

**STREAM & FLOODPLAIN ENHANCEMENT OF LOWER
TERWER CREEK: 2012**



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In Partnership with:

California Department of Fish and Wildlife

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Acknowledgements



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Introduction

The Yurok People have relied upon Klamath River and coastal resources for their subsistence, cultural, and economic livelihood since time immemorial. Central to Yurok culture is the harvest of anadromous fish. Runs of anadromous fish currently returning to spawn in Lower Klamath tributaries are depressed when compared with historical numbers. Extensive timber removal and road building activities has resulted in chronic sedimentation of streams and floodplains; a significant loss of channel-stored wood and riparian conifers; and a concomitant loss of habitat diversity and production potential in the sub-basin (Payne & Associates 1989; Gale and Randolph 2000; Beesley and Fiori 2007 & 2008; Gale and Beesley 2006; Voight and Gale 1998).

In the Klamath River, all runs of chinook salmon (*Oncorhynchus tshawytscha*), green sturgeon (*Acipenser medirostris*), and Pacific lamprey (*Lampetra tridentata*) are on the decline and coho salmon (*O. kisutch*) are listed as “threatened” under the Endangered Species Act. The Yurok Tribe is dedicated to rehabilitating degraded instream and riparian habitats to levels that support robust, self-sustaining populations of native anadromous fish. To help address this need, the Yurok Tribe’s Fisheries (YTFP) and Watershed (YTWRD) programs have been conducting fisheries and watershed assessments; and implementing instream and upslope restoration activities in the Lower Klamath River Sub-basin since the late 1990s.

Initial restoration planning efforts included developing the Lower Klamath Sub-Basin Watershed Restoration Plan that prioritized upslope restoration and identified tributary specific restoration objectives for each Lower Klamath tributary (Gale and Randolph 2000). Sub-basin restoration objectives included: 1) reducing sediment inputs from upslope sources by treating high priority watershed road segments and stream crossings; 2) restoring native, conifer-dominated riparian forests; and 3) enhancing freshwater aquatic habitats. Since 2007, YTFP has been working with Rocco Fiori of Fiori GeoSciences (FGS) to design and implement innovative stream and floodplain enhancement projects in priority Lower Klamath tributaries. Treatments have included installation of constructed wood and engineered log jams (CWJs & ELJs) to facilitate formation and maintenance of productive fish habitats (e.g. spawning beds, deep pools with cover, slow velocity habitats), and enhancing off-channel habitats to increase salmonid rearing capacity (YTFP 2010; Hiner et al. 2011; YTFP 2012; Beesley and Fiori 2012a & 2012b).

In 2009-2010, YTFP and FGS partnered with the U.S. Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration (NOAA) (Coastal and Marine Habitat Restoration Program - American Recovery and Reinvestment Act Funds). Primary objectives of these partnerships were to implement priority instream, riparian, and off-channel habitat restoration treatments in lower Terwer Creek to improve conditions for native fish and wildlife (YTFP 2010; Hiner et al. 2011; Beesley and Fiori 2012b). All work was conducted in the Lower Arrow Mills project reach of Terwer Creek (Figures 1-2). In 2009, YTFP and FGS constructed two ELJs (ELJ 1 & Crib Wall Jam) and extensive bioengineering to help protect valuable riparian habitats by reducing stream velocities in the reach. In 2010, treatments included enhancement of two off-channel habitat features to increase juvenile salmonid winter rearing capacity. Physical habitat monitoring data collected by YTFP in the Lower Arrow Mills reach since 2005 indicates positive habitat response (e.g. reduced soil loss along eastern bank, pool formation) to implemented treatments (Gale 2009; Hiner et al. 2011; Beesley and Fiori 2012a).

In 2011, YTFP and FGS partnered with USFWS, the California Department of Fish and Wildlife's (CDFW) Fisheries Restoration Grant Program (CA Adaptive Watershed Improvement Funds), and the U.S. Bureau of Reclamation (BOR) (Native American Affairs Program) to continue bioengineering and ELJ construction in the Lower Arrow Mills project reach (Beesley and Fiori 2012a). Project deliverables included augmenting Terwer ELJ 1 (e.g. adding wood and alluvium) and construction of an additional ELJ (Terwer ELJ 2) (Figure 3).

Project Overview

The current project was a partnership with FGS, CDFW's Fisheries Restoration Grant Program (CA Adaptive Watershed Improvement Funds), and the BOR (Native American Affairs Program) to continue ELJ construction in the Lower Arrow Mills project reach in lower Terwer Creek, Lower Klamath River Sub-basin (Figure 2). Terwer Creek is a fourth order watershed draining approximately 31.8 square miles of steep, forested terrain. Terwer Creek flows into the north side of the Lower Klamath River 5.6 river miles upstream of the Pacific Ocean (Figure 1). The watershed supports anadromous populations of chinook and coho salmon, steelhead (*O. mykiss*), coastal cutthroat trout (*O. clarkii clarkii*), and multiple species of lamprey. East Fork Terwer Creek is the largest tributary in the watershed and supports populations of coho, steelhead, coastal cutthroat trout, and lamprey species. The lower reaches of Terwer Creek also provides critically valuable winter rearing habitat for non-natal juvenile coho salmon.

Terwer Creek is located in the Klamath Glen Hydrologically Significant Area, which was given the highest priority rating in the Recovery Strategy for California Coho Salmon (CDFG 2004). The priority California coho recovery task addressed by this project was KR-KG-15 – implementing instream and riparian restoration in priority Lower Klamath River tributaries. For this project instream habitat restoration activities were conducted during October 2012. No fish relocation was necessary to perform project tasks and all other permit requirements were met.

Lower Terwer Creek Project objectives included:

- Increasing habitat complexity and stream channel stability in lower Terwer Creek by constructing two additional ELJs and an enhancing existing ELJ;
- Evaluating project effectiveness to facilitate adaptive management of the project area; and
- Creating high quality, resource-based employment opportunities for Yurok tribal members.

Driving Directions

The project site is located on property owned by Green Diamond Resource Company (GDRC - Contact: Ryan Bourque - Aquatic Monitoring Supervisor - PO Box 68; Korb CA, 95550). Heading south from the town of Klamath on U.S. Highway 101, take the first exit immediately before crossing the Klamath River (Exit for Highway 169 and Klamath Glen). Turn left at the stop sign, travel under the highway and remain on Highway 169 for approximately 2.6 miles. Turn left onto Arrow Mills Road and travel north for approximately 0.4 miles to a GDRC gate

(Road #U10). A GDRC key is required to pass through the gate. Proceed on the U10 road and take the first road on the left. Stay to the left at the fork and proceed ~100 feet to a parking area. The work site was located in Terwer Creek located just west of the parking area.

Engineered Log Jams

In October 2012, YTFP and FGS used heavy equipment, whole tree materials, and live willow cuttings to augment an existing ELJ (Terwer ELJ 2 – Lat: 41.525, Long: -123.987) and to construct two additional ELJs located upstream (Terwer ELJ 3 – Lat: 41.526, Long: -123.987, Terwer ELJ 4 – Lat: 41.527, Long: -123.986) (Figures 3-6). Terwer ELJ 2 was initially constructed by YTFP and FGS during summer 2011 to help protect valuable riparian habitats and improve mainstem conditions for native fish (Figure 3). Augmentation of ELJ 2 included adding additional whole tree materials and native alluvium to increase the ability of this structure to protect valuable riparian habitats and separate high flows at this site to promote maintenance of the side channel located in this reach. Terwer ELJ 3-4 were constructed to help further separate high flows at this site to help protect the off-channel wetland constructed in 2010 (Terwer Pond B), to reduce stream velocities and bank erosion in this reach, and to increase mainstem habitat complexity and velocity refuge for both juvenile and adult salmonids (Figures 4-6).

Physical Monitoring

YTFP conducted detailed topographic surveys in the Lower Arrow Mills project area to document baseline, as-built, and post-project conditions. For these surveys, YTFP and FGS used an established network of permanent bench marks in the project area to conduct surveys of the channel profile and cross sections. Surveys were conducted using an optical total station and a Recon data collector. All of the topographic surveys were conducted using the optical total station and a Recon data recorder. Baseline topographic surveys were conducted in the Lower Arrow Mills project area in May 2012. Surveys were repeated in October 2012 to document as-built conditions. In January 2013, cross sections within the project reach were resurveyed to document conditions following high flow events in November-December 2012. Survey data was imported into YTFP GIS and Microsoft Excel to assess changes in topography (Figures 7-9). The key points to note from the topographic surveys include the deepened channel in the as-built surveys and the cross sectional changes occurring following the high flow events (Figures 7-9).

YTFP established three new permanent photographic monitoring sites in the project area using a hand-held GPS receiver (sub-meter accuracy) (Table 1; Figures 3-6). These sites allowed YTFP to document short-term habitat changes that occurred in the project area during this project. These points are part of a larger network of permanent photo-points that exists in the Terwer Creek valley as part of YTFP's long-term channel monitoring program within this watershed.

Performance Measures

1. Total miles of instream habitat treated: 0.42 miles
2. Type of materials used for channel structure placement: Engineered Log Jams consisting of whole trees and logs with ballast materials (native bed materials) and live willow added.
3. Miles of stream treated with channel structure placement: 0.42 miles
4. Number of instream pools created by structure placement: 2
5. Number of structures placed in channel: 2 New ELJs, Enhanced 1 Existing ELJ
6. Type of monitoring: Physical monitoring
7. Location of monitoring: Onsite

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Table 1. Photographic monitoring site information for the “Stream & Floodplain Enhancement of Lower Terwer Creek: 2012”, Lower Klamath River (2011-2012).

Date	Site Name	Description	Latitude	Longitude	Orientation	Status
10/6/2011	TC ELJ 1-2-East	Pre-Project	41.5259	-123.9874	East Towards Road	Existing Point
3/29/2012	TC ELJ 1-2-East	Post-Project	41.5259	-123.9874	East Towards Road	Existing Point
4/24/2012	TC ELJ 3-4A	Pre-Project	41.526	-123.987	N. East & Slightly Upstream	New Point
10/20/2012	TC ELJ 3-4A	During Project	41.526	-123.987	N. East & Slightly Upstream	New Point
10/21/2012	TC ELJ 3-4A	As-Built	41.526	-123.987	N. East & Slightly Upstream	New Point
10/25/2012	TC ELJ 3-4A	Post-Project	41.526	-123.987	N. East & Slightly Upstream	New Point
4/24/2012	TC ELJ 3-4B	Pre-Project	41.525	-123.987	On ELJ2 - Upstream	New Point
10/20/2012	TC ELJ 3-4B	During Project	41.525	-123.987	On ELJ2 - Upstream	New Point
10/21/2012	TC ELJ 3-4B	As-Built	41.525	-123.987	On ELJ2 - Upstream	New Point
10/25/2012	TC ELJ 3-4B	Post-Project	41.525	-123.987	On ELJ2 - Upstream	New Point
3/30/2012	TC ELJ 2-3A	Pre-Project	41.524	-123.989	On levee - Downstream	New Point
10/25/2012	TC ELJ 2-3A	As-Built	41.524	-123.989	On levee - Downstream	New Point
12/20/2012	TC ELJ 2-3A	Post-Project	41.524	-123.989	On levee - Downstream	New Point

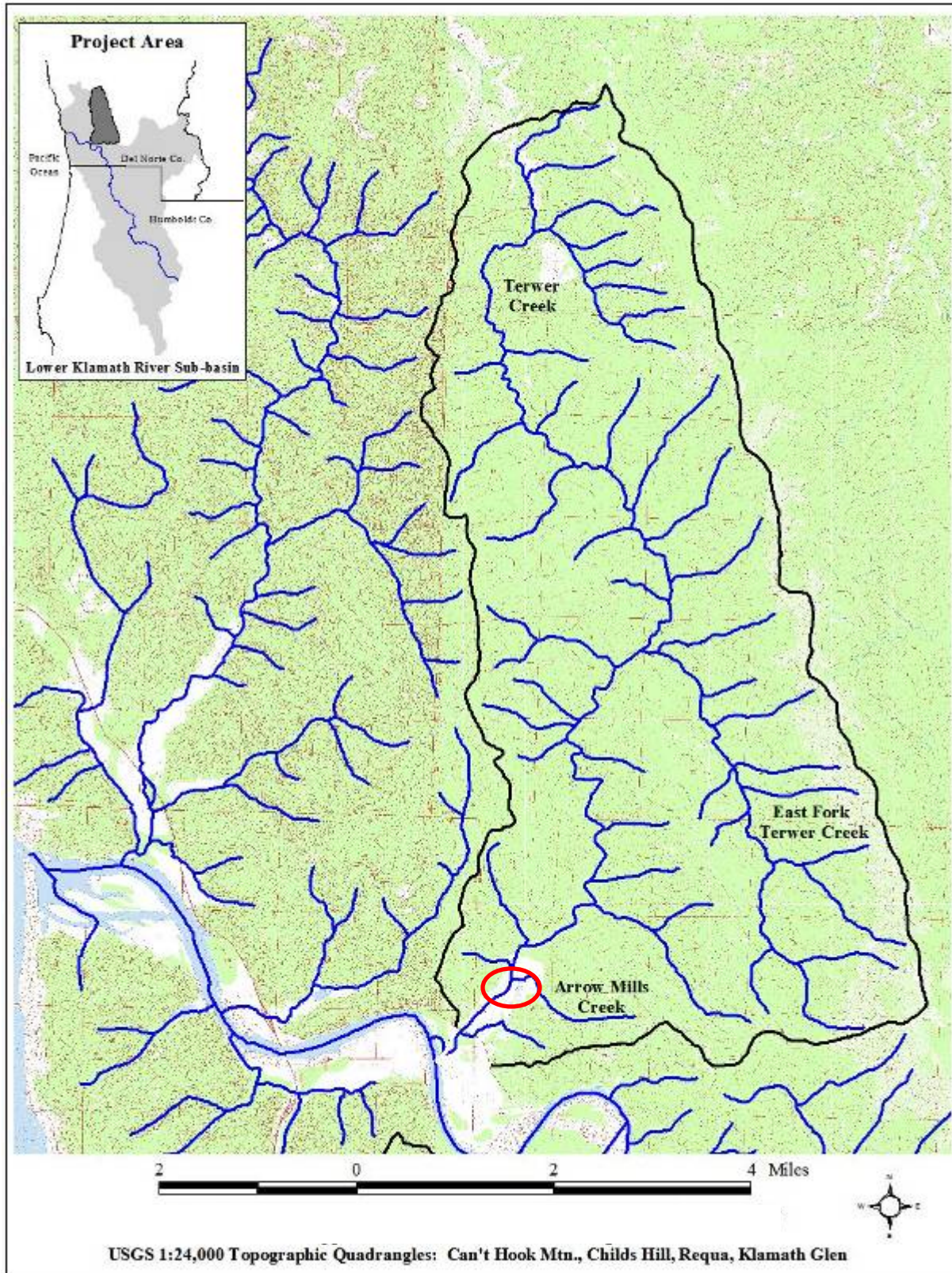


Figure 1. Terwer Creek project location map (area in the red oval), Lower Klamath River.



Figure 2. The Lower Arrow Mills Project Reach in Terwer Creek, Lower Klamath River, California (Base image: 2005 NAIP Aerial Imagery).



Figure 3. Photographs taken from a permanent photo-monitoring site in lower Terwer Creek (Site: TC ELJ1-2-East: Top – 10/6/11, Bottom – March 29, 2012).



Figure 4. Photographs of ELJs 3-4 constructed during 2012 in Terwer Creek, Lower Klamath River (Site: TC ELJ3-4A; Photo dates: a) 4/24/12, b) 10/20/12, c) 10/21/12, d)10/25/12).



Figure 5. Photographs of ELJs 3-4 constructed during 2012 in Terwer Creek, Lower Klamath River (Site: TC ELJ3-4B; Photo dates: a) 4/24/12, b) 10/20/12, c) 10/21/12, d)10/25/12).



a)



b)



c)

Figure 6. Photographs of ELJs 2-3 constructed during 2012 in Terwer Creek, Lower Klamath River (Site: TC ELJ2-3A; Photo dates: a) 3/30/12, b) 10/25/12, c) 12/20/12).

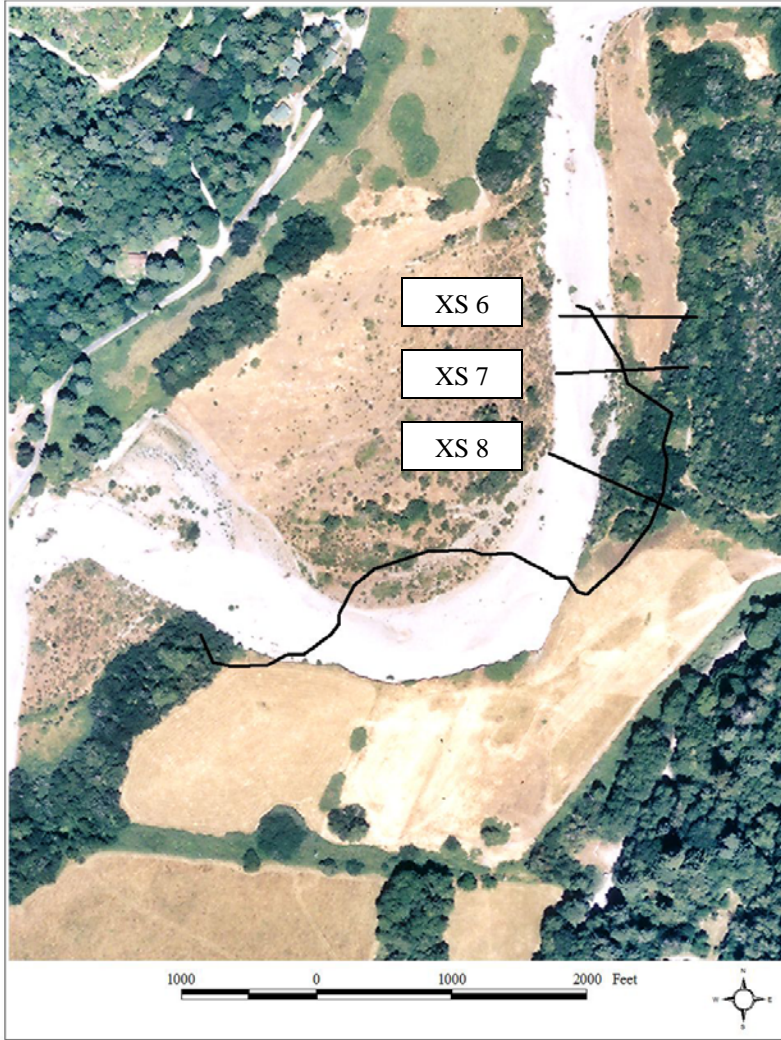


Figure 7. Longitudinal profile (May 2012) and cross sections surveyed during 2012-2013 in the Lower Arrow Mills project reach in Terwer Creek (Base Image – 2004 Air Photo).

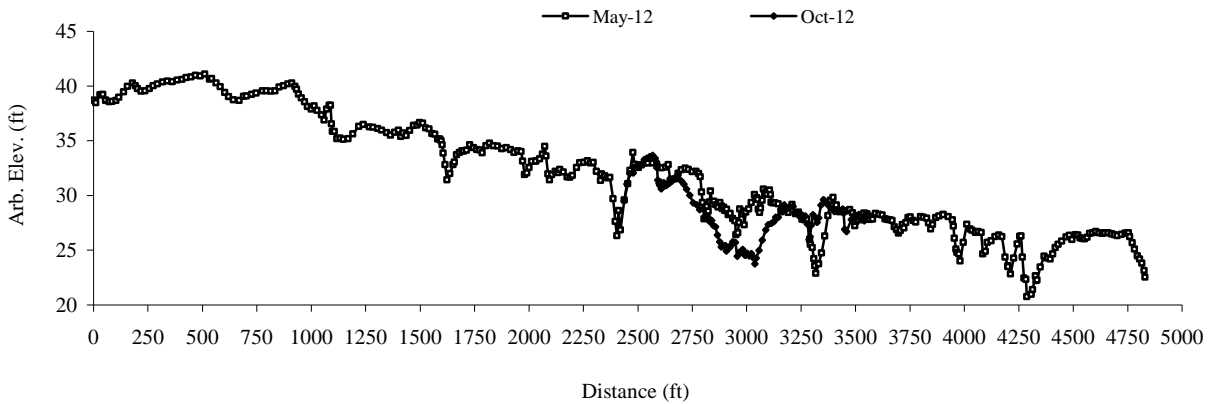


Figure 8. Longitudinal profile of Terwer Creek prior to 2012 restoration activities (May-12 Plot) and following construction (As-Built Oct-12 Plot).

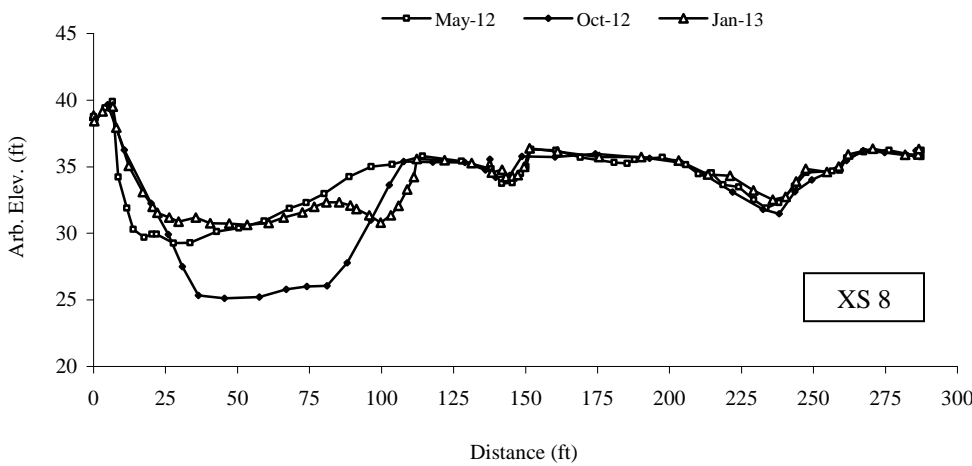
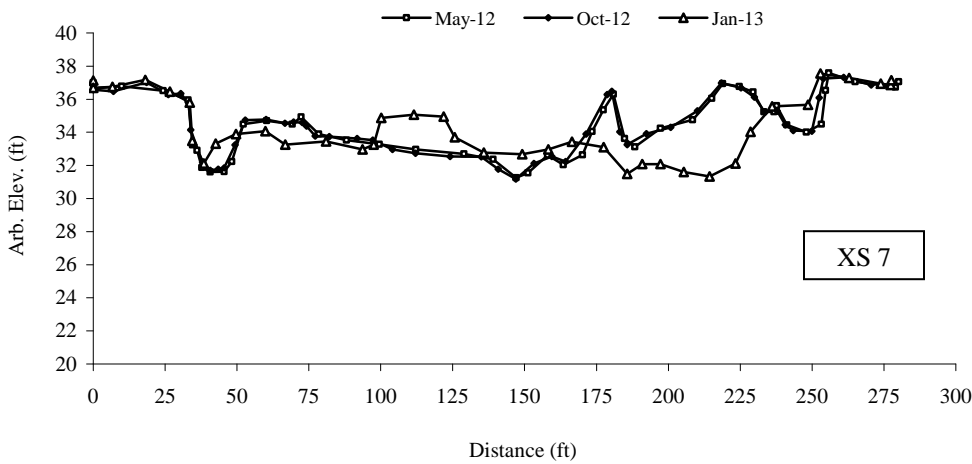
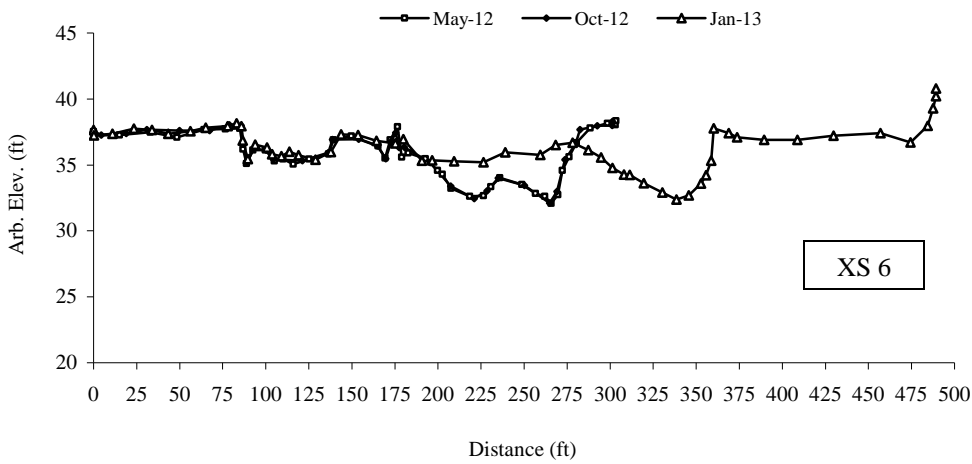


Figure 9. Cross section data collected in the Lower Arrow Mills project reach in Terwer Creek, Lower Klamath River (May 2012 - January 2013).

Final Project Budget

PROJECT NAME: Stream and Floodplain Enhancement of Lower Terwer Creek: 2012 - Agreement # A09-N5									
A. PERSONNEL SERVICES									
Level of Staff	No. Hours Requested	No. Hours Applicant Cost Share	No. Hours Partners Cost Share	Hourly Rate	Amount Expended	Amount Applicant Cost Share	Amount Partners Cost Share	Total Project Cost	
Fisheries Biologist II	0	0	40	\$24.00	\$0.00	\$0.00	\$960.00	\$960.00	
Fisheries Restoration Technician III - HEO	0	0	55.663	\$25.00	\$0.00	\$0.00	\$1,391.58	\$1,391.58	
Fisheries Restoration Technician III - HEO	0	0	76.771	\$25.00	\$0.00	\$0.00	\$1,919.28	\$1,919.28	
Fisheries Restoration Technician II - HEO	0	0	89.736	\$25.00	\$0.00	\$0.00	\$2,243.39	\$2,243.39	
Fisheries Survey Lead	0	0	80	\$17.00	\$0.00	\$0.00	\$1,360.00	\$1,360.00	
Fisheries Survey Technician	0	0	80	\$15.00	\$0.00	\$0.00	\$1,200.00	\$1,200.00	
Sub-Total					\$0.00	\$0.00	\$9,074.25	\$9,074.25	
Staff Benefits					\$0.00	\$0.00	\$1,204.25	\$2,994.50	
TOTAL PERSONNEL SERVICES					\$0.00	\$0.00	\$10,278.50	\$12,068.75	
B. OPERATING EXPENSES									
Description	No. of Units Requested	No. of Units Applicant Cost Share	No. of Units Partners Cost Share	Unit Price	Amount Expended	Amount Applicant Cost Share	Amount Partners Cost Share	Total Project Cost	
Materials and Supplies									
Nikon DTM-522 Total Station (Weekly Rental Fee)	0	1	0	\$450.00	\$0.00	\$450.00	\$0.00	\$450.00	
Recon Data Collector (Weekly Rental Fee)	0	1	0	\$350.00	\$0.00	\$350.00	\$0.00	\$350.00	
Trimble Geo XT (Weekly Rental Fee)	0	1	0	\$475.00	\$0.00	\$475.00	\$0.00	\$475.00	
Organic Rice Straw (Bale)	0	0	10	\$10.00	\$0.00	\$0.00	\$100.00	\$100.00	
Chainsaws (Weekly Rental Fee)	0	2	0	\$120.00	\$0.00	\$240.00	\$0.00	\$240.00	
Water Pump (Weekly Rental Fee)	0	2	0	\$250.00	\$0.00	\$500.00	\$0.00	\$500.00	
Fuel for Equipment (Gallons)	0	0	400	\$3.96	\$0.00	\$0.00	\$1,584.00	\$1,584.00	
Heavy Equipment Maintenance & Parts (hoses, oil, grease, misc. parts, filters, spill kits)					\$0.00	\$0.00	\$92.62	\$92.62	
Implementation Supplies (canvas hoses and fittings, chain and fasteners, log tongs)					\$0.00	\$0.00	\$328.50	\$328.50	
PROJECT NAME: Stream and Floodplain Enhancement of Lower Terwer Creek: 2012									
Sub-Contractor Expenses	Units	No. of Units Requested	No. of Units Applicant Cost Share	No. of Units Partners Cost Share	Unit Price	Amount Expended	Amount Applicant Cost Share	Amount Partners Cost Share	Total Project Cost
Excavator	Week	2.2	0	0	\$3,400.00	\$7,480.00	\$0.00	\$0.00	\$7,480.00
	Day	0	0	1	\$680.00	\$0.00	\$0.00	\$680.00	\$680.00
Excavator Mobilization	One Way Haul	2	0	0	\$375.00	\$0.00	\$0.00	\$750.00	\$750.00
End-dump Hauling & Driver	Hour	0	0	47	\$27.00	\$0.00	\$0.00	\$1,269.00	\$1,269.00
Front-end Loader	Week	2	0	0	\$1,785.00	\$4,589.07	\$0.00	\$0.00	\$4,589.07
Front-end Loader Mobilization	One Way Haul	2	0	2	\$250.00	\$0.00	\$0.00	\$500.00	\$500.00
Front-end Loader - Environmental Fee, Rental Protection						\$0.00	\$0.00	\$519.07	\$519.07
Poles (25-35 ft)	Piece	0	0	35	\$130.00	\$0.00	\$0.00	\$4,550.00	\$4,550.00
Stems with Rootwads (Large)	Piece	0	0	55	\$250.00	\$0.00	\$0.00	\$13,750.00	\$13,750.00
Licensed Geologist	Hours	18.3639	0	68.13611765	\$85.00	\$1,560.93	\$0.00	\$5,791.57	\$7,352.50
TOTAL OPERATING SERVICES					\$13,630.00	\$2,015.00	\$29,914.76	\$45,559.76	
C. SUB-TOTALS & ADMIN						Amount Expended	Amount Applicant Cost Share	Amount Partners Cost Share	Total Project Cost
Sub-Total (Personnel and Operating)						\$13,630.00	\$2,015.00	\$40,193.26	\$55,838.26
Administrative Overhead						\$0.00	\$0.00	\$2,099.02	\$2,099.02
D. GRAND TOTAL						\$13,630.00	\$2,015.00	\$42,292.28	\$57,937.28
¹ Yurok Tribe's Current Administrative Overhead Rate is 16.95% and is Applied to Every Charge Excluding Sub-contracts ≥ \$5,000									