Lower Terwer Creek Bioengineering Project

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Introduction

The Yurok People have inhabited the lands of and sustained themselves upon the resources of the Klamath River for centuries. The Yurok Tribe's entire culture is largely based upon the Klamath River and its associated fish populations. Today, only a fraction of historic anadromous fish runs return to spawn in the Klamath River and its tributaries. Although many factors have contributed to these declines in native fish runs, degradation of freshwater habitat has been pervasive in the Klamath River Basin. Kier and Associates (1991) note that "the fish habitats of the basin have been greatly diminished in extent and value in the past century by the construction of impassable dams and by stream diversions and sand and silt from mining, logging, grazing, road development, and floods." The declining health and productivity of the Klamath River's anadromous fisheries is of great cultural and economic concern to the Yurok Tribe.

To proactively address these declines, the Tribe initiated a large-scale, coordinated watershed restoration effort throughout the Lower Klamath sub-basin in conjunction with Green Diamond Resource Company (GDRC – formerly Simpson Resource Company) and the California Coastal Conservancy. This cooperative framework is intended to meet the mandates and objectives of tribal, state, and federal planning efforts, the Northwest Economic Adjustment Initiative and the state and federal ESA through innovative solutions to resource management issues between private landowners, Tribal interests, and public agencies.

In order to provide for meaningful restoration plans that truly address the limiting factors facing each salmonid species in a given drainage, the Yurok Tribe initiated the Lower Klamath River Watershed Assessment. This interdisciplinary effort, consisting of historical and current condition assessments throughout each of the Lower Klamath tributaries, resulted in the prioritization of restoration activities throughout the basin. The Lower Klamath Sub-Basin Watershed Restoration Plan (Gale and Randolph 2000) identifies chronic streambed sedimentation, heavily degraded instream and riparian habitat, and loss of habitat connectivity as the primary factors for salmonid decline. In order to address these problems, the Sub-Basin Plan prioritizes treatment of upslope sediment sources, in conjunction with instream and riparian restoration and fish barrier treatment.

The Yurok Tribal Fisheries Program (YTFP) undertook a multi-phase riparian enhancement project in Lower Terwer Creek beginning in 2003. Restoration treatments are designed to provide long-term benefits including reduction of sediment delivery, increased channel and streambank stability, increased habitat complexity, improved LWD recruitment potential, and self-sustaining riparian forests. This project was designed and implemented to protect and stabilize 1,250 feet of streambank that had experienced extensive erosion during high flow conditions in winter 2004-2005. This site was treated using bioengineering and log-boulder revetment methods to curb further lateral bank erosion and accelerate riparian revegetation.

Project Area

The Lower Klamath sub-basin encompasses the lower 40 miles of the Klamath River and its tributaries, between the confluence with the Trinity River and the Pacific Ocean. There are 25 anadromous fish bearing tributaries within the sub-basin (Figure 1). The Yurok Indian Reservation extends one mile on either side of the mainstem throughout the lower 44 miles of the Klamath River. An aquatic and riparian habitat summary for the sub-basin is presented in Table 1. A summary of aquatic species presence by tributary is presented in Table 2. All project work occurred within Lower Terwer Creek.

Terwer Creek is a fourth order stream that drains approximately 31.8 sq. miles of coniferous-forested mountains. The headwaters originate at an elevation of 1,600 ft. and flows southerly 13.9 miles, through mostly steep, highly confined stream channels. Terwer Creek is moderately to highly confined throughout most of its course, with "B" and "C" channel types dominant throughout (see Rosgen 1994 for channel type descriptions). The lower portion of the creek flows through a broad floodplain past the community of Klamath Glen (Figures 2-3). The Terwer Creek watershed supports anadromous populations of chinook salmon, coho salmon, steelhead trout, coastal cutthroat trout and Pacific lamprey. The East Fork is the largest tributary in the drainage, supporting populations of coho salmon, steelhead and coastal cutthroat trout.

This project area is located on private property owned by Ken Farley and Green Diamond Resource Company (GDRC – formerly Simpson Resource Company). The project area is located approximately 4,000 feet upstream from the Highway 169 Terwer Creek Bridge and encompasses two sites along the west side bank of Terwer Creek (Figure 3).

Traveling directions to the site are as follows: Traveling south on U.S. Highway 101 in Klamath, exit on Terwer Valley 169/Klamath Glen Exit. Drive approximately two miles, turning left on Terwer Valley Road. Drive approximately one mile traveling onto Ken Farley's private property. Drive approximately 1/8 mile and turn right onto a dirt road which leads to Terwer Creek where the project area is located.

Project Objectives

This funding continued a multi-phase riparian enhancement project in the Terwer Creek watershed. Restoration treatments were designed to provide long-term benefits including reduction of sediment delivery, increased channel and streambank stability, increased habitat complexity, improved LWD recruitment potential, and self-sustaining riparian forests.

YTFP has recently completed the second phase of stream restoration on lower Terwer Creek and plans to continue work upstream and downstream of completed projects with secured funding. In 2004-2005 YTFP completed a stream restoration project near Arrow Mills, located immediately across the stream channel from this project area (Figure 2). Bioengineering techniques were implemented to stabilize 1,600 feet of erosive streambank. Approximately 3,000 willow springs were planted along 1,600 feet of

streambank and willow siltation baffles were installed to dissipate stream flow energy, settle out smaller particle size substrate (fines) and increase mid channel bar elevation. Constructed willow siltation baffles were inundated in early December 2004 and proved to withstand high flows and properly settle out small fines while dissipating stream flow.

In December 2004 Terwer Creek exceeded bankfull capacity, resulting in severe bank erosion across the stream channel from the Arrow Mills work site. An unprotected gravel berm with minimal riparian vegetation was the key factor for this highly erosive section along the west bank of Terwer Creek. In addition to the erosive streambank contributing a large amount of sediment to the system, a private landowner (Ken Farley) was in jeopardy of losing a well supplying water for at least 6 other private landowners along lower Terwer Creek. YTFP requested adaptive management funding to continue bioengineering restoration work along this eroding streambank. YTFP felt that immediate attention was necessary to stabilize this highly erosive streambank with bioengineering and log/boulder revetment techniques. Bank erosion would continue to occur without immediate attention, resulting in a large amount of sediment input into the system.

This project resulted in the protection and stabilization of 1,250 linear feet of Terwer Creek streambank, as well as the prevention of an estimated 8,500 cubic yards of sediment that would have been delivered to the stream channel had the erosion been allowed to continue without treatment (Figure 4).

This Adaptive grant covered the purchase of boulders and heavy equipment operation and related expenses for the bioengineering work and boulder-log structure construction in the project site. The majority of crew labor associated with this work was included as an in-kind match through both Yurok Tribal funds and restoration funds secured by YTFP from the Bureau of Indian Affairs and the US Fish and Wildlife Service.

Project Tasks

All work commenced on August 22, 2005 and was completed on February 28, 2005. Below is a summary of completed tasks (see Figure 4 for project map):

- A total of 16 willow siltation baffles were constructed along the active channel within the project reach. “Quarter-ton” quarry rock was used on each of these baffles to minimize baffle scouring due to high flows. The baffles were constructed perpendicular to the stream and averaged 20-25 feet in length, 5’-6’ deep, and were spaced at 20-30 foot intervals.
- A total of 15 willow mattresses were constructed in the same reach. Each mattress was constructed parallel to the channel along the bank between each of the constructed baffles. The mattress trenches were dug 5’-6’ deep and pieces of SWD and chunks of LWD were placed in the bottom of most mattress trenches before backfilling.
- A total of eight log-boulder structures were constructed throughout the project reach. Five of these structures were constructed just upstream of Mr. Farley’s well in order to stabilize and protect this highly erosive streambank. Three willow mattresses were constructed in this same site between the uppermost structures. Two additional log-

boulder structures were built in the reach between the "well structures" and the baffle reach. In addition, one log-boulder structure was built at the upper end of the project reach, just upstream of the willow baffle/mattress project area. All log structures were built with the inclusion of live willow posts and brush to facilitate revegetation and stabilization of the structure sites.

- Crews installed a drip irrigation system throughout the willow baffle/mattress work area, with water being drawn from an adjacent perennially flowing and non-fish bearing tributary. Drip emitters and sprinklers were set up to water the planted willow brush and keep the backfilled trenches wet until fall rains and streamflow resumed in October.
- Following the onset of fall rain and resumption of streamflow in the project reach, the crew moved out of the active channel and began work on constructing willow baffles on the adjoining flood terrace. These baffles were constructed similarly to the instream baffles, although the lack of any high-velocity flows in this area allowed us to avoid using armoring boulders. These baffles also incorporated a mixture of willow brush and posts, rather then strictly brush that is used for the instream baffles. A total of 41 baffles were built on the flood terrace at the upper end of the reach.
- Crews also planted approximately 500 willow sprigs, as well as 30 big-leaf maple, 65 cottonwood, 41 red alder and 350 Douglas fir. The deciduous trees are all stock started from seed (maples) or cuttings (cottonwood) at the YTFP tree nursery and grown out for over a year. The fir trees were bareroot trees provided by GDRC.
- Crews removed numerous pampas grass sprouts and plants from throughout the project reach. In addition, Himalayan blackberry patches were removed from the baffle and log structure sites prior to installation.
- YTFP conducted photographic documentation of pre- and post-restoration conditions within the project area.

Project Reporting Metrics

Habitat Projects (all):

Watershed plan identifying project as a priority:

- Lower Klamath Sub-Basin Watershed Restoration Plan (Gale and Randolph 2000)
- Recovery Strategy for California Coho Salmon (CDFG 2004)

Priority habitat limiting factors identified in plans that are addressed by project:

- Reduction in sediment delivery to stream channel
- Protection/stabilization of streambanks

This project addressed the following tasks in the California state coho Recovery plan:

- Task # KR-KG-14 Provide technical and financial support to implement riparian restoration throughout alluvial reaches in lower Blue, Terwer, hunter and Salt creeks.
- Task # KR-KG-08b Implement the plan to restore in-channel and riparian habitat in tributaries.
- Task # KR-KG-07 Treat sediment sources and improve riparian and instream habitat conditions to provide adequate and stable spawning and rearing areas for coho salmon.

Type of monitoring included in project:

- Photographic documentation of pre- and post-restoration conditions within the project area.

Number of stream miles treated/affected by project:

- Stream miles treated: 0.24 miles (1,240 feet)
- Stream miles affected: 1.4 miles (7,400 feet)

Riparian Habitat Projects (HR):

Number of miles treated: 0.24 miles (1,250 feet)

Number of acres treated: 9.15 acres

Number of acres and type of invasive species controlled: 9.15 acres – pampas grass, Himalaya blackberry

Species and size of trees planted: Willow (posts, brush, and sprigs), Douglas fir (12”-24”), big-leaf maple (12’-24”), black cottonwood (12’-24”).

Number of trees/density of plantings: 500 willow sprigs, 30 big-leaf maple, 65 cottonwood, 41 red alder and 350 Douglas fir. Trees were spaced every eight feet throughout the project site.

Feet of streambank stabilized and treatments used: 1,250 feet.

- Stabilize 900 feet of erosive streambank within lower Terwer Creek using willow siltation baffles, willow stabilization techniques and planting native conifers, cottonwoods, and maples on stream terraces. Construct native material log/boulder revetments to stabilize 350 feet of erosive streambank. Restore long-term habitat complexity and stream channel stability on flood prone surfaces using willow planting and log/boulder structure techniques.

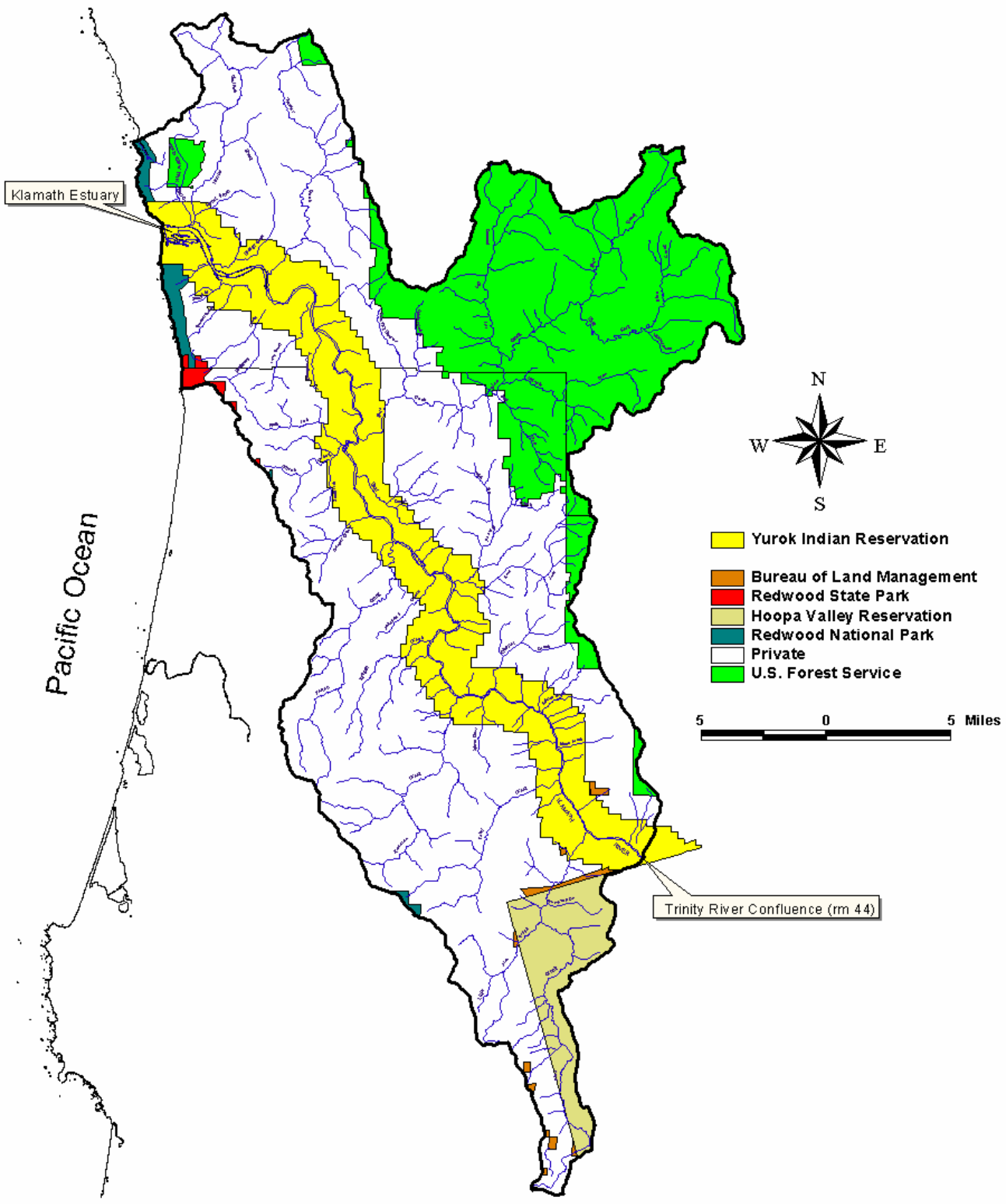

Figure 1. Lower Klamath River Sub-basin, California.

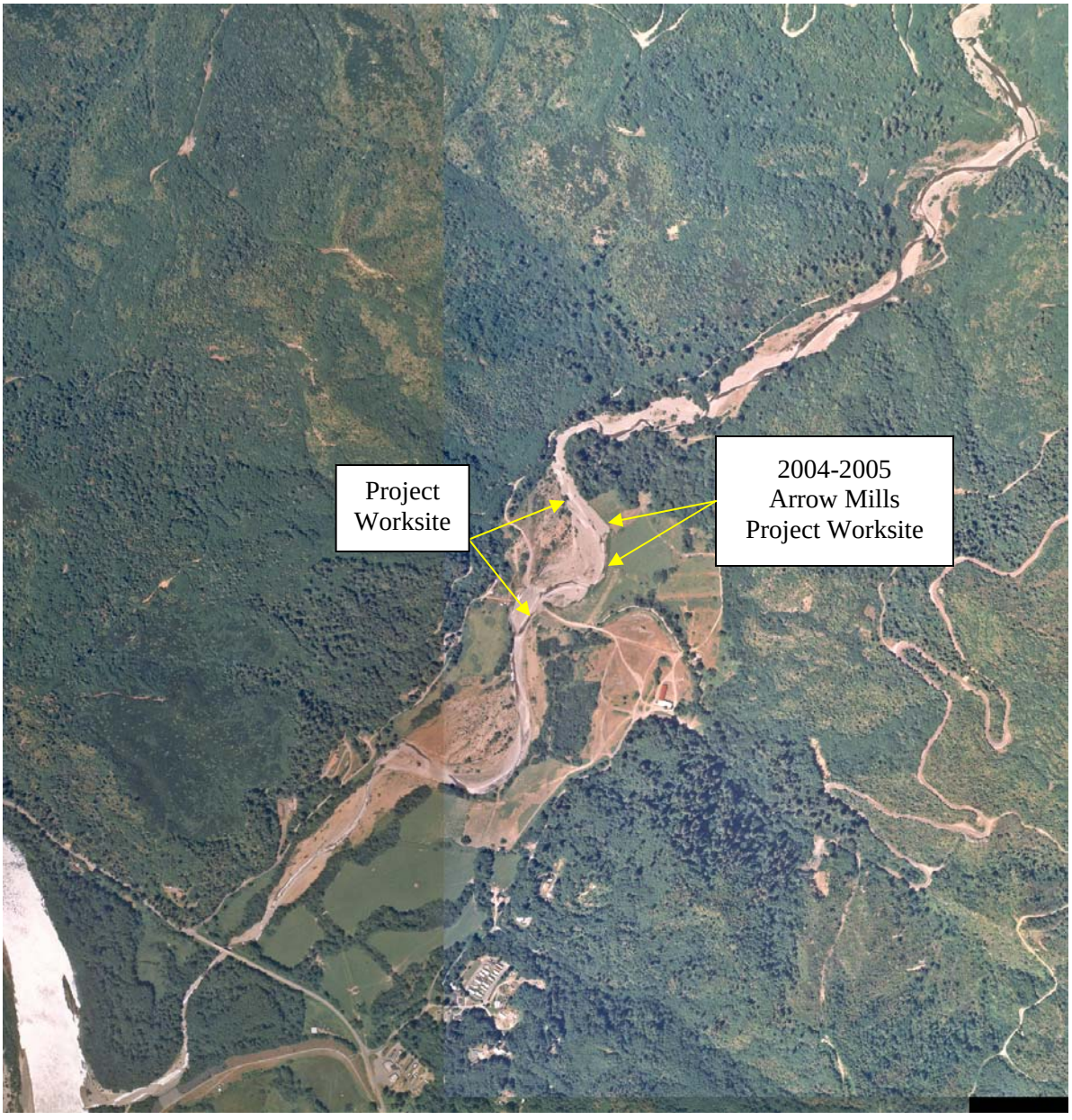

Figure 2. Aerial view of the lower 3.0 miles of Terwer Creek,
Lower Klamath River, California, 1997.

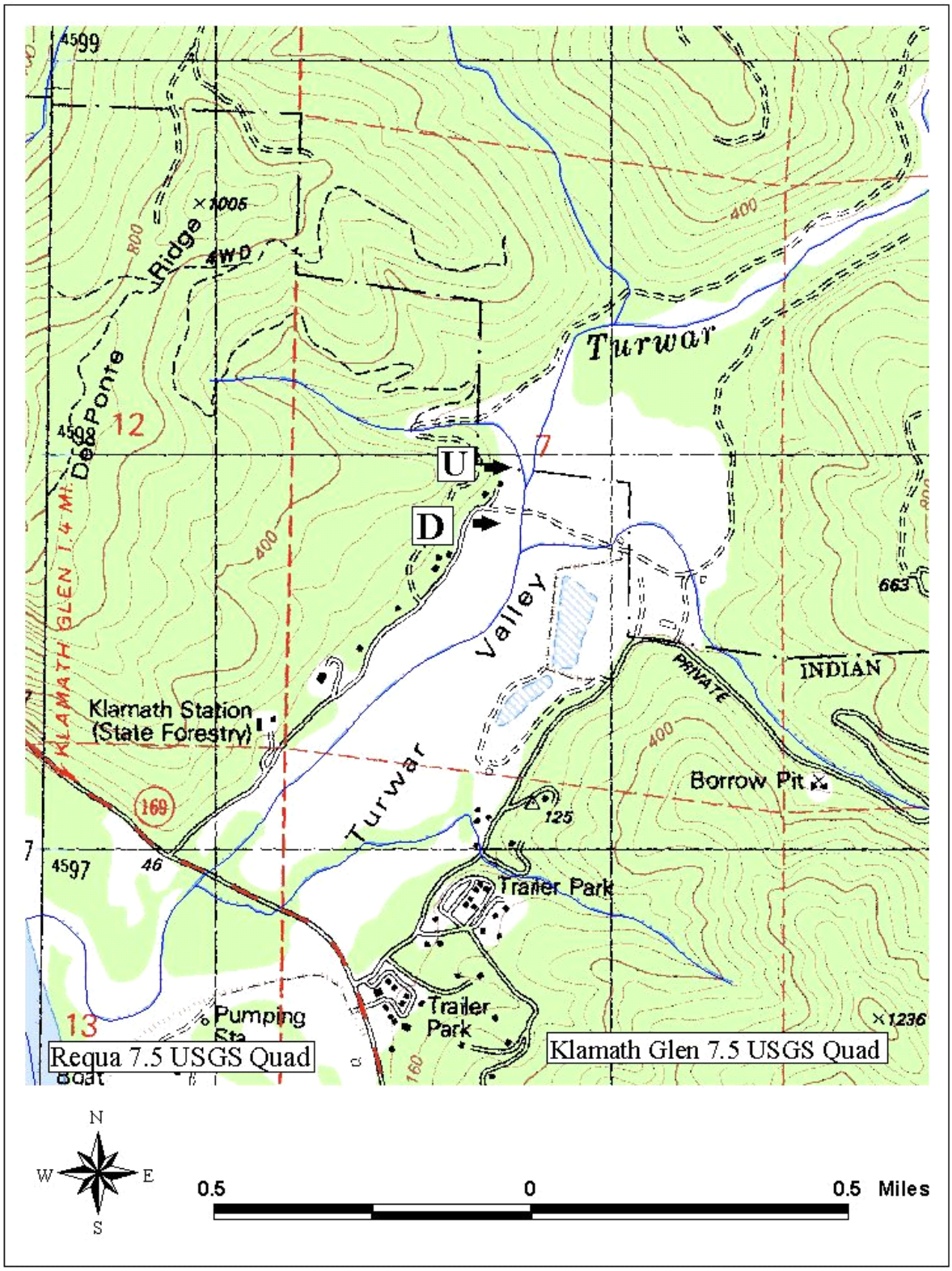

Figure 3. Project location map, Lower Terwer Creek Bioengineering Project, Lower Klamath River, California, 2006.

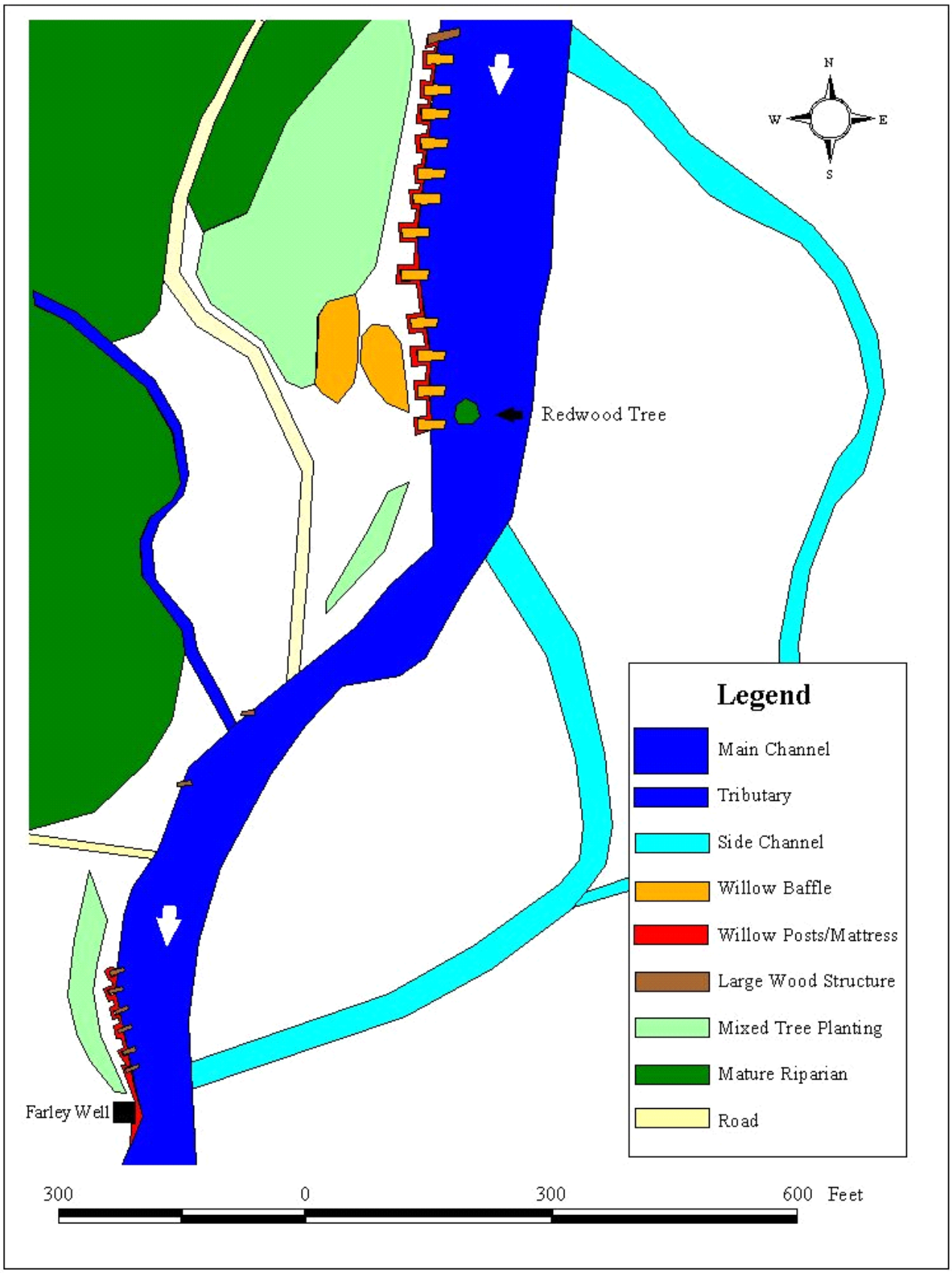

Figure 4. Project site map, Lower Terwer Creek Bioengineering Project, Lower Klamath River, California, 2006.

Table 1. Summary of physical habitat and riparian parameters by tributary, Lower Klamath River, California, 1996-1998.

Tributary	Drainage Size (sq. mi.)	Stream Order	Dominant Channel Type	Pool:Flatwater:Riffle Ratio	% Pools >=3ft Max. Depth	Ave. Shelter Rating	Prim./Sec. Cover Type	Prim./Sec. Substrate Type	Ave. Embeddedness (%)	Ave. Canopy Closure (%)	% Conifers in Canopy	Existing LWD Density (# pieces/mile)	Total Future LWD Density (# pieces/mile)	% Future LWD Composed of Live Conifers	% Future LWD Composed of Deciduous Trees <2' Dia.	Sub-surface Flow Severity
High Prairie Creek	4.2	2	A-4	46:44:10	7.1	31.5	LWD/BL	GR/SC	25-50	80%	23%	N/S	N/S	N/S	N/S	M
Hunter Creek																
- Mainstem	23.8	4	C-4	43:50:07	48.4	20.0	BL/LWD	GR/SC	50-75	79%	10%	186	328	14.9%	55.5%	H
- East Fork		3	B-4	26:73:01	10.5	18.8	LWD/BL	GR/SL	50-75	88%	7%	351	456	13.0%	55.4%	M
- Mynot Creek	4.9	2	F-4	49:48:03	5.3	23.7	TV/BL	GR/SA	50-75	76%	15%	209	381	33.8%	32.7%	H
Hoppaw Creek																
- Mainstem	4.9	3	F-4	37:39:24	1.7	15.7	LWD/SWD	GR/SC	50-75	91%	11%	275	413	24.4%	28.4%	H
- North Fork		2	A-4	62:11:27	2.0	17.1	LWD/BL	GR/SC	50-75	95%	27%	537	556	41.8%	23.5%	L
Saugep Creek	1.7	2	F-4	38:56:06	2.5	11.4	TV/SWD	GR/SL	50-75	84%	0%	N/S	N/S	N/S	N/S	L
Terwer Creek																
- Mainstem	32.8	4	B-3	36:52:12	32.9	67.1	BL/WW	BL/GR	0-25	61%	18%	169	512	21.9%	12.3%	M
- East Fork		3	A-2	35:59:07	13.7	84.7	BL/WW	BL/GR	25-50	71%	5%	264	519	20.7%	11.8%	N/A
McGarvey Creek																
- Mainstem	8.6	3	C-4	70:26:04	18.5	27.8	LWD/SWD	GR/SC	50-75	89%	8%	359	907	7.4%	61.4%	M
- West Fork		2	C-4	74:20:06	11.4	30.2	LWD/SWD	SL/GR	50-75	94%	11%	445	1,129	6.4%	68.9%	N/A
Tarup Creek	4.9	3	C-4	71:19:10	25.8	20.5	LWD/SWD	GR/SC	50-75	97%	7%	228	515	12.1%	59.2%	H
Omagaar Creek	2.5	2	B-4	35:52:13	5.0	19.4	LWD/BL	GR/SC	25-50	95%	10%	233	641	14.7%	56.4%	H
Blue Creek																
- Mainstem (below barrier)	128.3	5	C-2	23:61:16	88.4	14.2	BL/WW	BL/LC	25-50	41%	34%	N/S	N/S	N/S	N/S	N/A
- Crescent City Fork	13.4	4	B-2	27:61:12	51.3	17.2	BL/WW	LC/BL	25-50	87%	42%	169	569	56.1%	16.6%	N/A
- Nickowitz Creek	12.4	3	B-2	25:66:09	22.0	14.8	BL/WW	GR/SC	25-50	90%	27%	135	567	39.8%	31.4%	N/A
- Slide Creek	5.7	2	A-2	19:65:16	42.4	18.5	BL/WW	LC/BL	25-50	38%	77%	94	538	69.3%	2.3%	N/A
- West Fork	9.7	3	B-2	30:62:08	44.3	17.5	BL/WW	LC/GR	50-75	86%	12%	216	590	12.7%	41.3%	N/A
Ah Pah Creek																
- Mainstem	16.3	4	B-3	33:61:06	3.8	16.2	LWD/SWD	GR/SA	25-50	84%	8%	394	778	19.9%	54.0%	M
- North Fork		3	B-4	40:54:06	11.1	15.9	LWD/SWD	GR/SC	25-50	82%	9%	262	777	27.7%	53.4%	M
- South Fork		2	A-2	34:63:03	5.4	12.7	SWD/LWD	GR/SA	25-50	89%	9%	400	890	21.0%	48.4%	M
Bear Creek																
- Mainstem	19.3	3	A-2	38:47:15	9.8	74.1	BL/WW	BL/LC	25-50	73%	8%	188	323	26.2%	16.6%	H
- North Fork		3	B-3	32:52:16	6.3	78.4	BL/WW	BL/GR	25-50	77%	7%	312	533	23.4%	10.8%	N/A
Surpur Creek	5.7	3	B-3	73:23:04	19.9	16.5	BL/SWD	GR/SC	50-75	89%	6%	321	677	21.5%	46.2%	L
Little Surpur Creek	2.7	2	A-2	64:35:01	19.7	13.2	SWD/BL	SC/GR	50-75	93%	10%	255	486	21.1%	59.9%	L
Tectah Creek	19.9	3	B-3	48:45:07	27.8	18.6	BL/LWD	LC/SC	25-50	86%	11%	131	559	23.0%	49.5%	M
Johnsons Creek	3.4	2	B-3	69:27:04	15.6	15.6	BL/UC	SC/GR	50-75	94%	3%	116	474	3.5%	73.9%	H
Pecwan Creek (Lower Mainstem)	27.7	4	B-2	24:62:14	45.0	22.2	WW/BL	GR/BL	50-75	74%	31%	N/S	N/S	N/S	N/S	L
Mettah Creek																
- Mainstem	10.7	3	B-2	40:51:09	11.2	30.0	BL/WW	GR/SC	50-75	86%	17%	112	150	14.5%	12.5%	L
- South Fork		2	B-2	24:64:12	7.1	29.1	WW/BL	GR/SC	50-75	89%	22%	181	143	4.6%	20.4%	N/A
Roaches Creek	29.5	4	B-2	46:49:05	37.7	31.0	BL/WW	GR/BL	50-75	78%	30%	34	112	35.5%	8.2%	L
Morek Creek	4.0	2	A-2	24:51:25	4.6	18.9	BL/WW	GR/BL	50-75	85%	34%	78	309	4.5%	80.6%	L
Cappell Creek	8.6	2	A-2	43:30:27	18.6	21.8	WW/BL	BL/GR	50-75	79%	41%	N/S	N/S	N/S	N/S	L
Tully Creek																
- Mainstem	17.3	3	B-3	24:71:05	34.7	14.8	BL/WW	BL/GR	25-50	79%	8%	106	254	12.9%	9.9%	L
- Robbers Gulch		2	B-3	39:52:09	12.5	13.5	BL/SWD	SC/BL	50-75	84%	8%	166	363	10.3%	3.1%	N/A

Cover Type Codes: LWD= Large Woody Debris SWD=Small Woody Debris BL=Boulder WW=Whitewater TV=Terrestrial Vegetation UC=Undercut Bank

Substrate Codes: SL=Silt/Clay SA=Sand GR=Gravel SC=Small Cobble LC=Large Cobble BL=Boulder

Table 2. Summary of aquatic species presence by tributary, Lower Klamath River, California, 1996-2002.

Tributary	Chinook Salmon	Coho Salmon	Steelhead	Coastal Cutthroat Trout	Resident Rainbow Trout	Pacific/Brook Lamprey	Prickly/Coastrange Sculpin	Speckled Dace	Threespine Stickleback	Klamath Small Scale Sucker	Pacific Giant Salamander	Yellow Legged Frog	Tailed Frog
High Prairie Creek	n	y	y	y	n	y	y	y	y	y	y	y	y
Hunter Creek													
- Mainstem	y	y	y	y	n	y	y	y	y	y	y	y	y
- East Fork	y	y	y	y	n	n	y	n	n	n	y	n	y
- Mynot Creek	y	y	y	y	n	y	y	y	y	y	y	n	n
- Kurwitz Creek	n	n	y	y	n	n	y	n	n	y	y	n	y
Hoppaw Creek													
- Mainstem	y	y	y	y	n	y	y	y	y	y	y	n	y
- North Fork	n	y	y	y	n	n	y	y	y	y	y	n	y
Saugep Creek	y	y	y	y	n	y	y	y	y	y	y	n	n
Waukell Creek	n	y	n	y	n	y	y	y	n	n	n	n	n
Terwer Creek													
- Mainstem	y	y	y	y	n	y	y	y	y	n	y	y	y
- East Fork	n	y	y	y	n	n	y	n	n	n	y	n	y
McGarvey Creek													
- Mainstem	y	y	y	y	n	y	y	y	y	y	y	y	y
- West Fork	n	y	y	y	n	y	y	y	y	y	y	y	n
Tarup Creek	y	y	y	y	n	y	y	y	y	y	y	y	n
Omagaar Creek	n	y	y	y	n	n	y	y	n	n	y	y	y
Blue Creek													
- Mainstem (below barrier)	y	y	y	y	y	y	y	y	y	y	y	y	n
- Mainstem (above barrier)	n	n	n	n	y	n	n	n	n	n	y	n	n
- East Fork	n	n	n	n	y	n	n	n	n	n	y	n	n
- Crescent City Fork	y	y	y	y	y	n	y	n	n	n	y	n	n
- Nickowitz Creek	y	n	y	n	y	n	y	n	n	n	y	n	n
- Slide Creek	n	n	y	n	y	n	y	n	n	n	y	n	n
- West Fork	y	y	y	n	n	n	y	y	n	n	y	n	n
Ah Pah Creek													
- Mainstem	n	y	y	y	n	n	y	y	n	n	y	y	y
- North Fork	n	n	y	y	n	n	y	y	n	n	y	n	y
- South Fork	n	y	y	y	n	n	y	y	n	n	y	n	y
Bear Creek													
- Mainstem	y	y	y	y	n	n	y	y	y	y	y	y	y
- North Fork	n	n	y	y	n	n	y	n	n	n	y	y	y
Surpur Creek	n	n	y	y	n	n	y	y	n	n	y	y	n
Little Surpur Creek	n	y	y	y	n	n	y	y	n	n	y	y	n
Tectah Creek	y	y	y	y	n	y	y	y	y	n	y	y	y
Johnsons Creek	y	y	y	y	n	n	y	y	n	y	y	y	y
Pecwan Creek													
- Mainstem	y	y	y	y	n	n	y	y	n	y	y	y	n
- East Fork	n	n	n	n	y	n	n	n	n	n	y	n	n
- West Fork	n	n	n	n	y	n	n	n	n	n	y	n	y
Mettah Creek													
- Mainstem	y	n	y	y	n	n	y	y	n	n	y	y	n
- South Fork	n	n	y	y	n	n	n	n	n	n	y	y	y
Roaches Creek	y	y	y	n	y	y	y	y	y	n	y	y	n
Morek Creek	n	n	y	n	n	n	y	n	n	n	y	y	y
Cappell Creek	n	n	y	n	y	n	y	n	n	n	y	n	n
Tully Creek													
- Mainstem	n	n	y	n	n	n	y	n	n	n	y	y	n
- Robbers Gulch	n	n	y	n	n	n	n	n	n	n	y	n	n

Figure 5. Lower end of willow baffle/mattress project site before construction, Lower Terwer Creek, Lower Klamath River, California, 2005.

Figure 6. Upper end of willow baffle/mattress project site before construction, Lower Terwer Creek, Lower Klamath River, California, 2005.

Figure 7. Upper end of willow baffle/mattress project site before construction, Lower Terwer Creek, Lower Klamath River, California, 2005.

Figure 8. Excavating willow siltation baffle trench at lower end of baffle/mattress project site, Lower Terwer Creek, Lower Klamath River, California, 2005.

Figure 9. YTFP staff constructing willow siltation baffle, Lower Terwer Creek, Lower Klamath River California, 2005.

Figure 10. YTFP staff constructing willow siltation baffle, Lower Terwer Creek, Lower Klamath River California, 2005.

Figure 11. Backfilling willow siltation baffle, Lower Terwer Creek, Lower Klamath River California, 2005.

Figure 12. Placing quarter-ton quarry rock on willow siltation baffle, Lower Terwer Creek, Lower Klamath River, California, 2005.

Figure 13. Placing LWD in willow mattress trench, Lower Terwer Creek, Lower Klamath River California, 2005.

Figure 14. Backfilling willow mattress trench, Lower Terwer Creek, Lower Klamath River California, 2005.

Figure 15. Delivering water to willow siltation baffle installation site, Lower Terwer Creek, Lower Klamath River, California, 2005.

Figure 16. Project site following installation of willow baffles/mattresses, Lower Terwer Creek, Lower Klamath River, California, 2005

Figure 17. Project site following installation of willow baffles/mattresses, Lower Terwer Creek, Lower Klamath River, California, 2005.

Figure 18. Project site following installation of willow baffles/mattresses, Lower Terwer Creek, Lower Klamath River, California, 2005.

Figure 19. Removing non-native blackberries from highly erosive streambank, Lower Terwer Creek, Lower Klamath River California, 2005.

Figure 20. Planting willow cuttings in log-boulder bank stabilization structures, Lower Terwer Creek, Lower Klamath River California, 2005.

Figure 21. Installing boulders on log-boulder bank stabilization structures, Lower Terwer Creek, Lower Klamath River California, 2005.

Figure 22. Installing willow mattresses between log-boulder structures, Lower Terwer Creek, Lower Klamath River California, 2005.

Figure 23. Completing finishing touches on bank stabilization site, Lower Terwer Creek, Lower Klamath River, California, 2005.

Figure 24. Stabilized and revegetated streambank, Lower Terwer Creek, Lower Klamath River, California, 2005.

Figure 25. Boulder-log bank stabilization structures under increased streamflows, Lower Terwer Creek, Lower Klamath River, California, January 20, 2006.

Figure 26. YTFP staff installing willow baffles on adjoining flood terrace, Lower Terwer Creek, Lower Klamath River, 2005.

ACTUAL BUDGET
Lower Terwer Creek Bioengineering Project Budget
FY 2005 CDFG Fisheries Restoration Grant Program - Adaptive Funding

			Amount Expended	Amount of Cost Share	Project Total
Personnel Services Costs					
Level of Staff	**Number of Hours**	**Hourly Rate**			
Senior Fisheries Biologist	120	$26.73	$0.00	$3,207.60	$3,207.60
Fisheries Biologist II	360	$19.51	$0.00	$7,023.60	$7,023.60
Fisheries Biologist I	207	$14.43	$1,114.72	$1,875.90	$2,990.62
Excavator Operator	45.2	$40.93	$1,850.04	$0.00	$1,850.04
Excavator Technician	20	$24.83	$496.60	$0.00	$496.60
Fisheries Technician	1588	$12.00	$2,257.92	$16,800.00	$19,057.92
Staff Benefits			$1,169.84	$11,902.55	$13,072.39
Total Personal Services Costs			$6,889.12	$40,809.65	$47,698.77
Operating Expenses					
Excavator (Lowboy Hauling)			$1,411.00	$0.00	$1,411.00
Heavy Equipment Repair			$2,000.00	$0.00	$2,000.00
Materials and Supplies					
Quarry Rock (1-2') 150 Tons			$4,732.41	$0.00	$4,732.41
Quarry Rock (3'+) 42 Tons			$1,366.04	$0.00	$1,366.04
Willow cutting, planting & safety supplies			$765.20	$500.00	$1,265.20
Conifer Planting Supplies (hoedads, treebags)			$0.00	$300.00	$300.00
Misc. Hand Tools (McLeods, Pulaskis, shovels)			$0.00	$300.00	$300.00
Safety Equipment (chaps, gloves, eye/ear protection)			$0.00	$500.00	$500.00
Irrigation Supplies			$628.85	$2,000.00	$2,628.85
Backhoe (10 weeks @$800/week)			$0.00	$8,000.00	$8,000.00
Backhoe Supplies (hydraulic hoses & fittings, tires)			$1,238.55	$500.00	$1,738.55
Front-end Loader (6 weeks @800/week)			$0.00	$4,800.00	$4,800.00
Water Pumps (2 pumps x 6 weeks x $50/week/pump)			$0.00	$600.00	$600.00
GPS Unit (10 days @$50/day)			$0.00	$500.00	$500.00
Nikon Total Station (5 days @$50/day)			$0.00	$250.00	$250.00
Chainsaws (10 weeks @$120/week)			$0.00	$1,200.00	$1,200.00
Vehicle Expenses (fuel, maintenance, repair)			$0.00	$2,000.00	$2,000.00
Total Operating Expenses			$12,142.05	$21,450.00	$33,592.05
Project Subtotal			$19,031.17	$62,259.65	$81,290.82
Administrative Overhead @ 28.19% (thru 9/30/05) & @ 31.08% (thru 9/30/06)			$5,908.45	$19,350.30	$25,258.75
Total Estimated Budget			**$24,939.62**	**$81,609.95**	**$106,549.57**

Cost Share Percentage= 77%

Source and Amount of Cost Share:	Yurok Tribe - Matching Funds:	$5,592.01
	Yurok Tribe - In-kind:	$22,218.06
	BIA-Watershed Restoration Funds:	$53,799.87