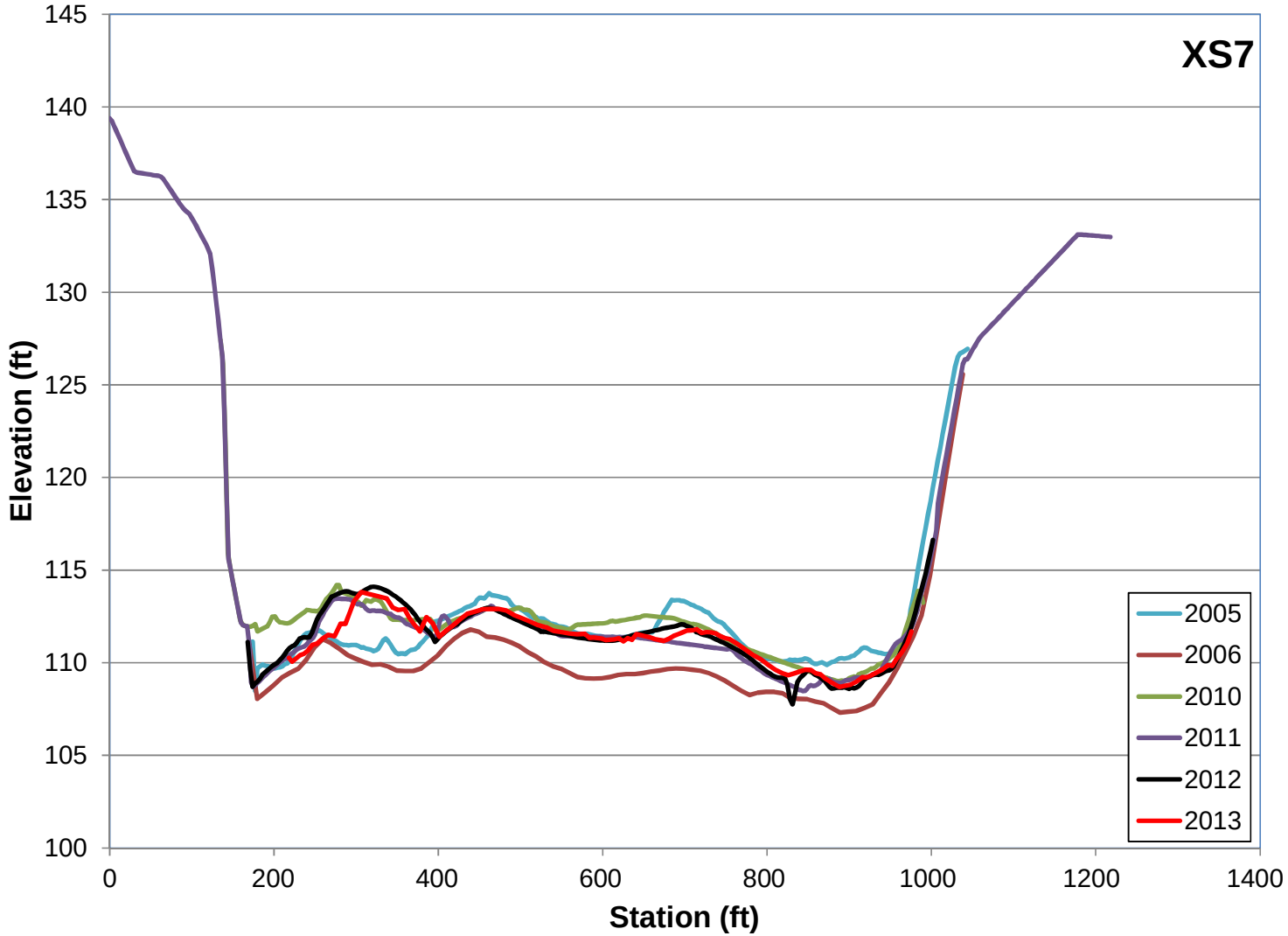


Figure 27. Comparative cross-section plots, 2005 to 2012 upstream of the M&T/Llano Seco fish screens and pump inlets on the upper part of the migrating bar.

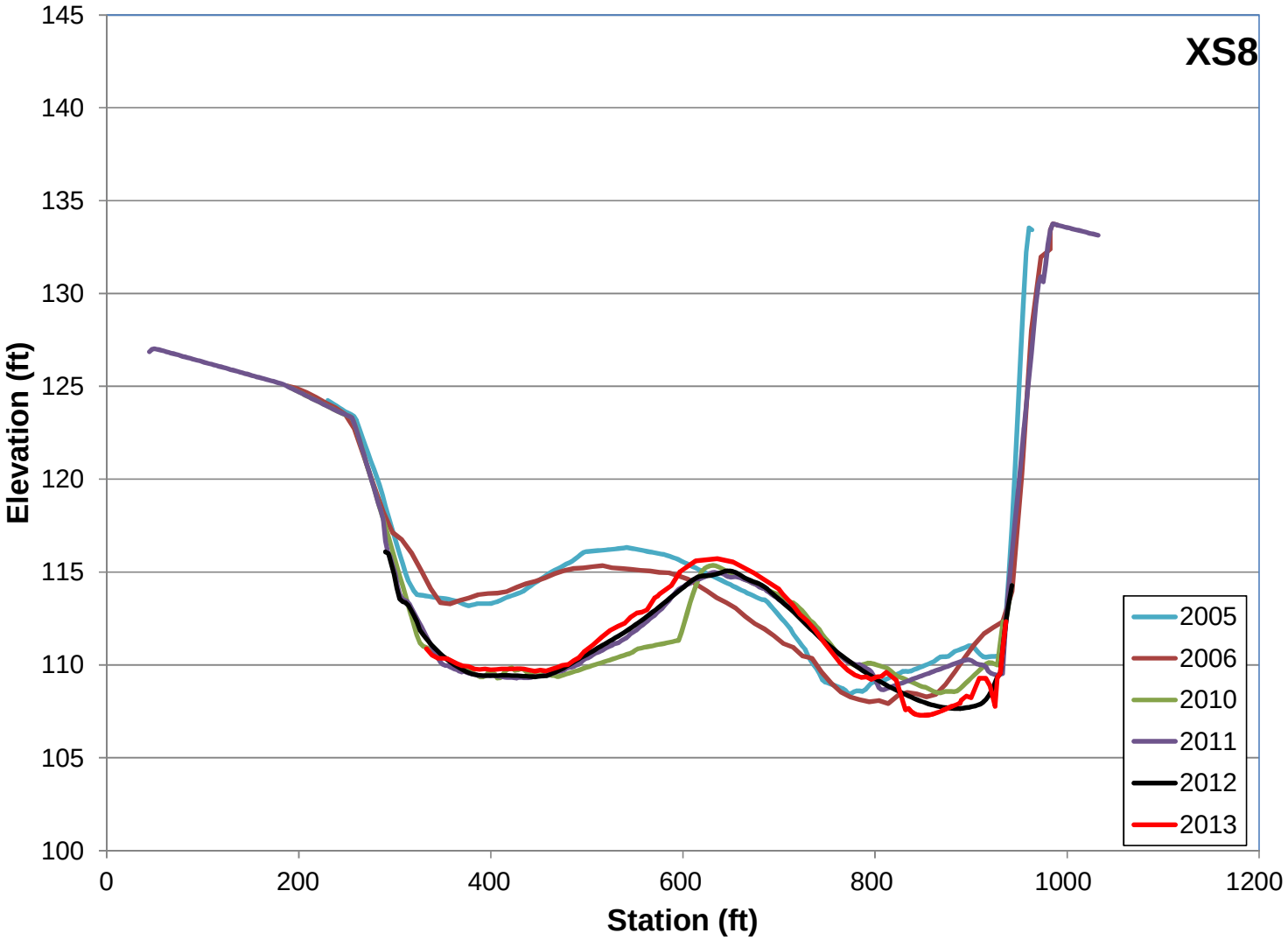


Figure 28. Comparative cross-section plots, 2005 to 2012 across the area that was dredged in 2007.

APPENDIX A

2013 Diver Reports

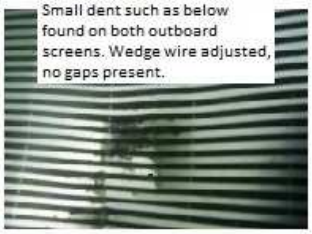
TETRA TECH

Big Valley Divers Inc.
P O Box 3284
Chico Ca. 95927
Off/Fax (530) 898-1110 Cl (530) 521-0588

3-20-13 - Big Valley Divers Inspection and Spring Cleaning Of:

M & T Ranch , Sacramento River Intake Station.
For: Les Heringer, Mike Bolen

Ord Ferry 3-20-13 River Stage ___ 97.1 _____



Screen #1 - Flanges and bolts tight. Small dent, no gap. Screen cleaned.
4.25' Average under screen to sand and gravel bottom.

Screen #2 - Flanges and bolts tight. No Damage. Screen cleaned.
3.75' Average under screen to sand and silt bottom.

Screen #3 - Flanges and bolts tight. Small dent, no gap. Screen cleaned.
3.5' Average under screen to sand and gravel bottom.

Screen #4 - Flanges and bolts tight. No Damage. Screen cleaned.
3' Average under screen to sand and silt bottom.

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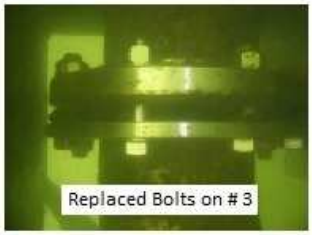
5-18-12 - Big Valley Divers Inspection and Spring Cleaning Of:

M & T Ranch , Sacramento River Intake Station.
For: Les Heringer, Mike Bolen

Ord Ferry 5-17-12 River Stage 97.75



Screen #1 - Flanges and bolts tight. Air test = No leaks. Screen cleaned. No dents.
6' from bottom of screen to sandy bottom.

Screen #2 - Flanges and bolts tight. Air test = No leaks. Screen cleaned. No dents.
5' From bottom of screen to sandy bottom.

Screen #3 - Flanges and bolts checked. 2 Galled Stainless Steel bolts found. Bolts removed and replaced. Bolts tightened. Air test = Small leak at beginning of air burst. Determined leak is workable and not to be repaired but will monitor. Screen cleaned. Two dents found. Diver able to rebend wedge wire back to operational status and closed up small gap. 4' From bottom of screen to sandy bottom.

Screen #4 - Flanges and bolts tight. Air test = No leaks. Screen cleaned. No dents.
3' From bottom of screens to sandy bottom.

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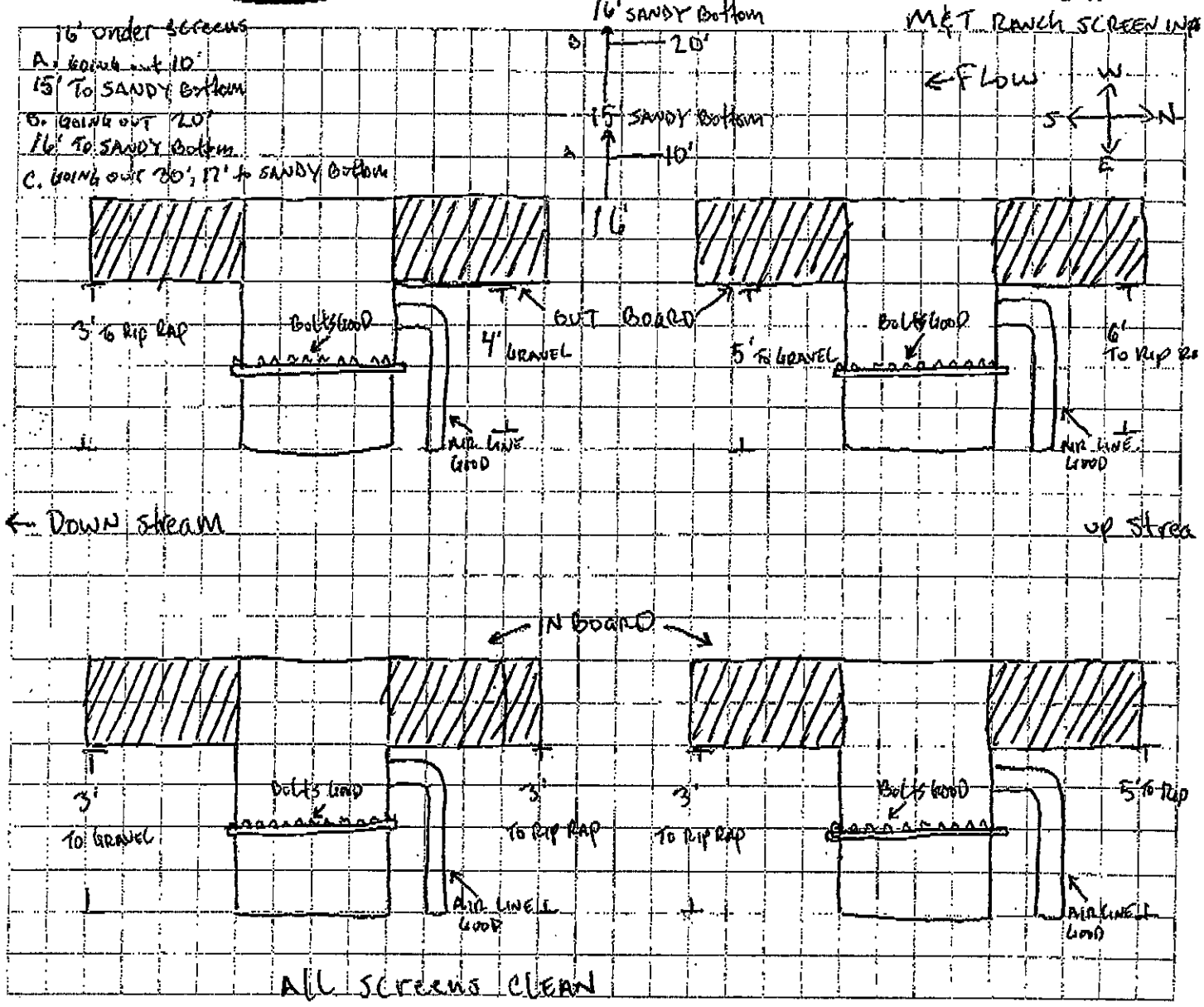
5-11-10



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- Lake & River Marina Maintenance
- Pump Stations, Fish Screens, Siphons
- Slide Gate and Hydraulic Install and Maintenance
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- Aquatic Barrier Construction
- Dredging, Water Jetting & Pigging
- Underwater Welding & Cutting
- Salvage and Recovery
- Hydro-Brush Hull Cleaning

BIG VALLEY DIVERS, INC.

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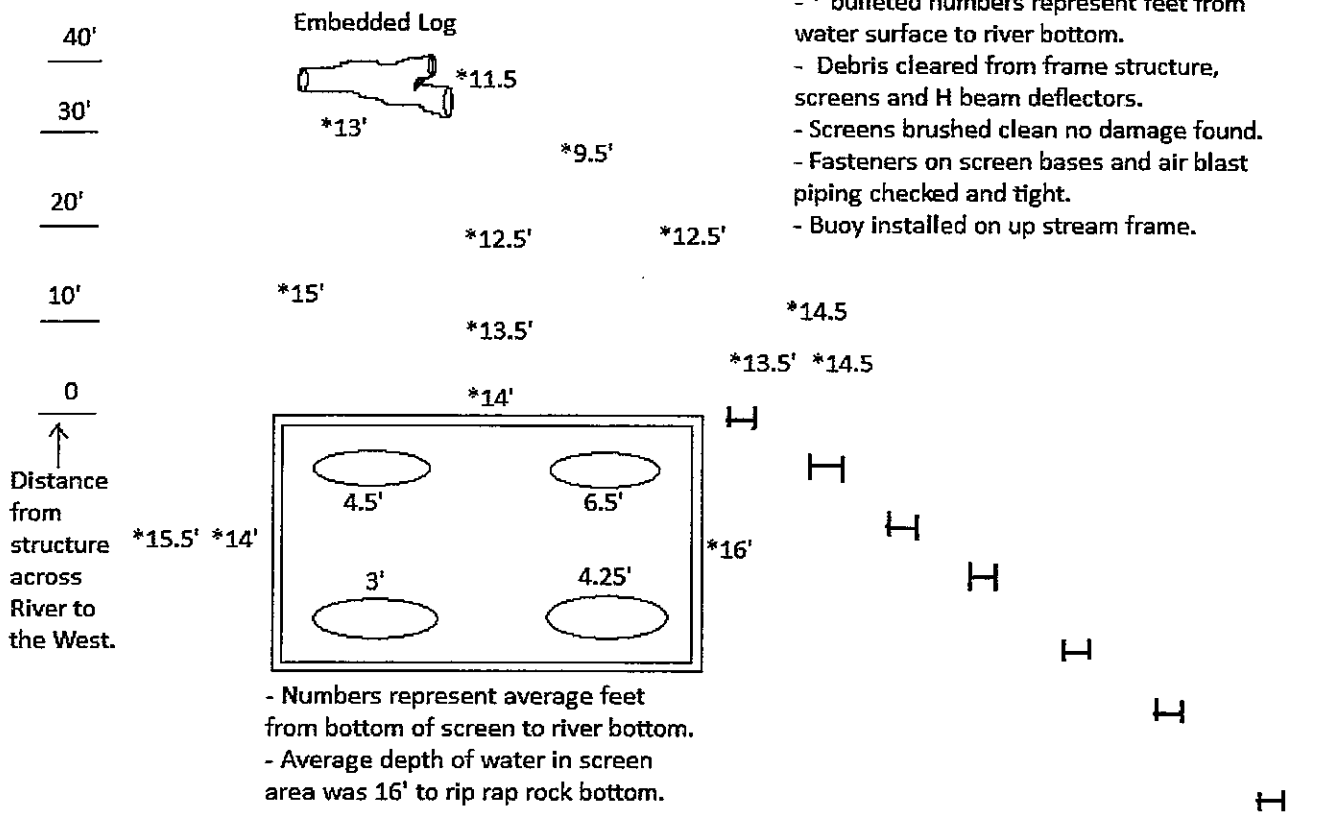
4-9-09 Big Valley Divers Dive Inspection and Spring Cleaning of:

M & T Ranch, Sacramento River Intake Station.
For: Less Heringer and Mike Bolen.

Ord Ferry Reading: 97.25

- * bulleted numbers represent feet from water surface to river bottom.
- Debris cleared from frame structure, screens and H beam deflectors.
- Screens brushed clean no damage found.
- Fasteners on screen bases and air blast piping checked and tight.
- Buoy installed on up stream frame.



- Numbers represent average feet from bottom of screen to river bottom.
- Average depth of water in screen area was 16' to rip rap rock bottom.

Big Valley Divers Inc.
P O Box 3284
Chico Ca. 95927
Off/Fax (530) 898-1110 Cl (530) 521-0588

To: M&T RANCH – CHICO ORd Ferry River Stage 97.25'

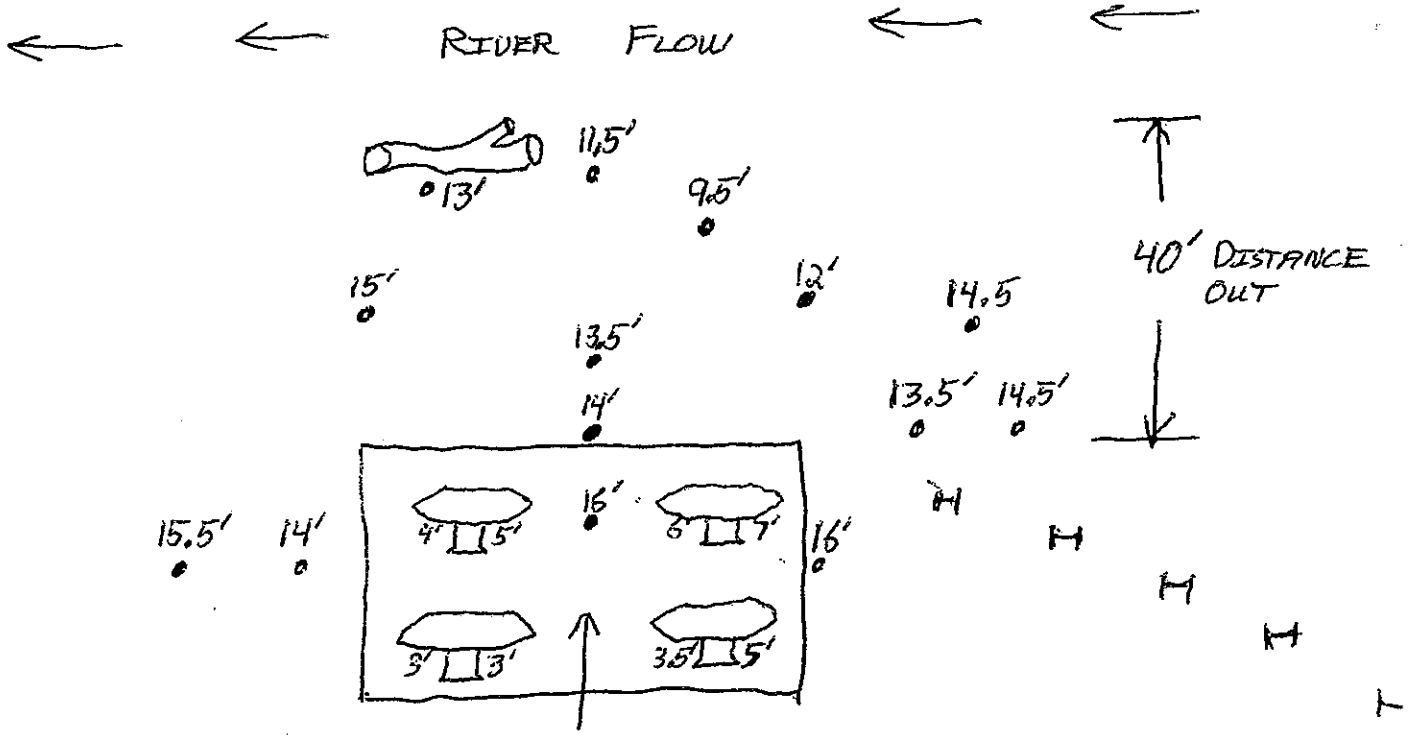
Rep: MIKE BOLIN
Re: 09 SPRING PUMP INSPECTION

DIVE REPORT

Date	4-9-09	Water Elevation	
Location	SAC. RIVER PUMPS	Depth	VARIED
		Water Temp.	55°
Requested By	MIKE BOLIN	Visibility	5'
Site Forman	MIKE	Current (fps)	2 FPS
Dive Supervisor	DOUG	Photos Y / N	N

Purpose of job: (Please note basic Tasks, Measurements (IE Before and After), and Drawings.

Readings Taken on 4-9-09



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INVOICE

CUSTOMER

NAME	M & T Ranch
ADDRESS	3964 Chico River Rd.
CITY	Chico CA.95928
PHONE	Of. (530) 342-2954 Cl. (530) 521-4464 Fx (530) 000-0000
REP	Les Heringer / Mike Bolin
Re	Install Bouys and Clean Fish Screens

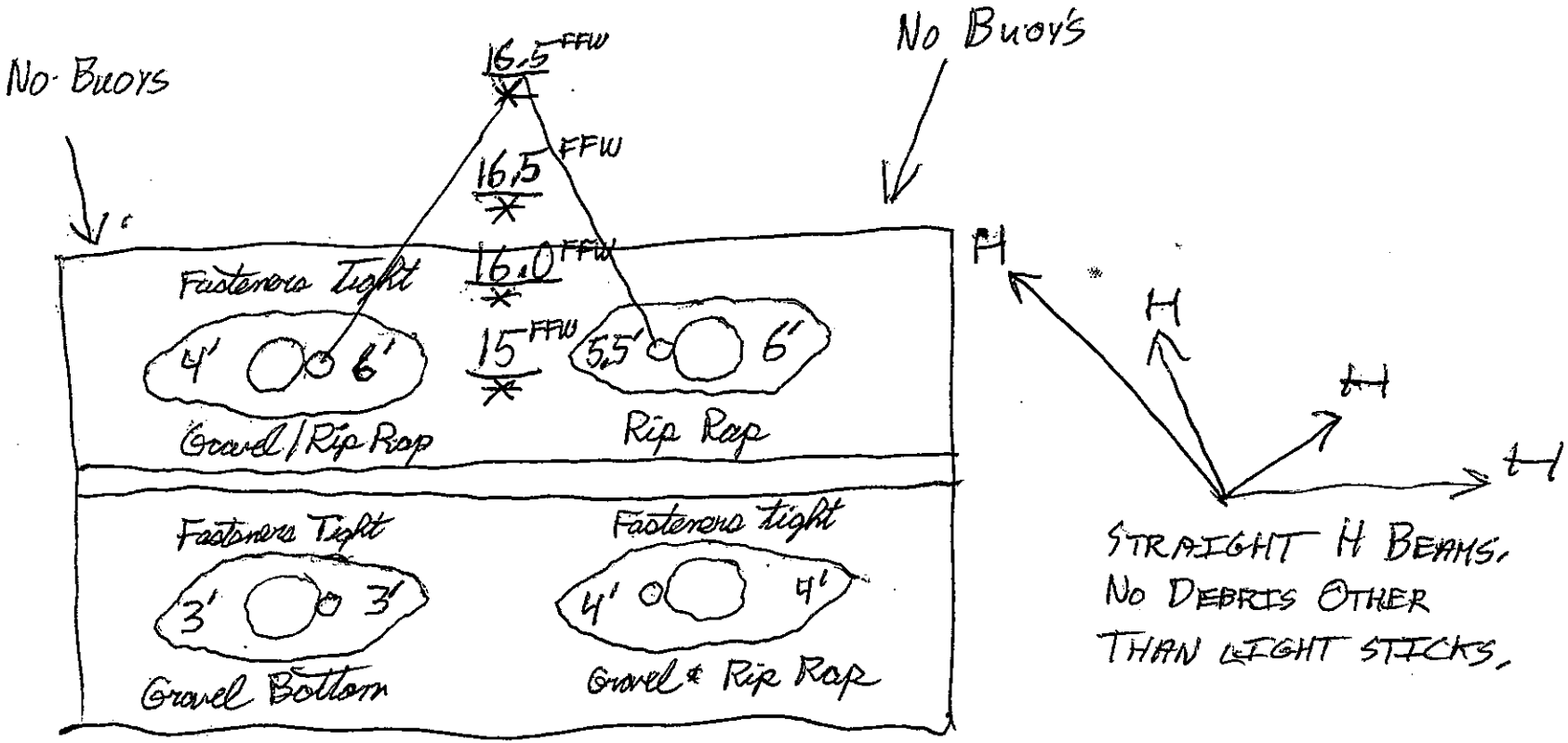
DATE	UNITS	DESCRIPTION	PER UNIT	TOTAL
6/5/2008	1	3 Person Dive Team, Heavy Gear, Full Comms.	1450	1450
	25	Mileage 1 Vehicles.	0.75	18.75
	1	Bouy	55	55
	1	Anchor Chains.	35	35
		1 - Anchors were attached with new chains.		0
		2 - Screens were cleaned.		0
		3 - Gravel encroachment is still held off as rip rap is around base of intakes.		0
				0
				0
				0
				0
				0
				0
				0
				0
				0
				0
				0
				0
				0
				0
				0
				0
TOTAL				1558.75

NOTES

Thank You For Using Big Valley Divers.
Doug.

← River Flow ←

Big Valley Divers
Doug @ 521-0588

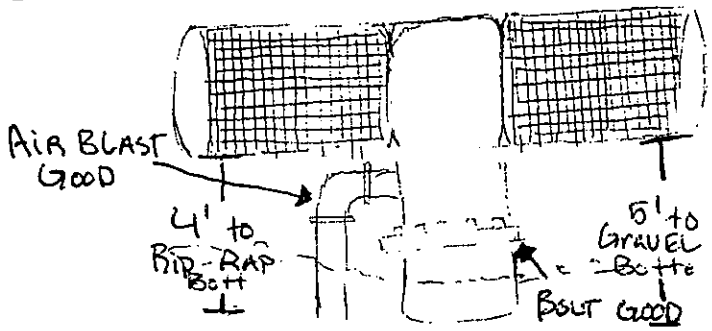


ORD FERRY EL = 97.7

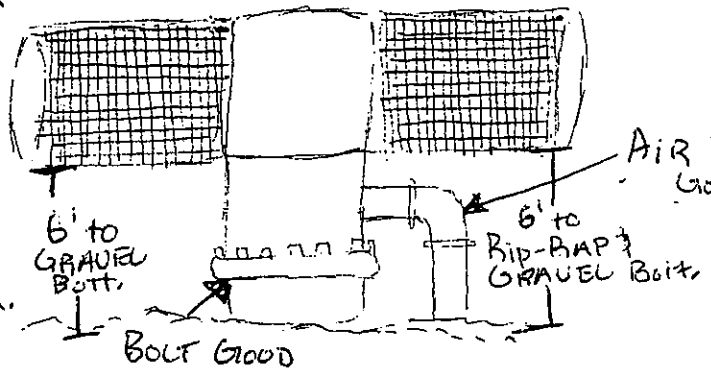
FLOW = 7,950

4-14-08
INSPECTION.

OUTER



SIDE



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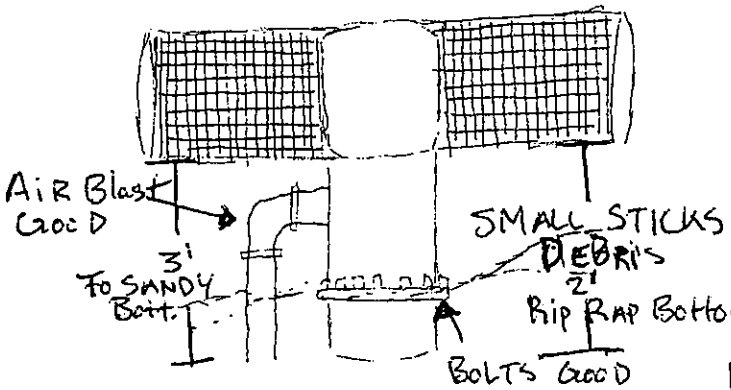
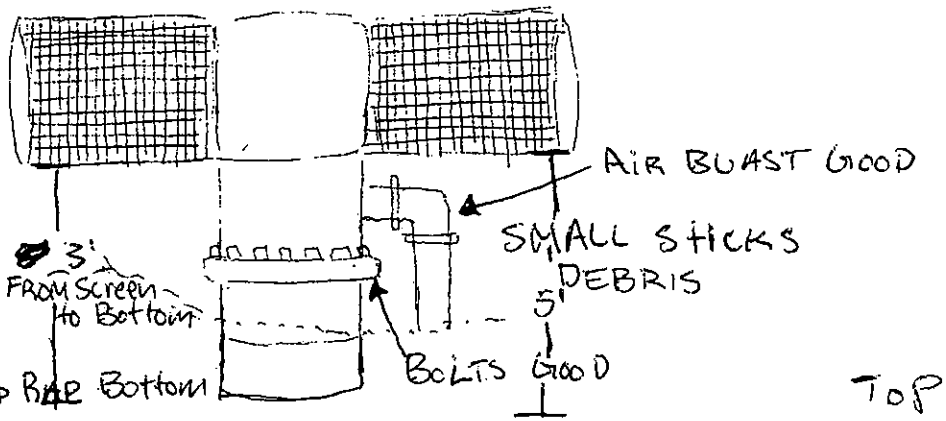
CA 95927

INER.

DOWN STREAM



UPSTREAM



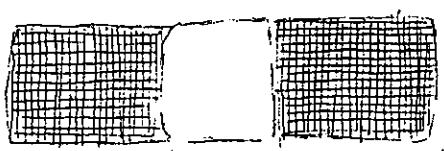
TOP

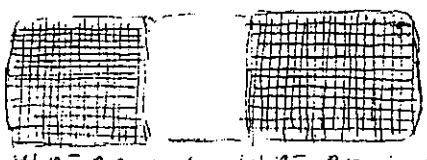
NOTES:
UPSTREAM-INER: UPST. 3' From SCREEN to Bottom
DOWN 5' From SCREEN TO Bottom
RipRAP Bottom
BOLTS GOOD/AIR BLAST Good

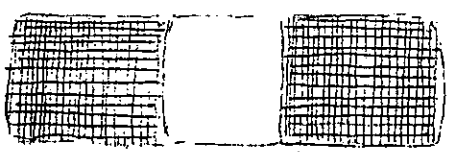
DOWN STREAM-INER: UPST. 2' to Rip RAP Bott.
Down. 3' to SANDY Bott.
BOLTS GOOD/AIR Blast Good

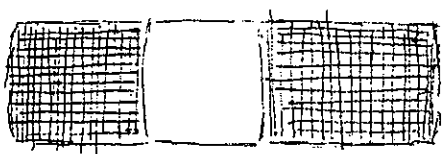
DOWN STREAM + Outter: UPST: 5' to GRAVEL Bott.
Down: 4' to Rip RAP Bott
Bolts GOOD/ AIR BLAST GOOD

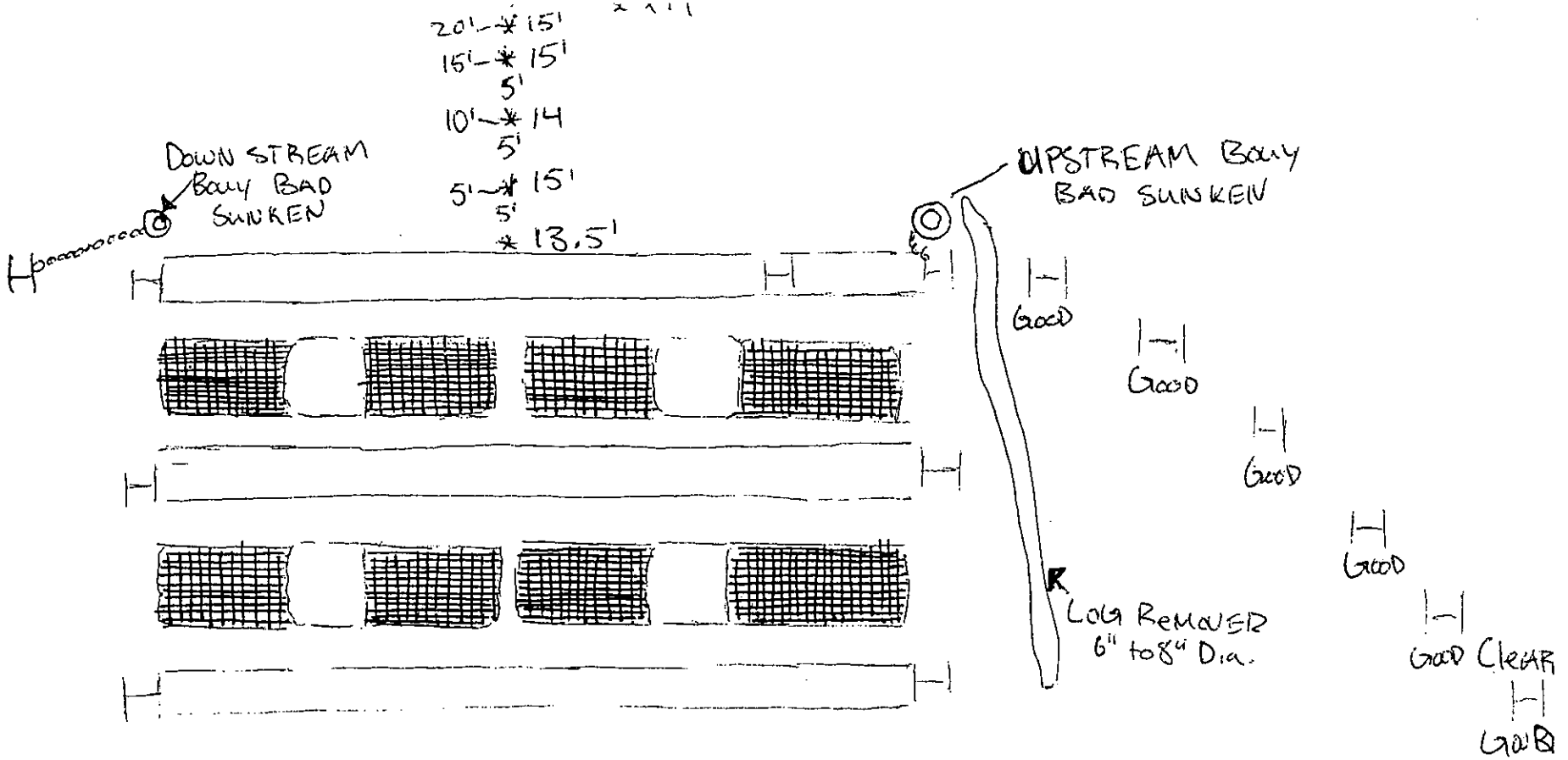
DOWNSTREAM-Outer: UPST: 6' TO Rip-RAP/Gravel Bott.
Down: 6' TO GRAVEL Bottom.
BOLTS GOOD/AIR BLAST GOOD











NOTES: *Depth READING STRAIGHT OUT From MIDDLE OF STRUCTURE
5' = 15' *PAST 30' SLOPES UP GRADUALY
10' = 14' * BOTH BOUY's SUNKEN
15' = 15' * REMOVED LOG FROM STRUCTURE
20' = 15' * ALL H-BEAMS GOOD
25' = 15'
30' = 14'

4-14-08 INSPECTION

P.O. Box 3254
Chico, CA 95927

BIG VALLEY DIVERS, INC.

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Chico, CA 95927
Office (530) 898-1110 Cell (530) 521-0588 Fax (530) 898-1110

To: M & T Ranch
3964 Chico River Rd.
Chico Ca. 95928

Attn: Less Herringer, Mike Bolin

Re: 07 Pump Station Inspection.

DIVE REPORT

Date	3-26-07	Water Elevation	97.7 – Ord Ferry
Location	Main Pumping Plant.	Depth	17'
		Water Temp.	52
Requested By	Less Heringer	Visibility	3'
Site Forman	Mike Bolin	Current (fps)	1fps
Dive Supervisor	Doug Maxfield		

Purpose Of Job

1 – Check fish screen intake structure for winter damage and debris.
2 – Check clearances from bottom of fish screen to river bottom.
3 – Brush fish screens clean.
4 – Check fasteners and hardware.

Report

1 – No major winter damage was found. Screens and surrounding protective structures were found to be in tact. No holes were found and screen integrity was found to be intact.

2 – Screen #1 average clearance 4' to gravel and rip-rap bottom.
Screen #2 average clearance 3' to gravel bottom.
Screen #3 average clearance 5.5' to 6' to rip-rap bottom.
Screen #4 average clearance 5' to gravel and rip-rap bottom.

3 – Diver traveled West from fish screen structure. The encroaching gravel bar began a slight downward gradient continuing to the West. The bottom leveled off 20' West of the structure and about 1.5' lower than the screen structure bottom elevation. Diver reported that the bottom appeared to continue flat to the West.

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4 – Fish screens were brushed clean.

5 – Fasteners were checked and no loose hardware was found.

6 - Both buoys need to be replaced this year.

7 – The deflector H beam structure up-stream was cleared of minor debris and all beams were straight and structurally sound.

Report complete.

BIG VALLEY DIVERS, INC.
P.O. Box 3284
Chico, CA 95927

River Flow

BIG VALLEY DIVERS, INC.
Douglas R. Maxfield
Lic # 757776
"DIVING SAFE SINCE 1994"
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FAX: (530) 898-1110
CELL: (530) 521-0588
ads@sunset.net
- Commercial Divers Specializing in Northern & Central California Underwater Needs.
- Irrigation Districts, Powerhouse & Dam Maintenance and Repair, Clean Water.
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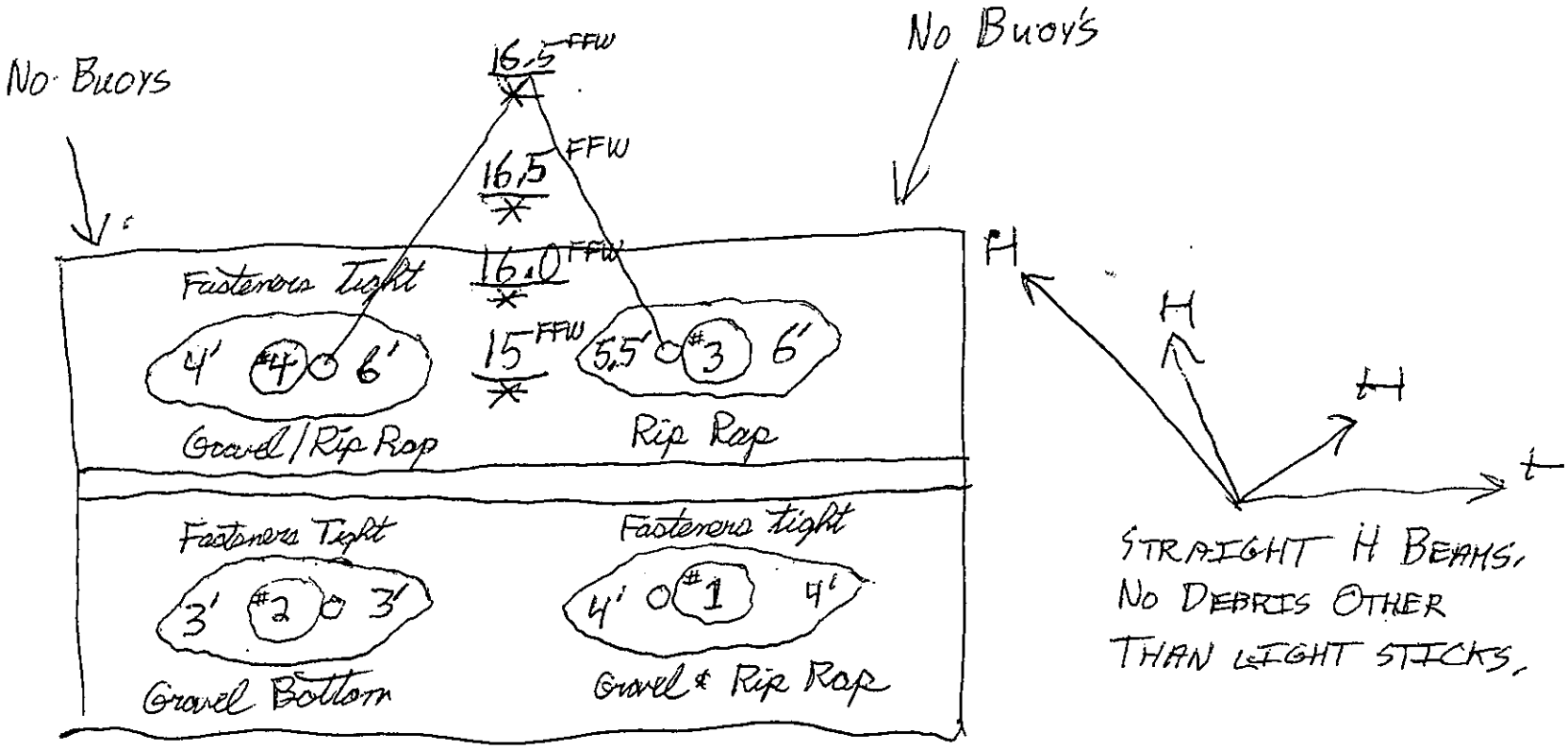

ORD FERRY EL. = 97.7

FLOW = 7,950

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100' Old Ferry Co.

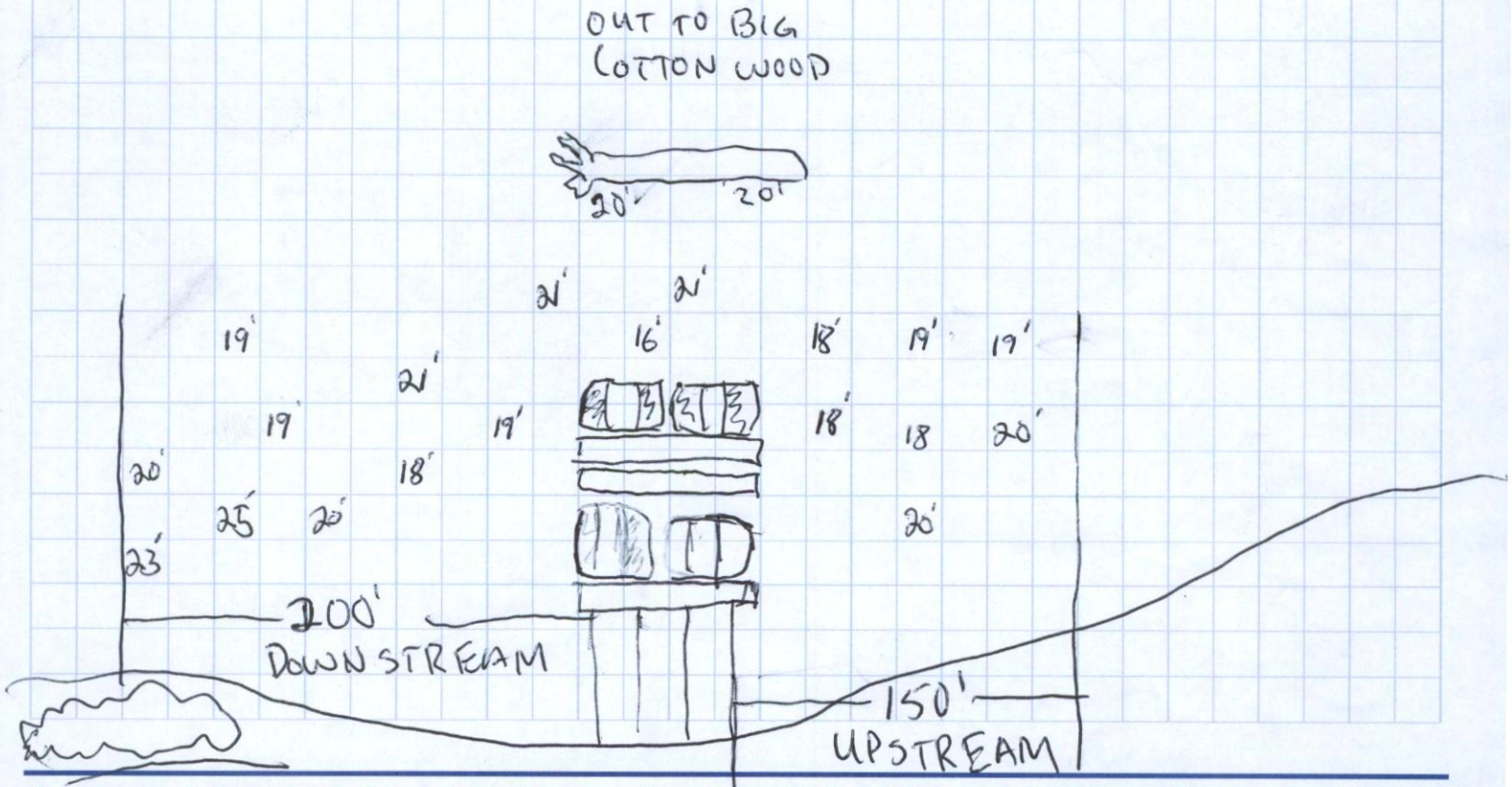
M & T RANCH ATTEN: LES

DEPTH SOUNDING

4-22-11

16,000 c.f.s. - Sac River

Area under screens clear to concrete/rip rap.



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