YUROK TRIBE

FINAL
Macroinvertebrate Report: 2012

Yurok Tribe Environmental Program
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I. Introduction

This report summarizes the methods and results of macroinvertebrate sampling conducted on tributaries of the lower Klamath River for water year 2012 (WY12). The Yurok Tribe Environmental Program (YTEP) collected macroinvertebrate samples at nine tributary sites starting in May and ending in July in an effort to assess the physical/habitat and biological conditions on the lower reaches of selected Klamath River tributaries during the sampling period. This data was added to previous years' macroinvertebrate data as part of an endeavor to build a multi-year data set on the Lower Klamath River. Additional macroinvertebrate sampling efforts took place along four tributaries of the Klamath River that were monitored before and after bridge replacement conducted by Cal Trans occurred. Macroinvertebrate sampling results for Cal Trans Four Bridges Project are located in appendix A. This summary is part of YTEP's comprehensive program of monitoring and assessment of the chemical, physical, and biological integrity of the Klamath River and its tributaries in a scientific and defensible manner.

II. Background

The Klamath River Watershed

The Klamath River system drains much of northwestern California and south-central Oregon (Figure 1). Thus, even activities taking place on land hundreds miles off the YIR can affect water conditions within YIR boundaries. For example, upriver hydroelectric and diversion projects have altered natural flow conditions for decades. The majority of water flowing through the YIR is derived from scheduled releases of impounded water from the Upper Klamath Basin that is often of poor quality with regards to human needs as well as the needs of fish and wildlife.

Some historically perennial streams now have ephemeral lower reaches and seasonal fish migration blockages which may be influenced by inadequate dam releases from water diversion projects along the Klamath and Trinity Rivers. The releases contribute to lower mainstem levels and excessive sedimentation which in turn causes subsurface flow and aggraded deltas. Additionally, the lower slough areas of some of the Lower Klamath tributaries that enter the estuary experience eutrophic conditions during periods of low flow. These can create water quality barriers to fish migration when dissolved oxygen levels are inadequate for migrating fish. The Klamath River is on California State Water Resource Control Board's (SWRCB) 303(d) List as impaired for temperature, dissolved oxygen, and nutrients and portions of the Klamath River were recently listed as impaired for microcystin and sedimentation.

The basin's fish habitat has also been greatly diminished in area and quality during the past century by accelerated sedimentation from mining, timber harvest practices, and road construction, as stated by Congress in the Klamath River Act of 1986. Management of private lands in the basin (including fee land within Reservation boundaries) has been, and continues to be, dominated by timber harvest for the last 100 years.

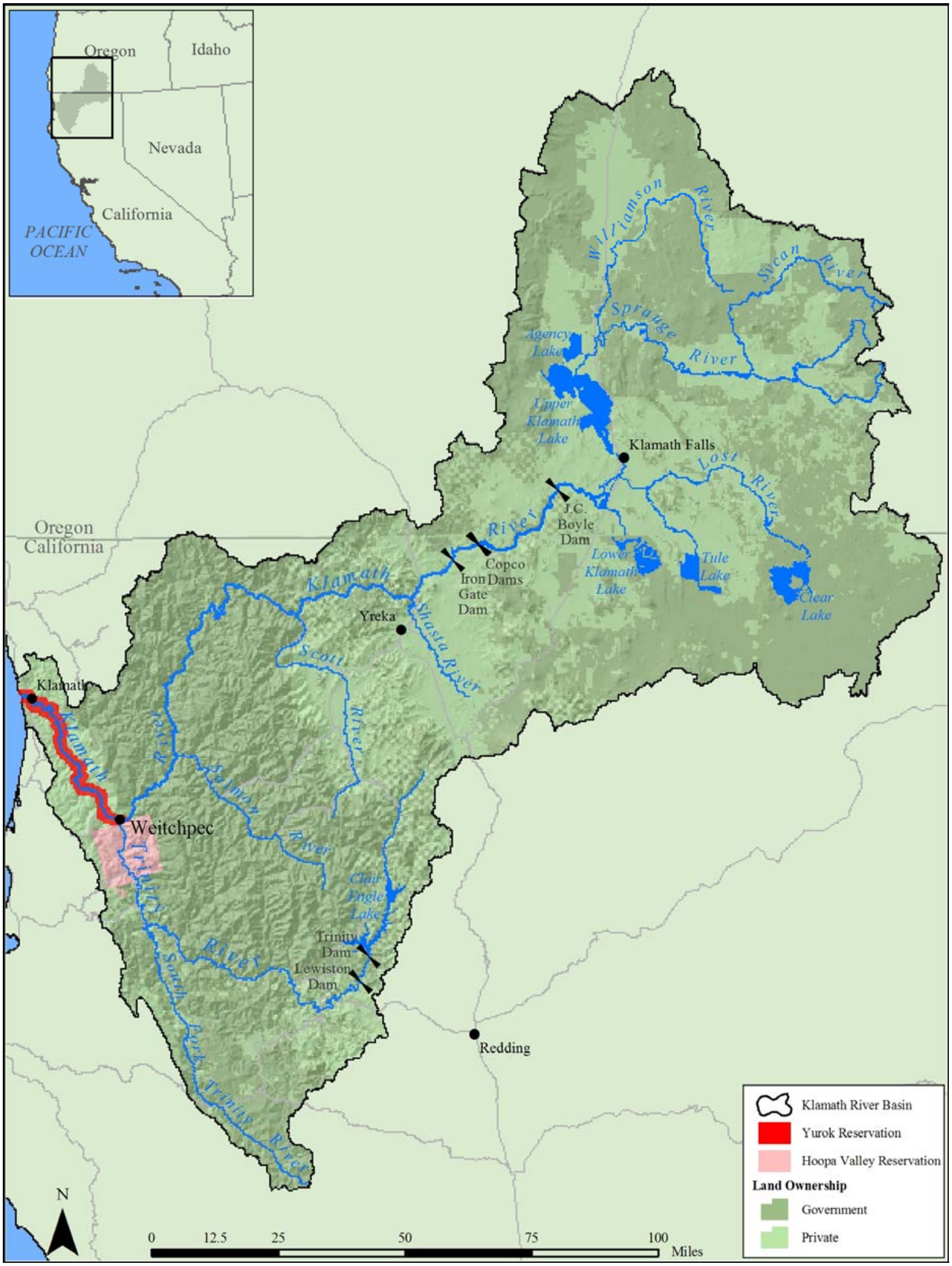

Figure 2-1. Klamath River Basin Map.

The Klamath River

The health of the Klamath River and associated fisheries has been central to the life of the Yurok Tribe since time immemorial fulfilling subsistence, commercial, cultural, and ceremonial needs. Yurok oral tradition reflects this. The Yurok did not use terms for north or east, but rather spoke of direction in terms of the flow of water (Kroeber 1925). The Yurok word for salmon, *nepuy*, refers to “that which is eaten”. Likewise, the local waterways and watershed divides have traditionally defined Yurok aboriginal territories. Yurok ancestral land covers about 360,000 acres and is distinguished by the Klamath and Trinity Rivers, their surrounding lands, and the Pacific Coast extending from Little River to Damnation Creek.

The fisheries resource continues to be vital to the Yurok today. The September 2002 Klamath River fish kill, where a conservative estimate of 33,000 fish died in the lower Klamath before reaching their natal streams to spawn, was a major tragedy for the Yurok people.

The Yurok Indian Reservation

The current YIR consists of a 55,890-acre corridor extending for one mile from each side of the Klamath River from the Trinity River confluence to the Pacific Ocean, including the channel (Figure 2). There are approximately two dozen major anadromous tributaries within that area. The mountains defining the river valley are as much as 3,000 feet high. Along most of the river, the valley is quite narrow with rugged steep slopes. The vegetation is principally redwood and Douglas fir forest with little area available for agricultural development. Historically, prevalent open prairies provided complex and diverse habitat.

The majority of the lands in the YIR are fee lands, (mostly owned by Green Diamond Resource Company), which are managed intensively for timber products. A small portion of the YIR consists of public lands managed by Redwood National/State Parks (RNSP), the United States Forest Service (USFS) and private landholdings. The Yurok Tribe owns approximately 13,000 acres within the YIR and manages the landscape for multiple uses to meet the needs of the Yurok Tribal membership.

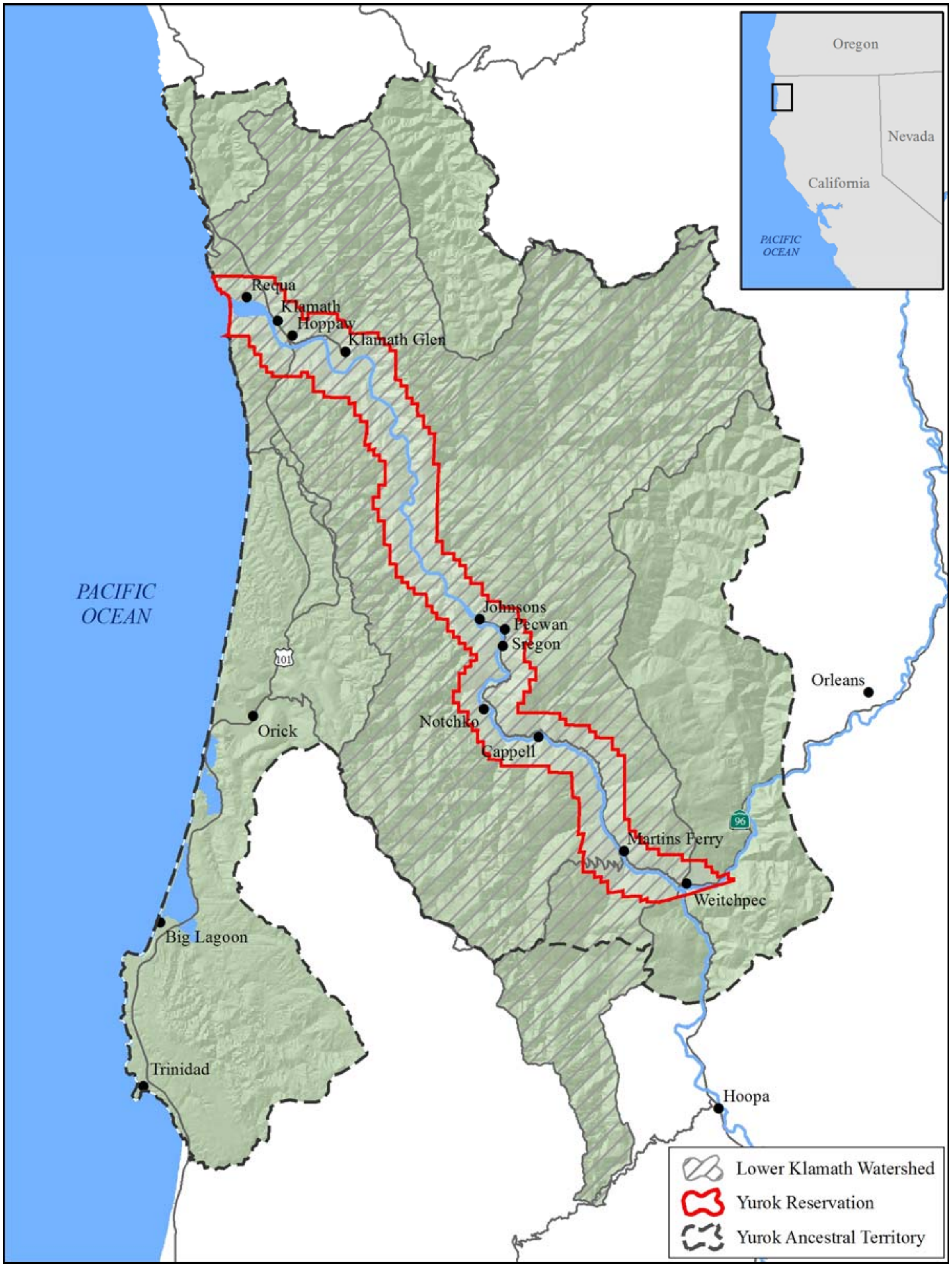

Figure 2-2. Map of Yurok Indian Reservation and Yurok Ancestral Territory.

Yurok Tribe Water Monitoring Division

In 1998, YTEP was created to protect and restore tribal natural resources through high quality scientific practices. YTEP is dedicated to improving and protecting the natural and cultural resources of the Yurok Tribe through collaboration and cooperation with local, private, state, tribal, and federal entities such as the Yurok Tribe Fisheries Program (YTFP), US Fish and Wildlife Service (USFWS), the United States Environmental Protection Agency (USEPA), Green Diamond Resource Company, the North Coast Regional Water Quality Control Board (NCRWQCB), and the United States Geological Survey (USGS). Funding allocated under the Clean Water Act Section 106 primarily funds YTEP's water monitoring activities.

Macroinvertebrate Sampling

Evaluating the biological community of a stream or river through assessments of macroinvertebrates provides a sensitive and cost effective means of determining stream condition. Macroinvertebrates, being greater than 0.5mm in size (invertebrates large enough to be seen with the naked eye) are fairly stationary, and are responsive to human disturbances. In addition, the relative sensitivity or tolerances of many macroinvertebrates to stream conditions is well known. Sampling of stream macroinvertebrates for biological assessments is an essential component of any comprehensive stream condition evaluation. The objective of studying macroinvertebrate communities is to monitor the general health and water quality conditions of tributaries to the Klamath River. According to the California Stream Bioassessment Procedure (CSBP) developed by the California Department of Fish and Game (DFG), benthic macroinvertebrate communities indicate physical and habitat characteristics that determine the stream integrity and ecological health.

III. Site Selection

Klamath River Tributaries

Site selection criteria for macroinvertebrate sampling include spatial distribution, herbicide application activity, watershed restoration activities, proposed future development, and other concurrent water quality monitoring activities. Sites are located in the lower reaches of watersheds that characterize water quality and watershed health condition. YTEP is in the process of developing baseline conditions to document the magnitude and duration of water quality impacts. The following parameters were used as selection criteria for macroinvertebrate sampling:

1. *Spatial Distribution* - Sites located in the lower reaches of watersheds that characterize water quality and watershed health condition. Areas chosen to monitor baseline and long-term trends.

2. *Activity Specific* -Sites located above and/or below herbicide applications and other activities that may potentially impact water quality.

3. *Watershed Restoration Activities*- Sites located in watersheds and sub-watersheds that have active or proposed restoration activities. Sites are selected to monitor the long-term trends by tracking the watershed's recovery.

4. *Proposed Future Development*- Sites near locations of resource and proposed resource development.

Nine tributary locations (Table 3-1, Figure 3-1) were chosen as meeting these requirements. They are: Lower Turwar (Figures 3-2, 3-3), Upper Turwar (Figures 3-2, 3-4), McGarvey (Figures 3-5, 3-6), Lower Blue (Figures 3-7, 3-8), Mainstem Pecwan (Figures 3-9, 3-10), East Fork Pecwan (Figures 3-9, 3-11), Mettah (Figures 3-12, 3-13), Roach (Figures 3-12, 3-14), and Tully (Figures 3-15, 3-16). Mainstem Pecwan was renamed due to naming convention consistency with USGS maps. Previous reports called this same site West Fork Pecwan or WP1, but it has now been changed to be called Mainstem Pecwan or MP2.

Table 3-1. Selection criteria priority matrix for tributary macroinvertebrate sampling*

Creek	Watershed	Sub watershed	Site ID	Primary Criteria	Secondary Criteria	Other
Lower Turwar	Turwar	Turwar	Tu1	1	3	2
Upper Turwar	Turwar	Turwar	Tu2	1	3	2
McGarvey	McGarvey	McGarvey	Mc1	3	1	
Lower Blue	Blue	Lower Blue	Lb1	1	3	2
Mainstem Pecwan	Pecwan	Pecwan	MP2	1	4	
E.F.Pecwan	Pecwan	EF Pecwan	EP1	1	4	
Mettah	Mettah	Mettah	Me1	3	1	
Roach	Roach	Roach	Ro1	1	3	
Tully	Tully	Tully	Ty1	1	4	2

*These criteria may change over time, this is an initial criteria designation based on current activities

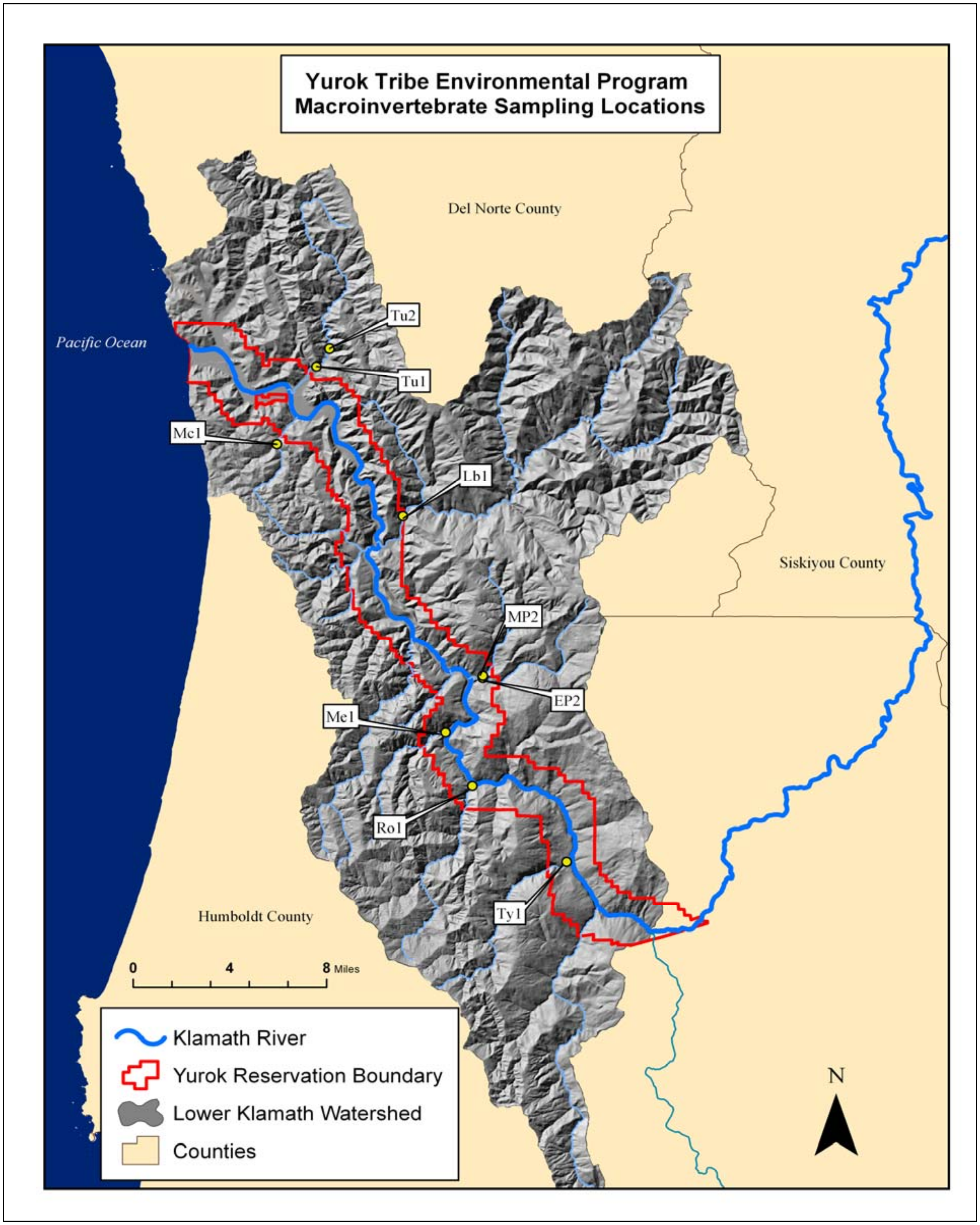

Figure 3-1. Yurok Tribe Environmental Program Macroinvertebrate Sampling Site Locations, 2012

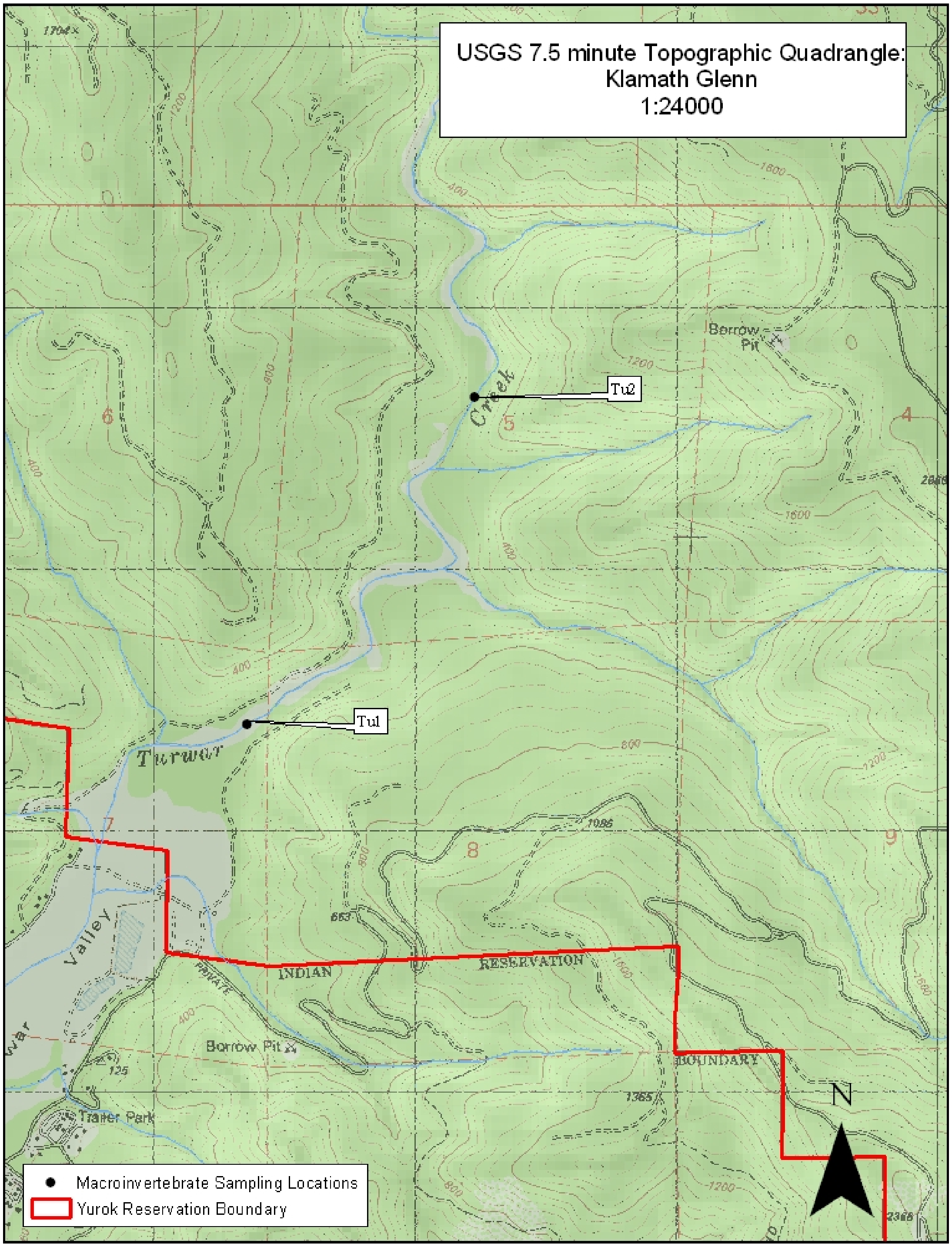

Figure 3-2. Lower (Tu1) and Upper (Tu2) Turwar Sampling Location Map, WY12


Figure 3-3. Photo of Lower Turwar (Tu1) Sampling Location, WY12


Figure 3-4. Photo of Upper Turwar (Tu2) Sampling Location, WY12

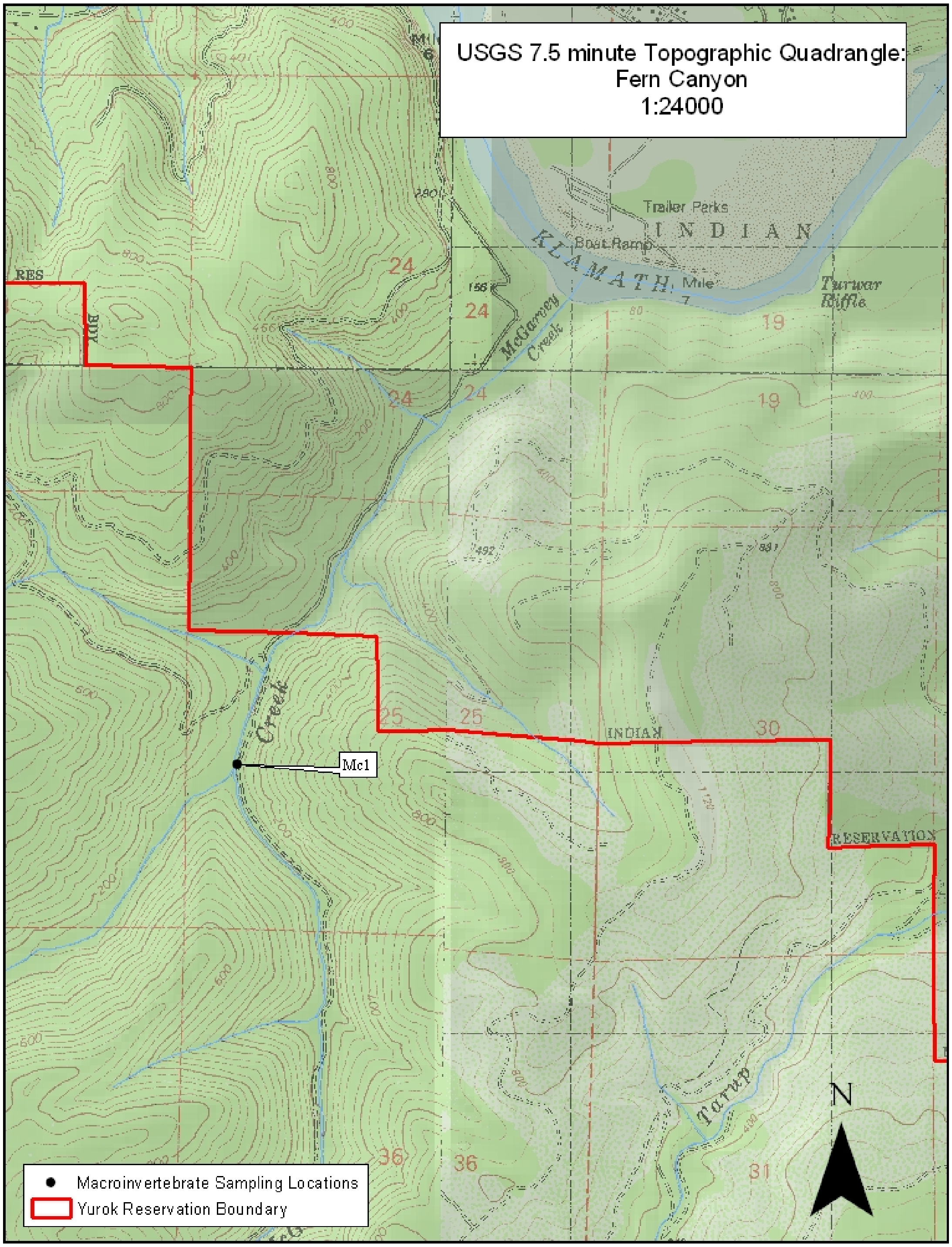

Figure 3-5. McGarvey Creek (Mc1) Sampling Location Map, WY12

Figure 3-6. Photo of McGarvey Creek (Mc1) Sampling Location, WY12

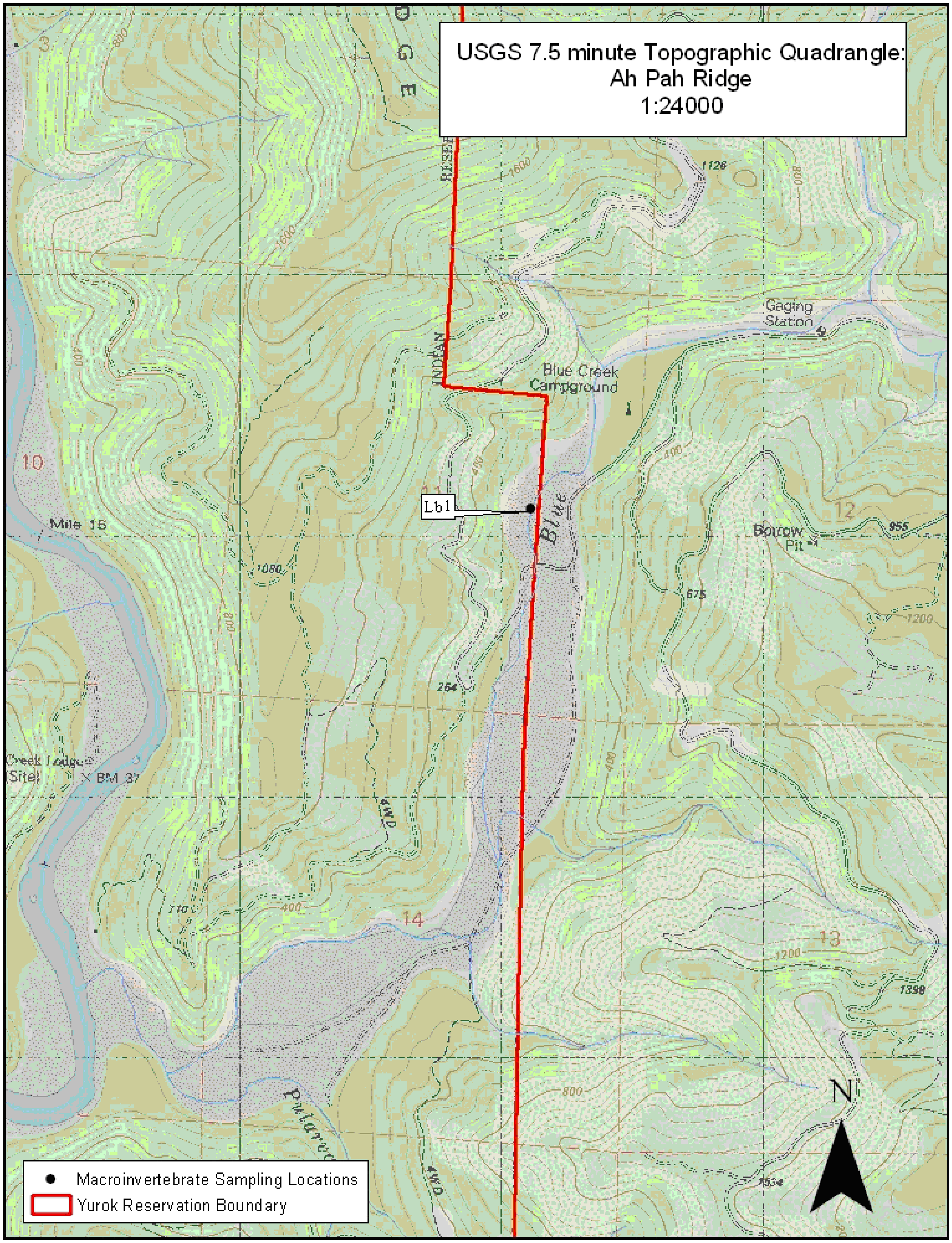

Figure 3-7. Blue Creek (Lb1) Sampling Location Map, WY12

Figure 3-8.Photo of Lower Blue Creek (Lb1) Sampling Location, WY12

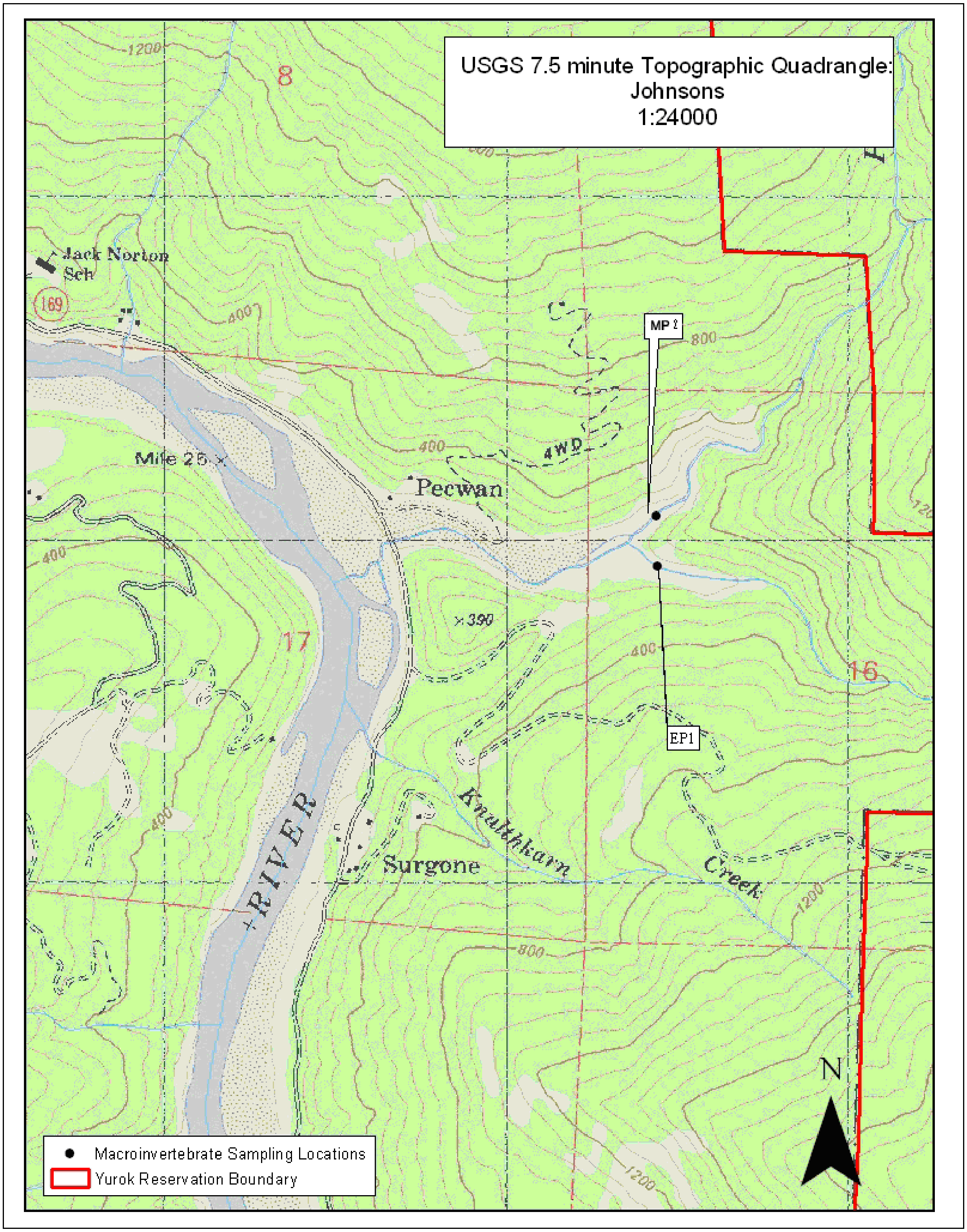

Figure 3-9. Mainstem Pecwan Creek (MP2) and East Fork Pecwan Creek (EP1) Sampling Location Map, WY12

Figure 3-10. Photo of Mainstem Pecwan Creek (MP2) Sampling Location, WY12

Figure 3-11. Photo East Fork Pecwan Creek (EP1) Sampling Location, WY 12

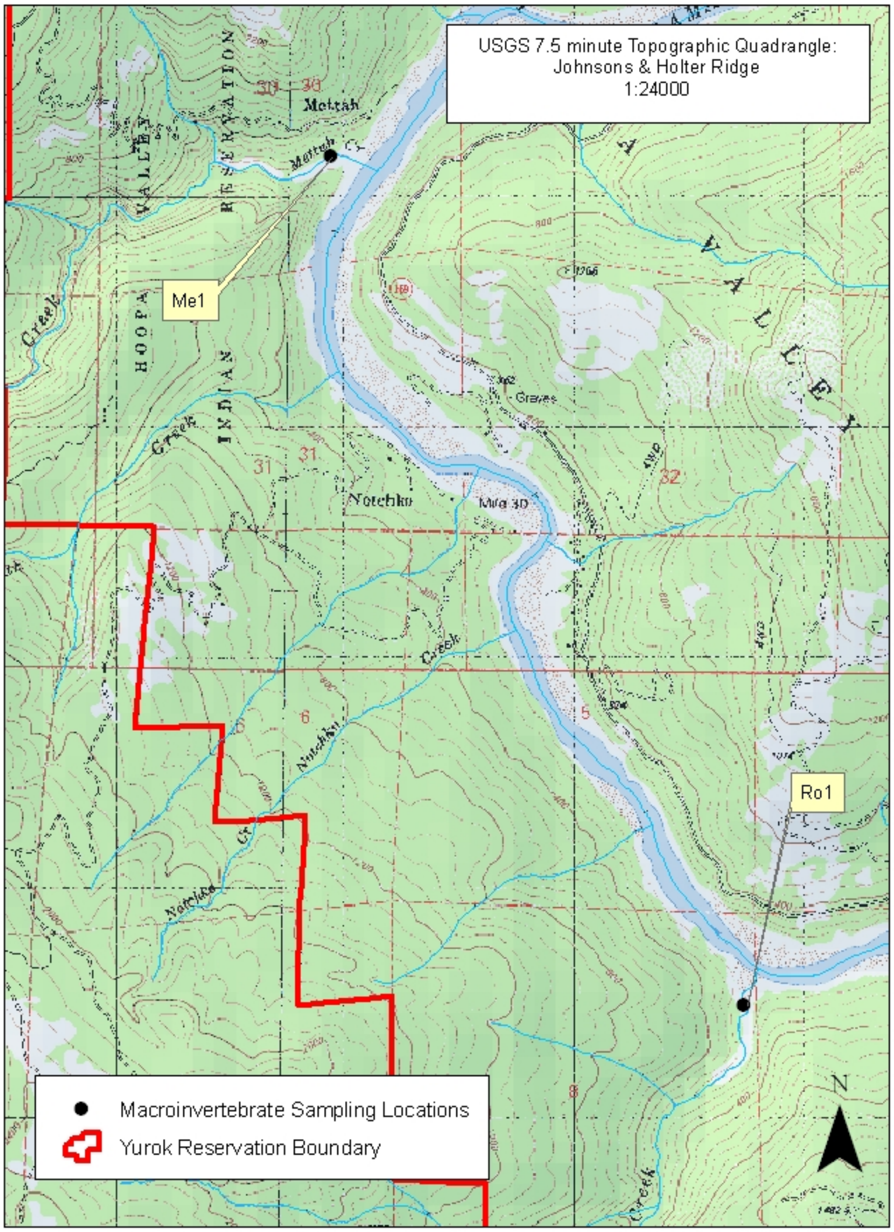

Figure 3-12. Mettah Creek (Me1) and Roach Creek (Ro1) Sampling Location Map, WY 12


Figure 3-13. Photo of Mettah Creek (Me1) Sampling Location, WY 12

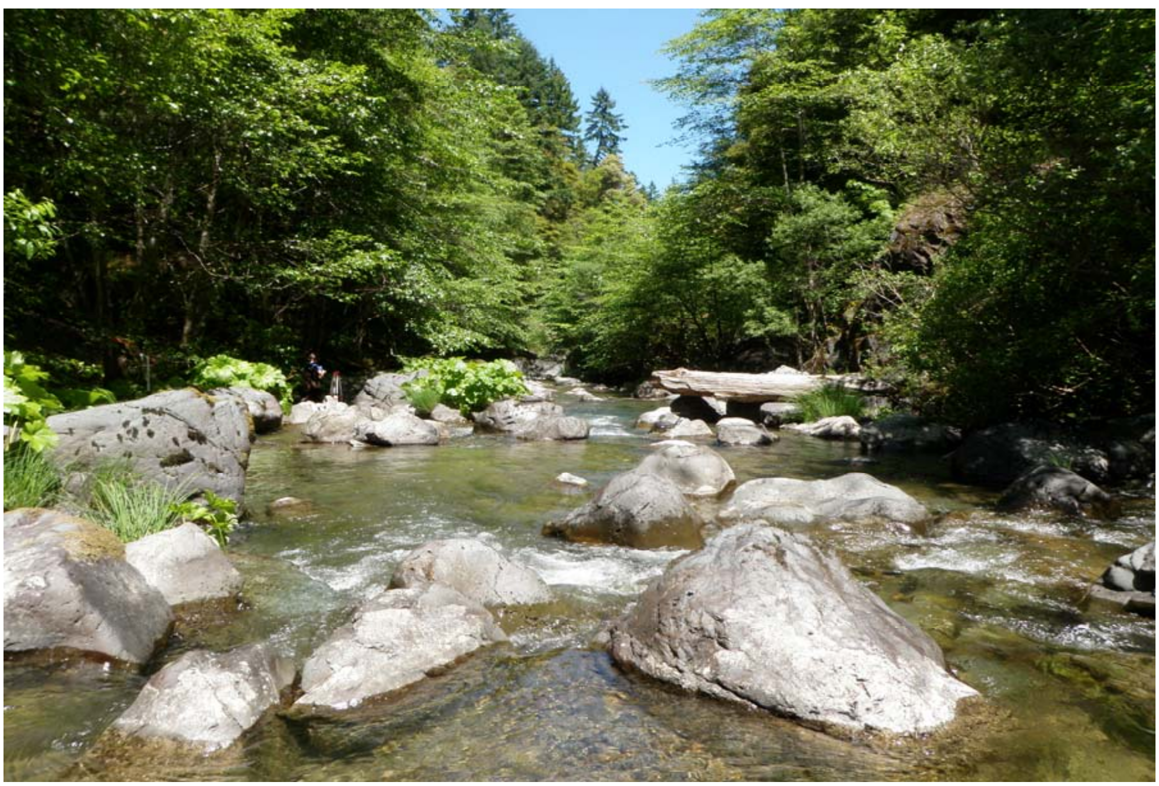
Figure 3-14. Photo of Roach Creek (Ro1) Sampling Location, WY 12

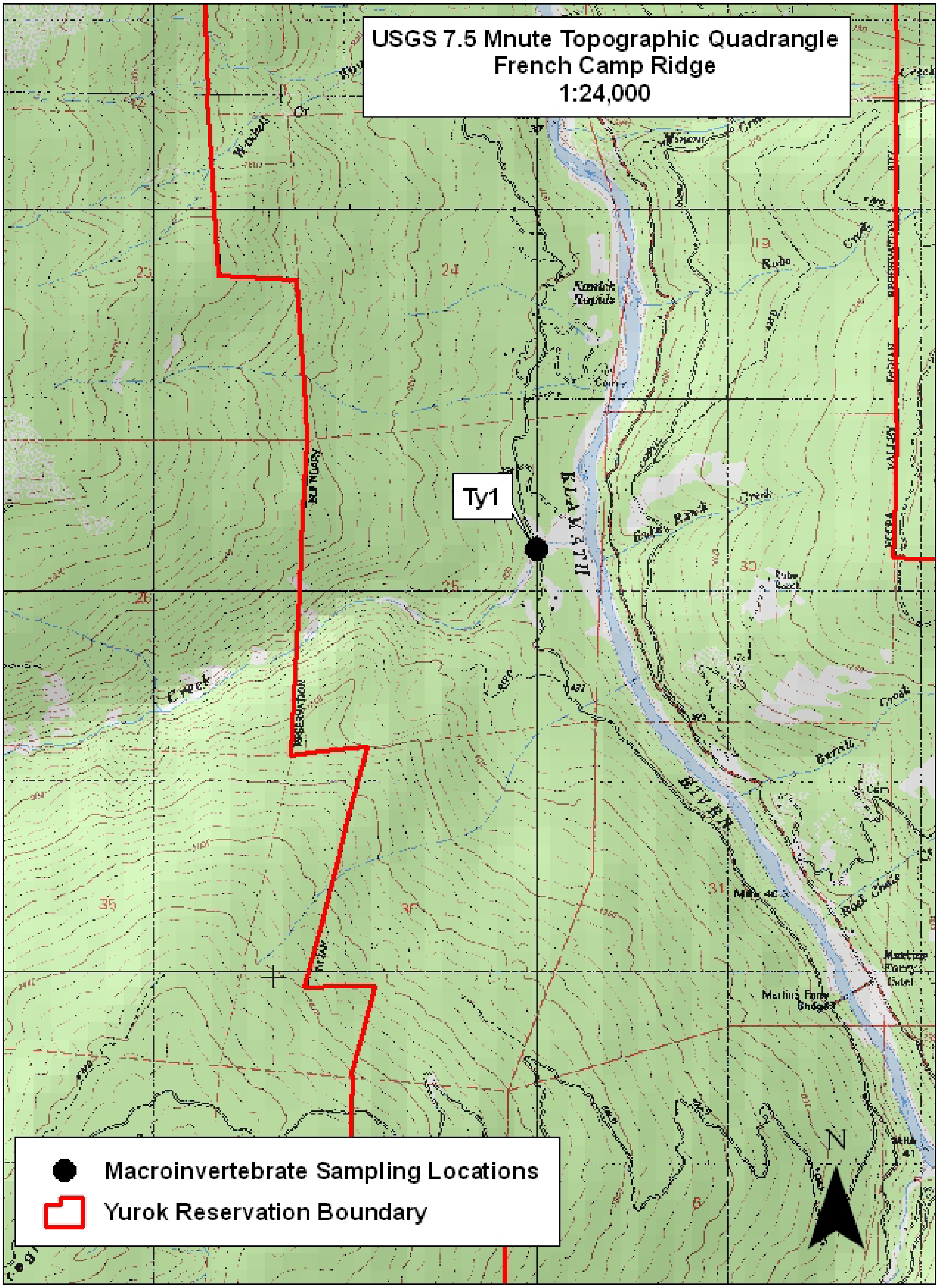

Figure 3-15. Tully Creek (Ty1) Sampling Location Map, WY12


Figure 3-16. Photo of Tully Creek (Ty1) Sampling Location, WY12

IV. Methods

YTEP sampled benthic macroinvertebrate populations in selected tributaries to the Lower Klamath River during the spring and summer months. Sampling was performed using the multi-habitat methods located in the State of CA Surface Water Ambient Monitoring Program (SWAMP) *Standard Operating Procedures for Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California February 2009* that was adapted from the US EPA's "Rapid Bioassessment Protocols of use in Streams and Rivers". This protocol reference and internet link is located in Appendix B. This protocol also includes the collection of water quality parameters and physical habitat conditions in the channel and the riparian zone. This report does not contain this information and is available upon request.

The parameters measured include:

- Epifaunal Substrate/Available Cover
- Embeddedness
- Velocity/ Depth Regimes
- Sediment Deposition
- Channel Flow Status
- Channel Alteration
- Frequency of Riffles (or bends)
- Bank Stability
- Vegetative Protection
- Riparian Vegetative Zone Width
- Algae Presence

The Hydrologic Specialist and two AmeriCorps members collected specimens which were sent to a lab where a certified taxonomist identified and calculated the number and types of species.

A variety of Quality Control measures were undertaken in the macroinvertebrate sampling methods. Sample labels were properly completed, including the sample identification code, date, stream name, sampling location, and collector's name, then placed into the sample container. Chain-of-custody forms, when needed, included the same information as the sample container labels. After sampling had been completed at a given site, all nets, pans, and other equipment that had come in contact with the samples were rinsed thoroughly, examined carefully, and picked free of organisms and debris. The equipment was examined again prior to use at the next sampling site.

Data generated in the field and laboratory is reviewed prior to being released internally or to an outside agent. Laboratory processing is contracted to Jonathan Lee, a qualified local CSBP taxonomist and California Bioassessment Laboratories Network (CAMLnet) member. The CSBP has three levels of Benthic Macroinvertebrate (BMI) identification. Level 3 is the professional level equivalent and requires identification of BMIs to a standard level of taxonomy, usually the genus and/or species. If questionable macroinvertebrates are encountered, the CDFG Aquatic Bioassessment Laboratory is used as a reference to verify the specimens. Past review of macroinvertebrate results by CDFG have shown that all identifications and counts are accurate.

After processing the samples, the biological matrices are received from the taxonomist in an Excel spreadsheet format identifying the sample ID and the breakdown of BMI species into standard taxonomic levels.

V. Results

Metric scores can be used to describe macroinvertebrate community structure and determine disturbance status of a stream habitat.

The following is a brief description of metrics calculated for YTEP's results obtained from WY12 tributary sampling efforts which have proven to be useful in the Pacific Northwest (Fore et al. 1996; Karr and Chu 1999) and northern California (Harrington et al. 1999). Mainstem Pecwan was renamed due to naming convention consistency. USGS maps previous reports called this same site WP1 or West Fork Pecwan but it is indeed Mainstem Pecwan.

- *Taxa Richness:* A richness measure. The total number of distinct taxa in a sample. Reflects health of the community through measurement of the variety of taxa present. Generally increases with increasing water quality, habitat diversity, and/or habitat suitability (Plafkin et al. 1989) (Table 5-1, Figure 5-1)

- *EPT Taxa Richness:* A richness measure. The total number of Ephemeroptera (Mayfly), Plecoptera (Stonefly), and Trichoptera (Caddisfly) taxa present. These orders are considered generally sensitive to disturbance. Expected to decrease with human induced disturbance (Table 5-1, Figure 5-2)

- *Percent Sensitive EPT Index:* A composition measure. Proportion of sample composed of Ephemeroptera, Plecoptera and Trichoptera taxa which have been assigned a tolerance value of 0 to 3. Expected to decrease with degraded habitat (Table 5-1, Figure 5-3)

- *Percent Dominant Taxon:* A Tolerance/Intolerance measure. Percent contribution of the most numerous taxon present in a sample. A community dominated by relatively few taxa would indicate environmental stress (Plafkin et al. 1989). Expected to increase with stress (Table 5-1, Figure 5-4).

- *Tolerance Value:* A tolerance/intolerance measure. A biotic index which evaluates tolerance of benthic macroinvertebrate to organic enrichment. Taxa tolerant of organic enrichment are also generally tolerant of warm water, fine sediment, and heavy filamentous algal growth (Wisseman 1996). Scale is 0 through 10, 0 being highly intolerant and 10 being highly tolerant of organic enrichment. The tolerance value is calculated as: $TV=\_(n_i\ t_i)/N$, where n_i is the number of individuals in a taxon, t_i is the tolerance value for that taxon, and N is the total number of individuals in the sample. Value expected to increase with stressed environment. Tolerance values are from California Department of Fish and Game (2003) listed values, however are subject to modification as more data is gathered (Table 5-1, Figure 5-5).

- *Shannons Diversity Index (H):* A diversity index is a mathematical measure of taxa diversity in a community. Shannons index accounts for both abundance and evenness of the taxa present. The proportion of taxa *i* relative to the total number of taxa (p_i) is calculated, and then multiplied by the natural log of this proportion (lnp_i). The resulting product is summed across taxa, and multiplied by -1: $\boldsymbol{H}=-\_p_i \ln p_i$; Diversity is expected to decrease with disturbance (Table 5-1, Figure 5-6)

Karr and Chu (1999) consider relative abundance to be a poor candidate for use in stream monitoring because of the great natural variation that can occur. Low relative abundance during rapid flow may, in fact, be related to sediment input. The primary disturbance within the study streams is expected to be an increase in fine sediment. Fine sediment reduces the area of substrate available for colonization by macroinvertebrates. Areas of fine sediment in running water are unstable and do not allow a foothold for macroinvertebrates. Fine sediment also fills in areas around cobble substrates reducing usable habitat. Lenat et al. (1981), in North Carolina streams, found that during high flows the addition of sediment simply reduced the available habitat and therefore invertebrate density. Exposed cobble/rubble substrates act as refugia but the number of exposed surfaces is reduced by sediment input.

Lenat et al. (1981) also noted a stable sand community which developed during low flow conditions. This consisted of tolerant small grazers capable of rapid colonization and reproduction which utilized increased periphyton growing on the stable sand. Relative abundance and tolerance values would increase in stable sand.

Table 5-1. Reported macroinvertebrate metrics for Lower Klamath tributary sites sampled in WY12

Site	Sample Date	Total # of Specimens	Taxa Richness	EPT Richness	Sensitive EPT	% Dominant Taxon	Tolerance Value	Shannon's D.I.	Est Relative Abundance
McGarvey	5/15/2012	511	53	30	34.64	14.87	3.40	3.15	1136
Lower Turwar	5/18/2012	500	31	19	39.00	28.20	3.46	2.24	756
Upper Turwar	6/8/2012	501	37	20	16.77	43.71	4.69	2.25	1927
Mettah	5/25/2012	500	42	23	44.40	13.00	2.94	2.92	910
Roach	6/14/2012	409	42	21	36.92	22.74	3.40	3.08	409*
Tully	7/10/2012	505	49	25	20.20	19.21	4.19	2.78	1180
Mainstem Pecwan	7/16/2012	501	42	27	42.51	28.14	3.31	2.63	1600
East Fork Pecwan	7/24/2012	500	41	24	31.00	33.40	3.90	2.53	980
Blue Creek	7/27/2012	400	37	21	37.25	22.50	3.79	2.91	400*

*Note: Estimated relative abundance not calculated for Roach and Blue Creek since a minimum of 500 specimens was not yielded during the lab sub sampling procedure.

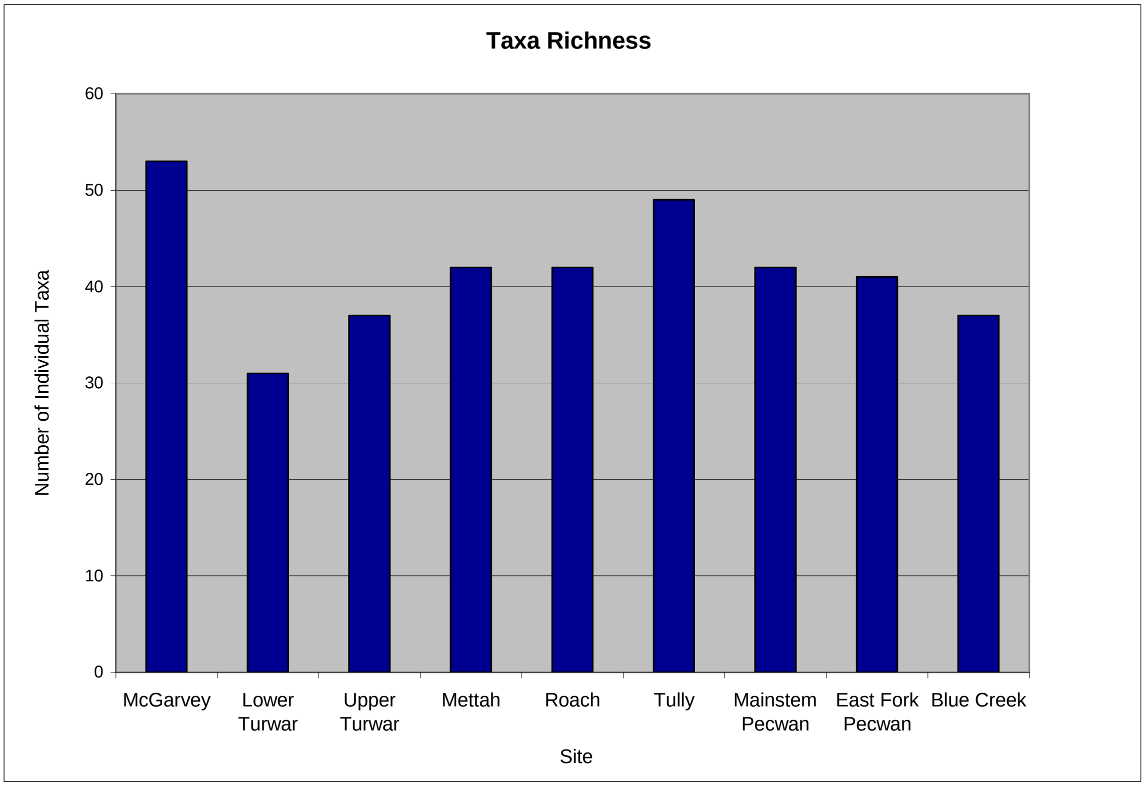

Figure 5-1. Taxa Richness for Klamath River Tributaries, WY 12.

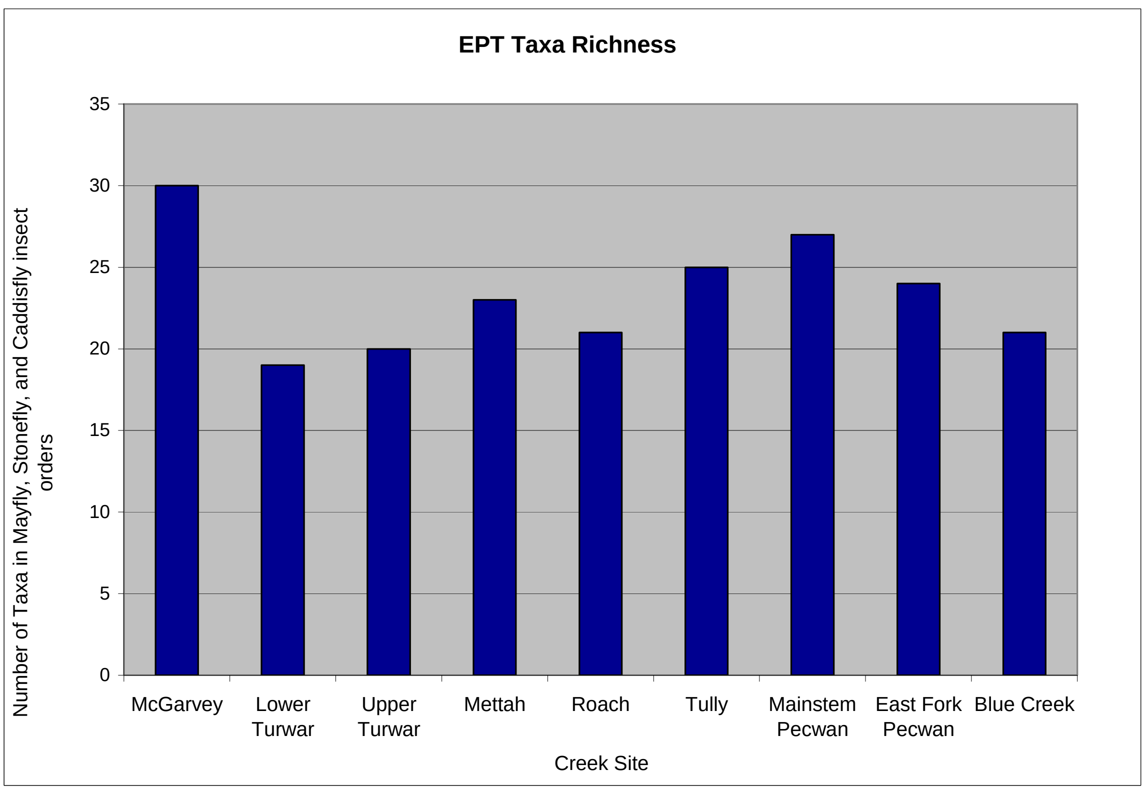

Figure 5-2. EPT Taxa Richness for Klamath River Tributaries, WY 12.

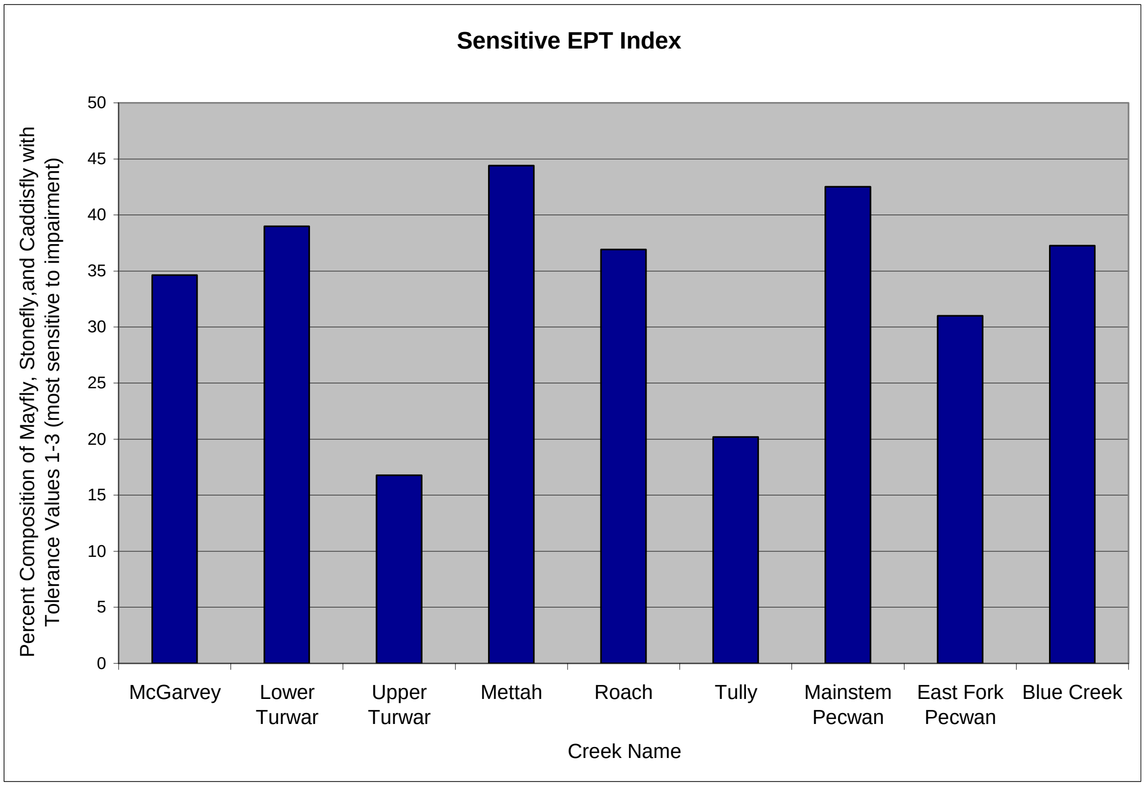

Figure 5-3. Sensitive EPT Index (%) for Klamath River Tributaries, WY 12.

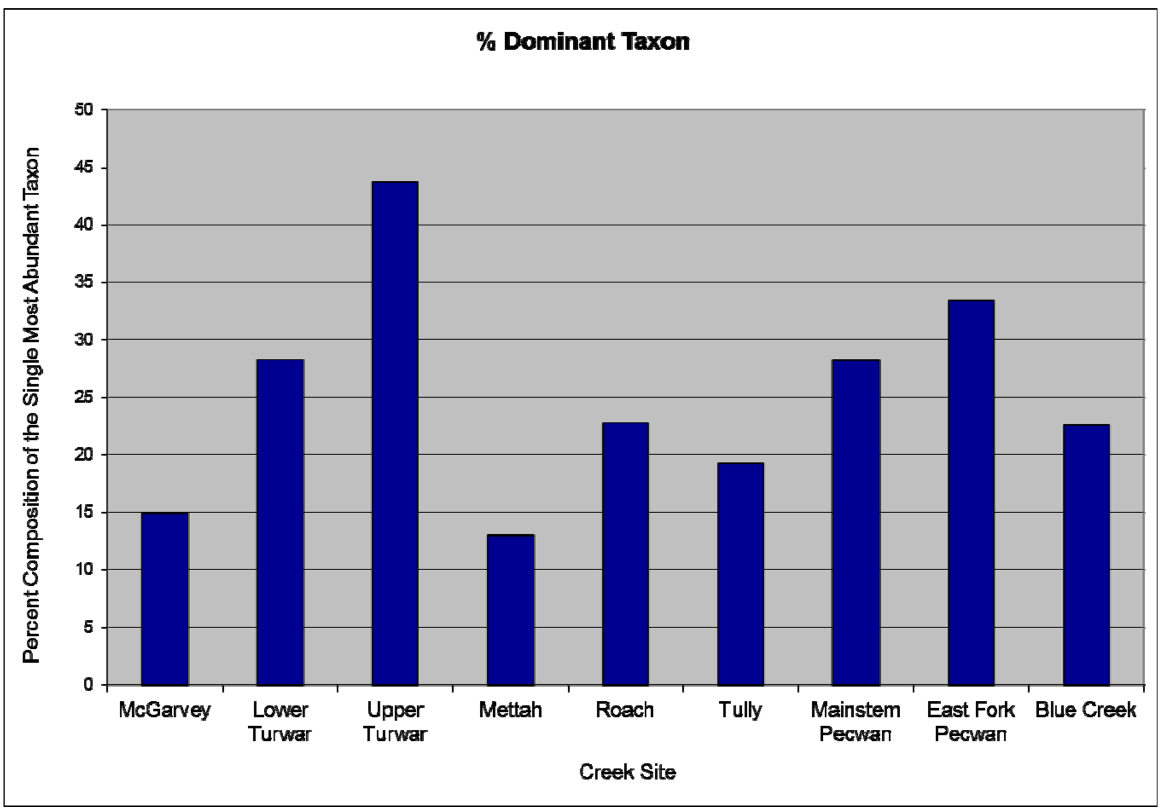

Figure 5-4. % Dominant Taxon for Klamath River Tributaries, WY 12.

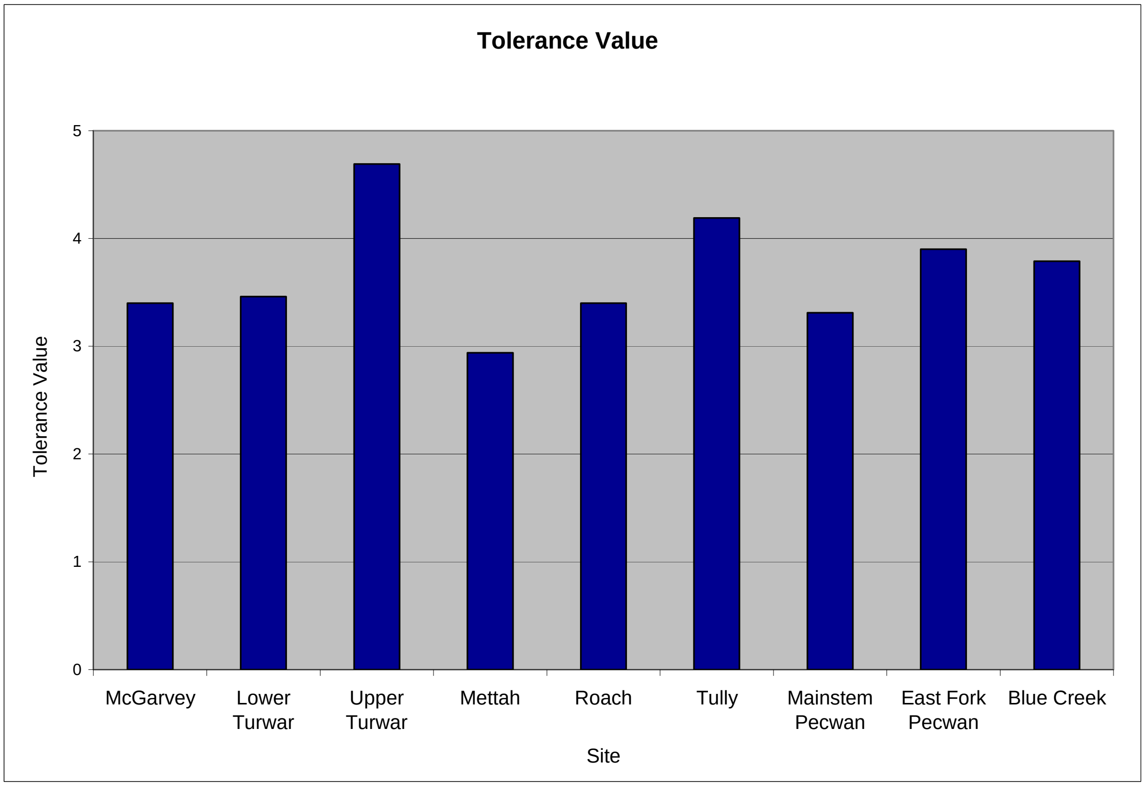

Figure 5-5. Tolerance Values for Klamath River Tributaries, WY 12.

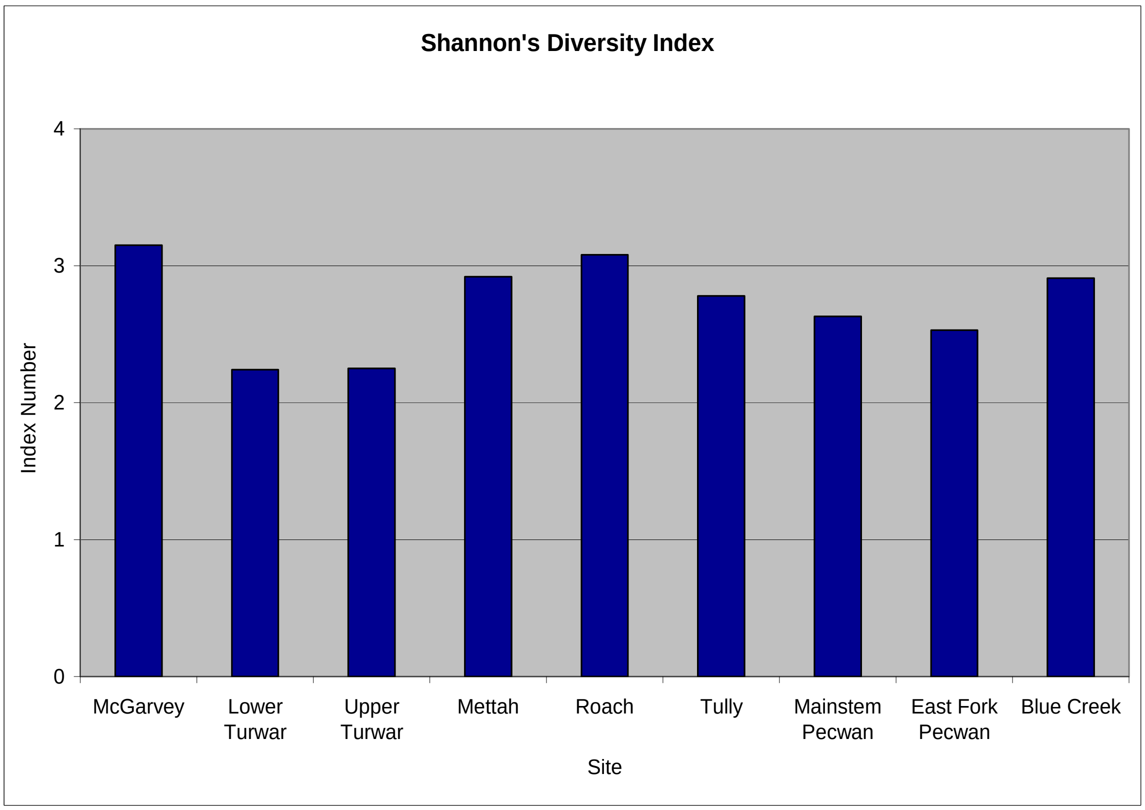

Figure 5-6. Shannon Diversity Index for Klamath River Tributaries, WY 12.

Macroinvertebrate results are presented for WY12 using the North Coast IBI. State of California developed the North Coast IBI to generate a single value to meausure stream health. Among the metrics used, 6 of the 8 were statistically different than the reference sites in early development of the IBI index for the Klamath region. A separate scoring scale was created to correct these statistical differences for streams that fall within the Klamath and North Coast mountain regions. In order to insure the greatest quality control, this separate scoring system was used when generating the metric for WY12. The results of this ranking method are as follows, along with the IBI scoring key.

Table 5-2. IBI Scoring Key

Total Metric Score	Value
0-20	very poor
21-40	poor
41-60	fair
61-80	good
81-100	very good
>52	"unimpaired"

Table 5-3. North Coast IBI Scores for Klamath River Tributaries WY 12

Site	Date	EPT Richness	Coleoptera Richness	Diptera Richness	% Intolerant	% non-Gastropod Scrapers	% Predator	% Shredder	% non-Insect	score
McGarvey	5/15/2012	10	9	5	7	6	8	6	7	72.5
Lower Turwar	5/18/2012	7	7	5	9	10	10	2	9	73.75
Upper Turwar	6/8/12/	7	10	7	5	5	10	3	9	70
Mettah	5/25/2012	9	10	8	8	10	3	10	9	83.75
Roach*	6/14/2012	8	10	8	8	10	5	3	9	76.25
Tully	7/10/2012	9	10	8	5	10	8	9	8	83.75
Pecwan Mainstem	7/16/2012	10	7	4	10	10	6	9	8	80
East Fork Pecwan	7/24/2012	9	9	6	8	7	3	9	8	73.75
Blue Creek*	7/27/2012	8	9	6	9	10	5	5	8	75

* Although sampling sites with less than 450 specimens are not considered acceptable data according to NorCal B-IBI standards, this data is still included for comparison purposes.

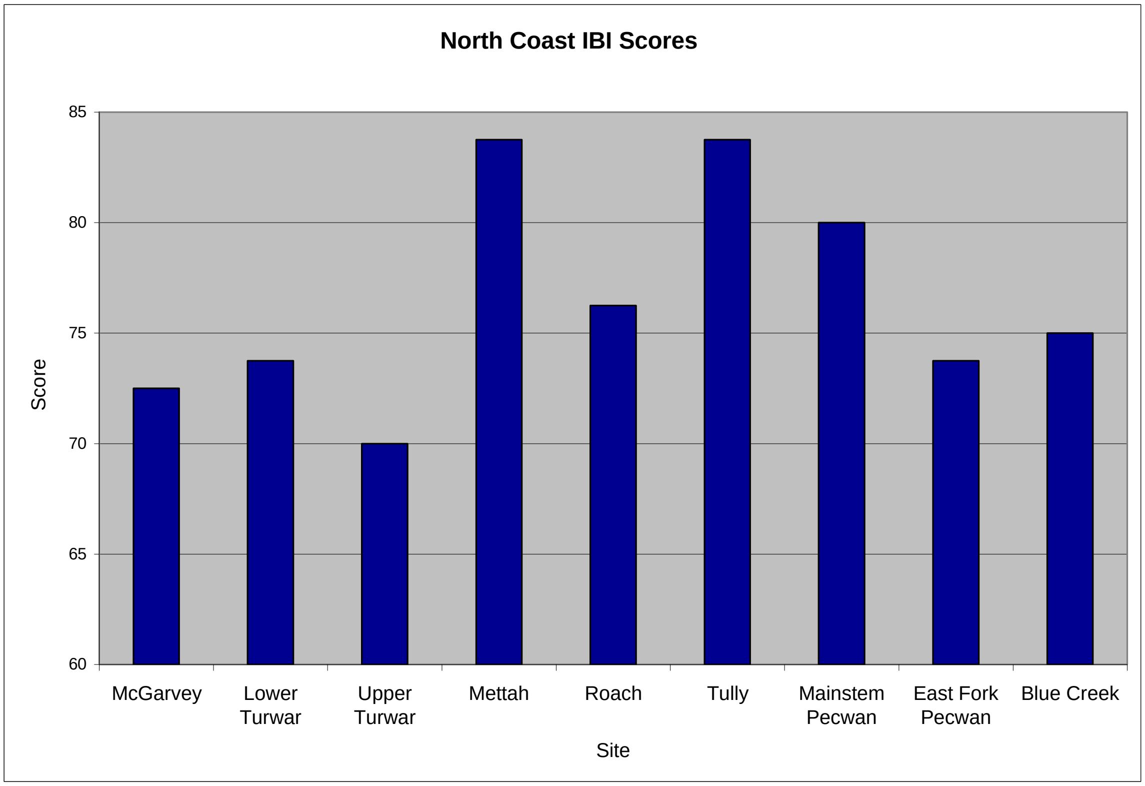

Figure 5-7. North Coast IBI Scores for Klamath River Tributaries, WY 12.

VI. Additional Habitat Characterization

The nine macroinvertebrate sampling sites are annually scored for additional habitat characterization. Additional habitat characterization is defined by three parameters. The three parameters include Epifaunal Substrate/Cover, Sediment Deposition, and Channel Alteration. Under each parameter the site is given a score ranging from 1 to 20. The numerical score correlates to the quality of the over all reach physical habitat for a particular sampling year (Table 7-1). The sampling site's additional habitat characterization score for each parameter has been compiled into a graph to illustrate the quality of physical habitat from the 2001 to the 2012 sampling year (Figure 7-1 through 7-9).

Table 7-1. Additional Habitat Characterization Key

Additional Habitat Characterization Key				
Parameter	**Optimal**	**Suboptimal**	**Marginal**	**Poor**
Epifaunal Substrate/Cover	Greater than 70% of substrate favorable for epifaunal colonization	40-70% mix of stable habitat; well-suited for colonization	20-40% mix of stable habitat; substrate frequency disturbed	Less than 20% stable habitat; lack of habitat is obvious
Score:	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Sediment Deposition	Little to no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition	Some new increase in bar formation, mostly from gravel , sand, or fine sediment; 5-30% of the bottom affected	Moderate deposition of new gravel, sand or fine sediment on bars; 30-50% of the bottom affected	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequency
Score:	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Channel Alteration	Channelization or dredging absent or minimal: stream with normal pattern	Some channelization present, (e.g. bridge abutments; recent channelization not present)	Channelization or shoring structures present on both banks; 40 to 80% of stream reach disrupted	Over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed
Score:	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

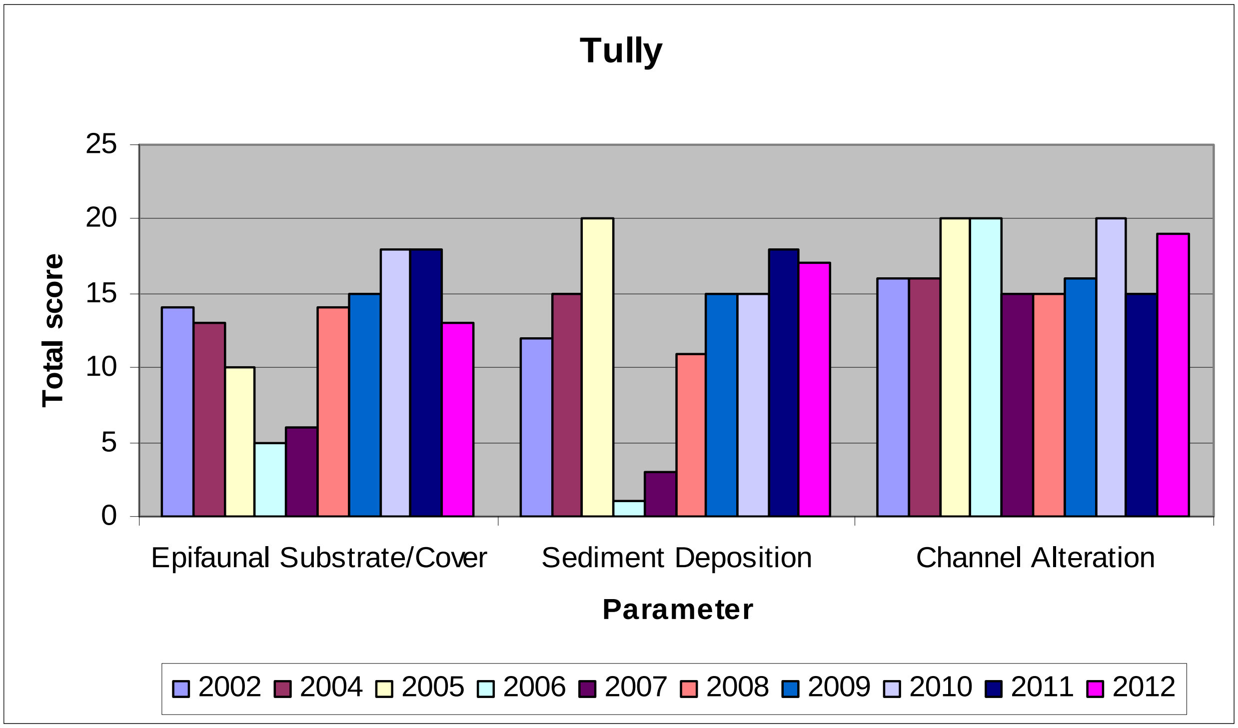

Figure 7-1. Additional Habitat Characterization, Tully Creek (Ty1).

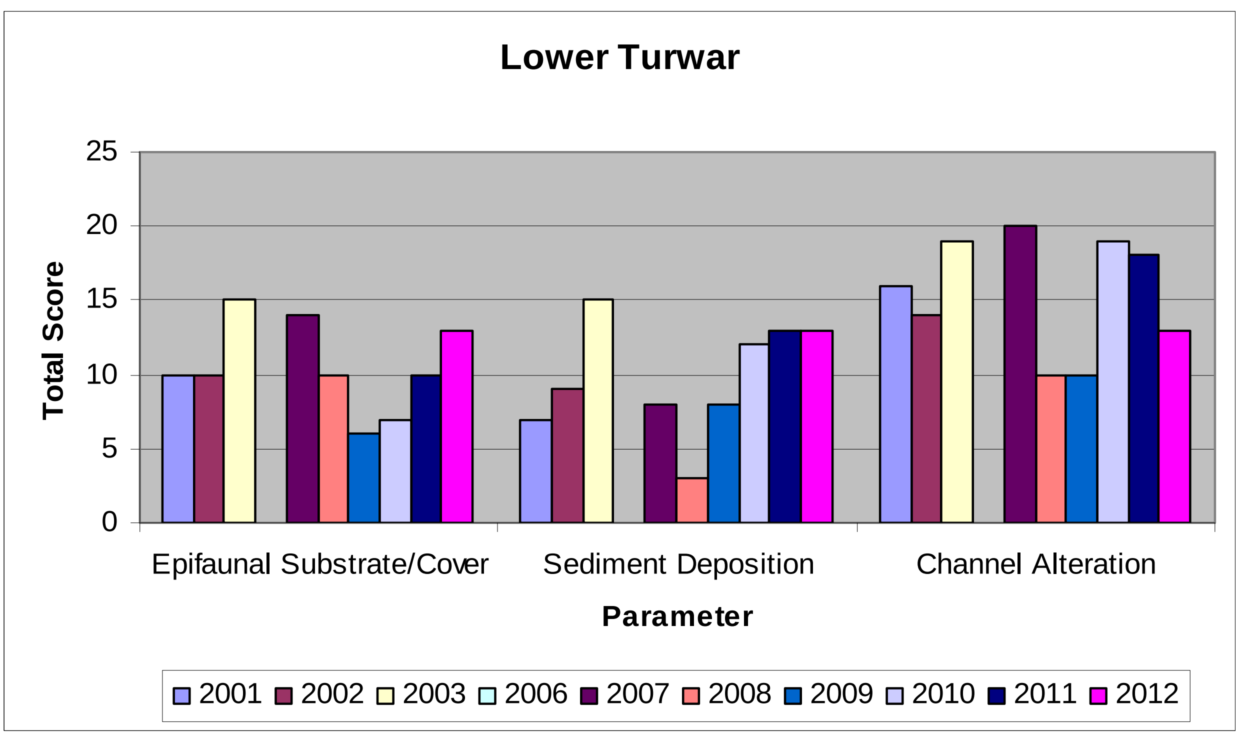

Figure 7-2. Additional Habitat Characterization, Lower Turwar (Tu1).

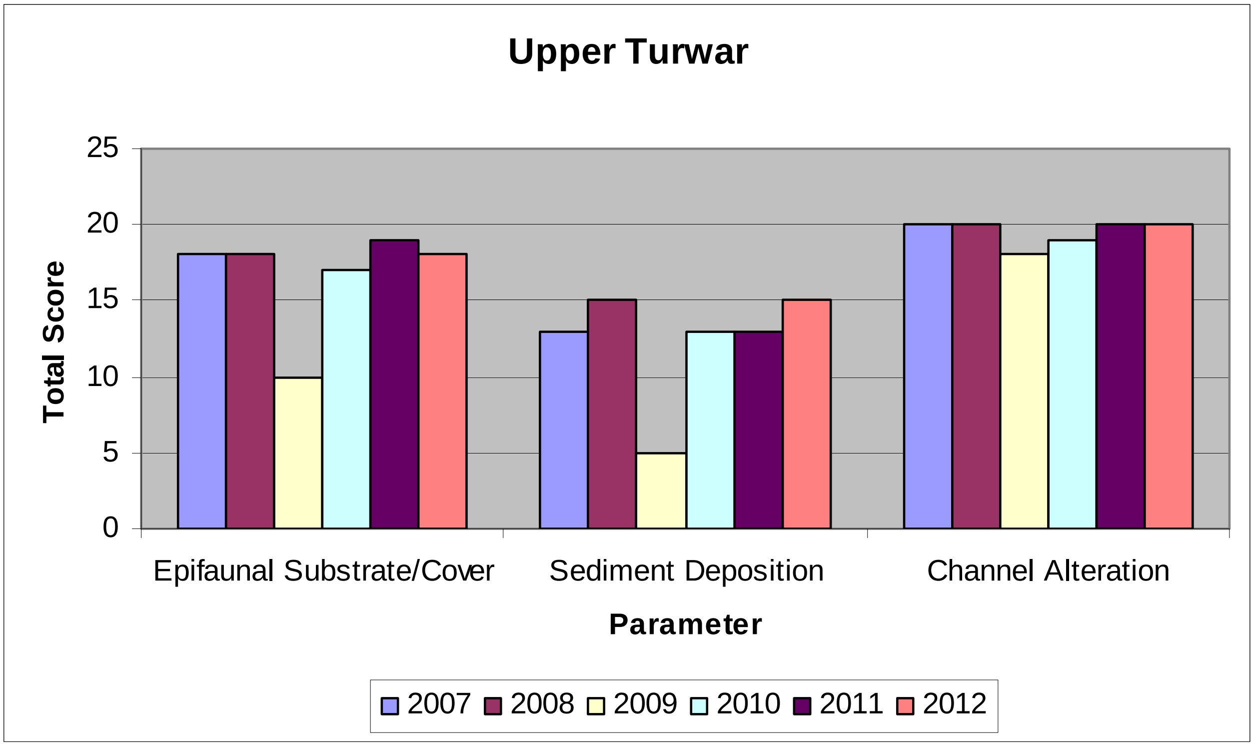

Figure 7-3. Additional Habitat Characterization, Upper Turwar (Tu2).

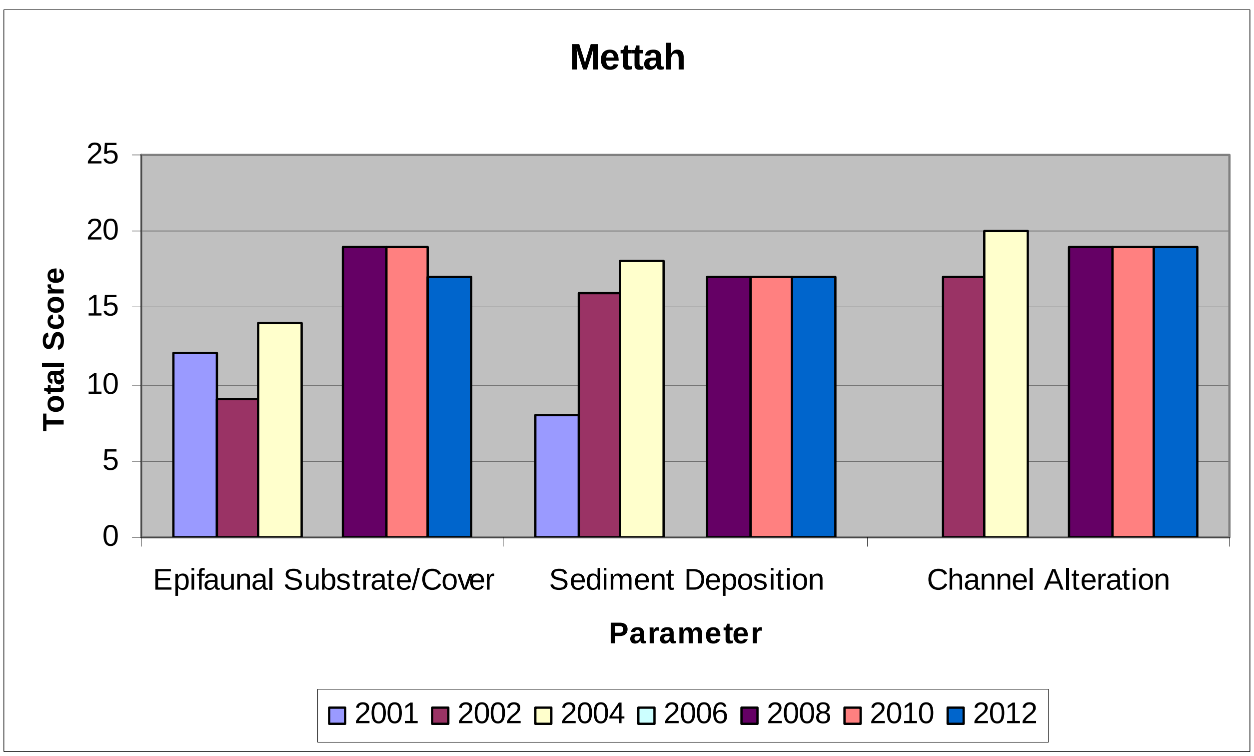

Figure 7-4. Additional Habitat Characterization, Mettah Creek (Me1).

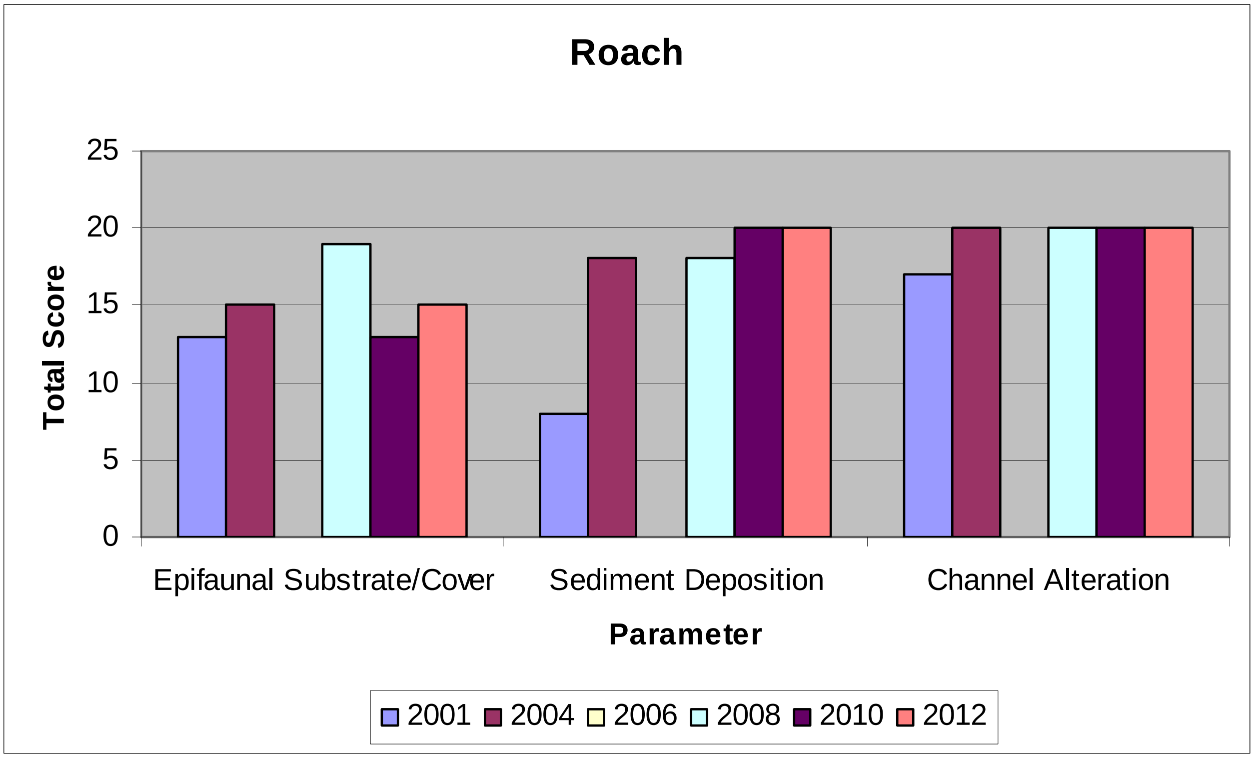

Figure 7-5. Additional Habitat Characterization, Roach Creek (Ro1)

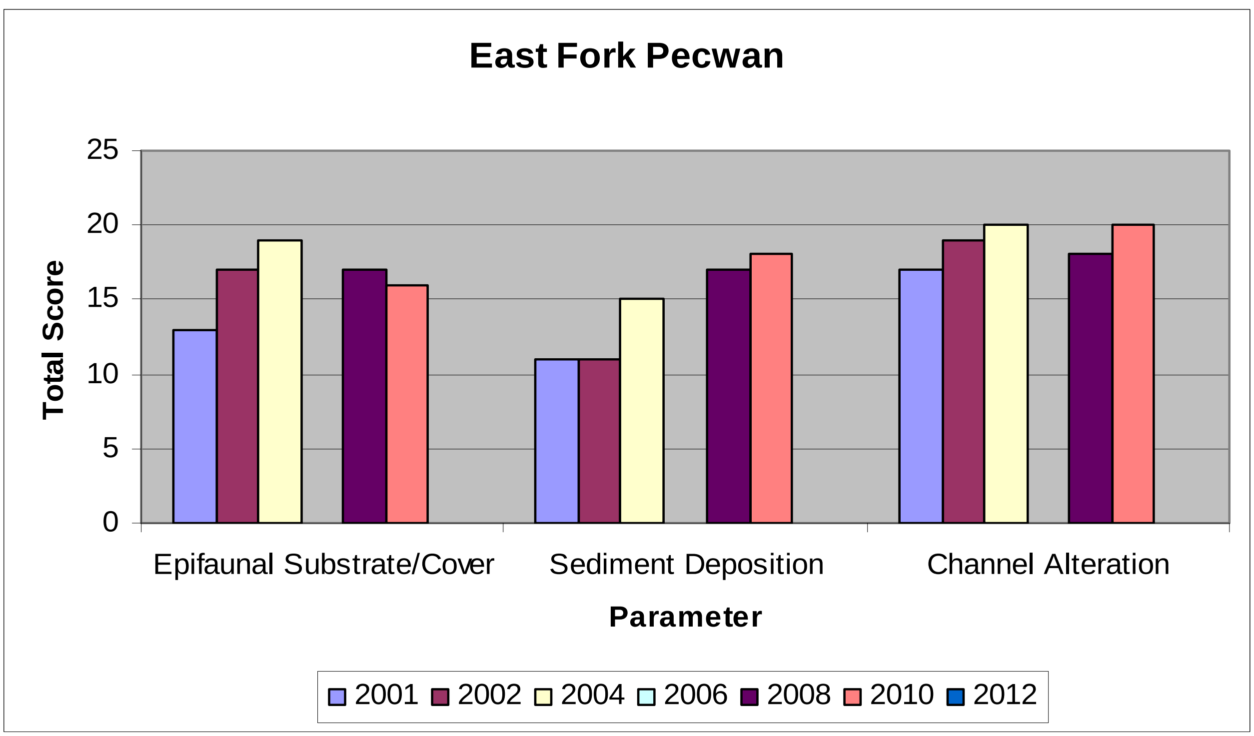

Figure 7-6. Additional Habitat Characterization, East Fork Pecwan Creek (Ep1)

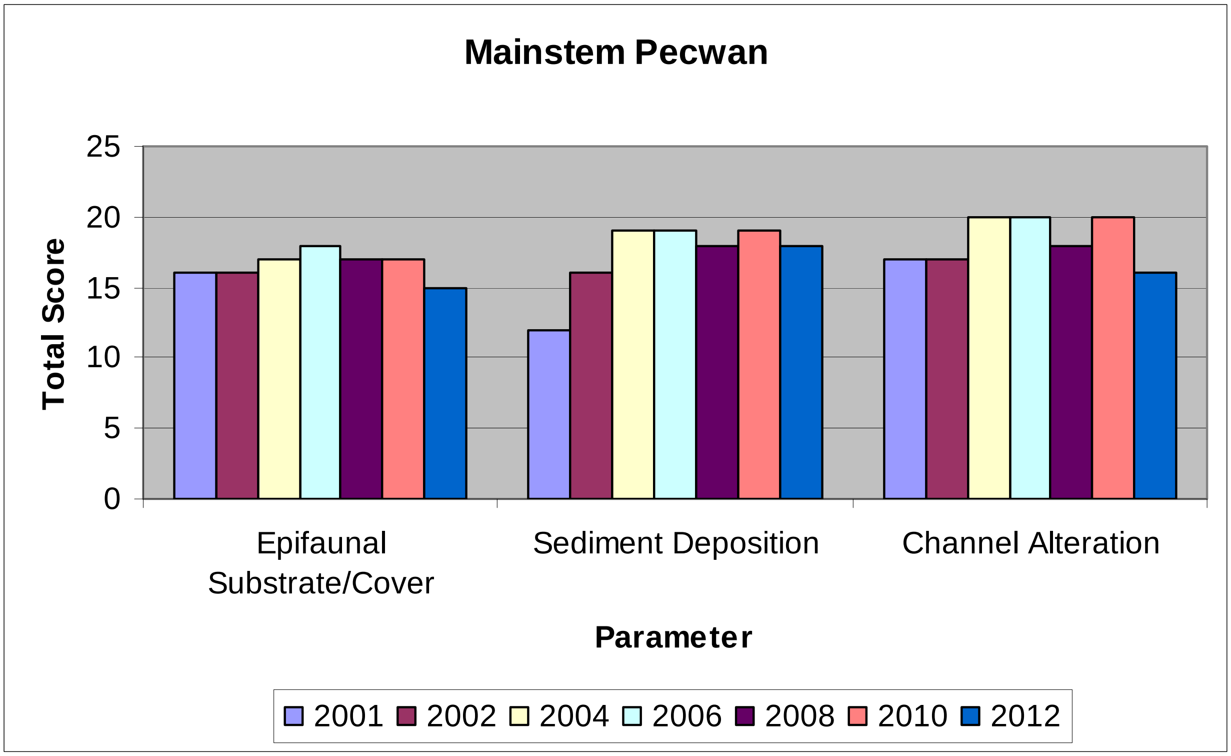

Figure 7-7. Additional Habitat Characterization, Mainstem Pecwan Creek (Mp2).

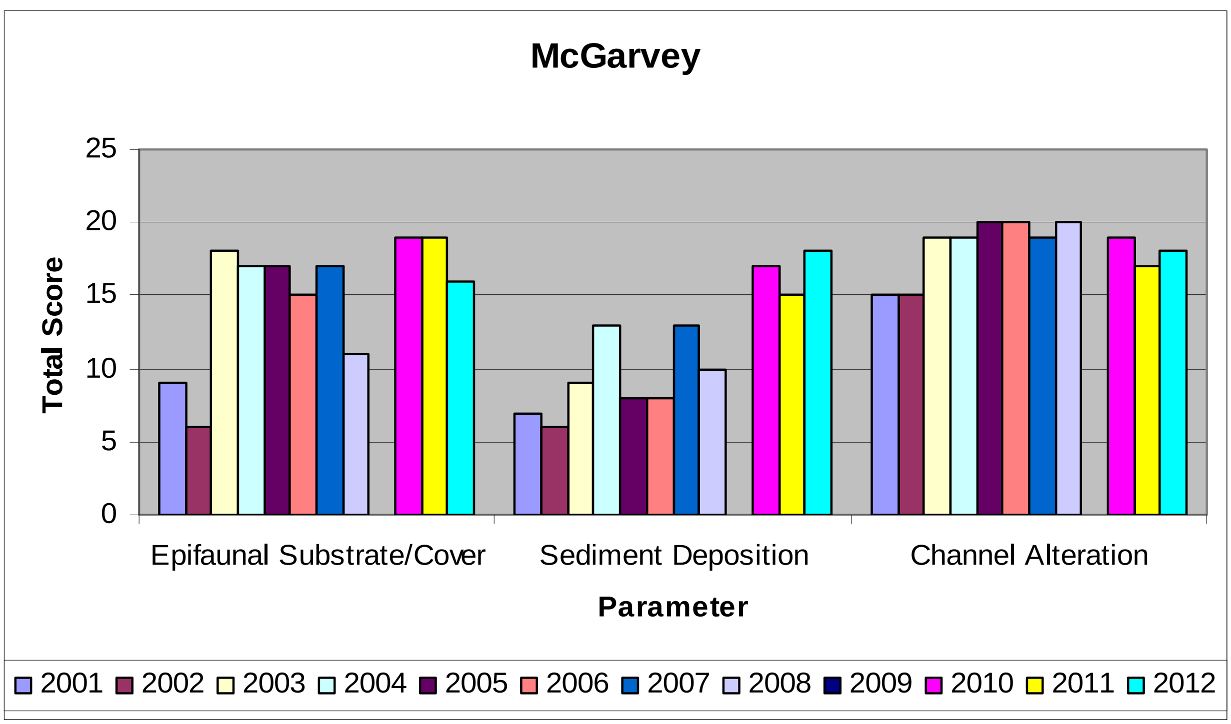

Figure 7-8. Additional Habitat Characterization, McGarvey Creek (Mc1).

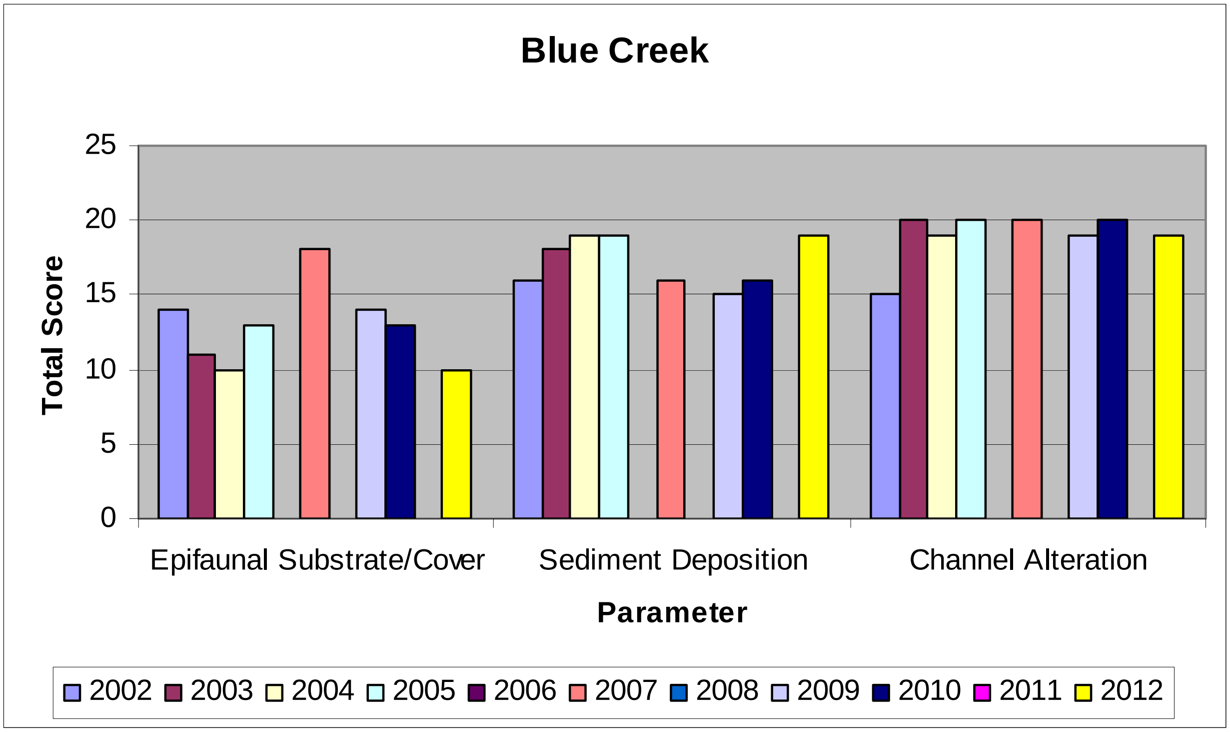

Figure 7-9. Additional Habitat Characterization, Blue Creek (Lb1)

VII. Discussion

YTEP strides to collect the most credible data possible, and to accomplish this YTEP follows the SWAMP *Standard Operating Procedures for Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California* protocol. This protocol requires a minimum of 500 total number of specimens in the sub sample to generate appropriate statistics for the stream, giving us a statistically significant sampling set from which results were generated. All sampling sites for the Water Year (WY) 12 yielded over 500 total specimens, except Roach Creek with 409 specimens and Blue Creek with 400 specimens. Streams with less than 500 specimens negatively affect richness measures such as, EPT, Coleoptera, and Diptera. Although sampling sites with less than 500 specimens are not considered acceptable data according to NorCal B-IBI standards, this data is still included for comparison purposes. All data for Klamath River tributaries is summarized to assess the overall health of these sub-watersheds for the water year 2012.

The North Coast IBI index scores provide a single numerical value for accessing stream health using a combination of metric parameters. The IBI single scoring criterion provides an efficient and effective tool for conclusions about each tributary's overall stream health. The WY 12 sites scored in the "good or "very good" rating value categories using the NC IBI metrics.

In 2009, 2010, and 2011, Lower Turwar was rated "fair" and as an impaired stream using the NC IBI metrics. The factors that may have brought down Lower Turwar's IBI score are Coleoptera richness and Percent Non-Gastropod low numbers, 3 and 2 respectively. Water year 2010 and 2011 yielded higher scores for the Lower Turwar due to a considerable wet spring seasons which caused the channel to not dry as early as in previous years. In 2012, Lower Turwar has improved and was rated as "good" with a score of 73.75. The improvement may have been caused by the 2010 and 2011 spring rain flow and the multiple restoration projects that have been completed around Lower Turwar over the past couple of years.

All of the tributary sampling sites for WY 2012 were found to be in the "unimpaired" range. The index for IBI scores defines "impaired" as a score of 52 or below. Of the nine tributary sites sampled two scored as "very good" and seven were scored as "good." All of these sample sites exist in areas of either historic and or active logging operations.

The scores for Additional Habitat Characterization varied per site. Each of the nine sites yielded consistently higher scores at the suboptimal and optimal levels for the Channel Alternation parameter, while lower scores were recorded for Epifaunal Substrate/Cover and Sediment Deposition parameters. Tully Creek in 2006 recorded the lowest scores for two parameters. Tully recorded a score of 1 for Sediment Deposition and a score of 5 for Epifaunal Substrate/Cover. The lowest score recorded for Channel Alteration was 13 in 2012 at Lower Turwar Creek. Each sampling site recorded at least one score of 20 for the Channel Alteration parameter between 2001 and 2012. Columns that have been left blank in various sampling site graphs, such as McGarvey, represent the years in which the site was sampled for macroinvertebrates, but no Additional Habitat Characterization scores were recorded.

As of 2012 Mainstem Pecwan (MP2) was renamed due to naming convention consistency with USGS maps, previous reports called this site Wp1 or West Fork Pecwan but it is the same site as Mainstem Pecwan. The previous data recorded for Additional Habitat Characterization has been combined with the current Mainstem Pecwan data and is recorded under the MP2 sampling site.

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Appendix A

Water Quality Permitting Macroinvertebrate Report WY12

I. Introduction

This report summarizes the methods and results of macroinvertebrate sampling conducted on select tributaries of the Klamath River that had bridge construction projects implemented by California Department of Transportation (Cal Trans) on Highway 169 on the Yurok Reservation. The tributaries that had bridges replaced from 2009 to 2011 include: Rube Ranch Creek, Martins Ferry School Creek (School Creek), Cappell Creek, and Mawah Creek. The Yurok Tribe's Water Quality Certification included a monitoring condition that required Cal Trans to collect macroinvertebrate samples upstream and downstream of the four bridges prior to and after bridge construction. This monitoring effort will help to determine if any environmental impact was caused by the Cal Trans bridge construction projects and to establish baseline conditions for these streams.

II. Site Selection

Bridge replacement took place at Rube Ranch Creek, School Creek, Cappell Creek, and Mawah Creek. The sites were sampled upstream and downstream of the existing bridges and were sampled again after the bridges were replaced. The four creeks are all tributaries to the main stem of the Klamath River, thus it is important to monitor the impacts associated with these bridge replacement projects.

The sections sampled for macroinvertebrates above and below the bridges began at the base of each bridge then headed in their respective directions, up or downstream. Due to Rube Ranch Creek and School Creek's steepness and over grown vegetation, the sections surveyed could not be150 meters in length along the stream. School Creek was surveyed 25 meters up and downstream, where as Rube Ranch Creek was surveyed 30 meters up and downstream. Cappell Creek was surveyed 150 meters up and downstream. Mawah Creek was surveyed 165 meters upstream and 150 meters downstream.

Sampling sites pre and post construction

Figure A-1. Rube Ranch Creek (downstream) 2010

Figure A-2. Rube Ranch Creek (downstream) 2012

Figure A-3. Rube Ranch Creek (upstream) 2010

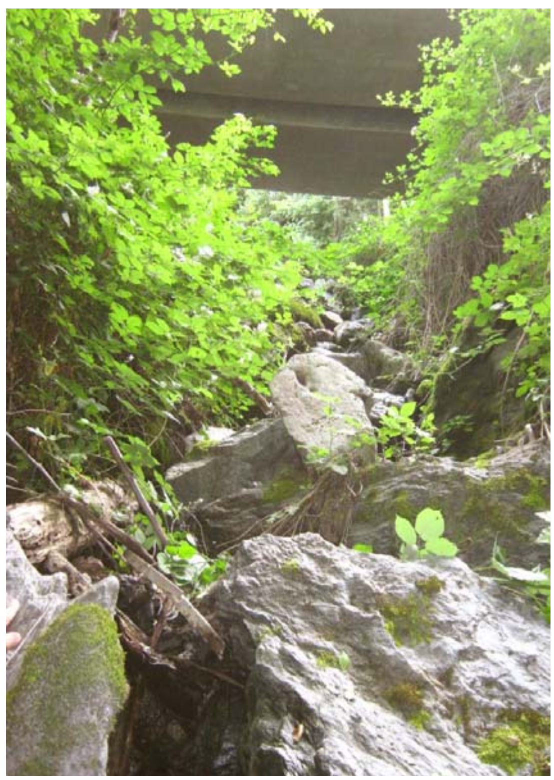

Figure A-4. Rube Ranch Creek (upstream) 2012


Figure A-5. School Creek (downstream) 2010


Figure A-6. School Creek (downstream) 2012


Figure A-7. School Creek (upstream) 2010


Figure A-8. School Creek (upstream) 2012

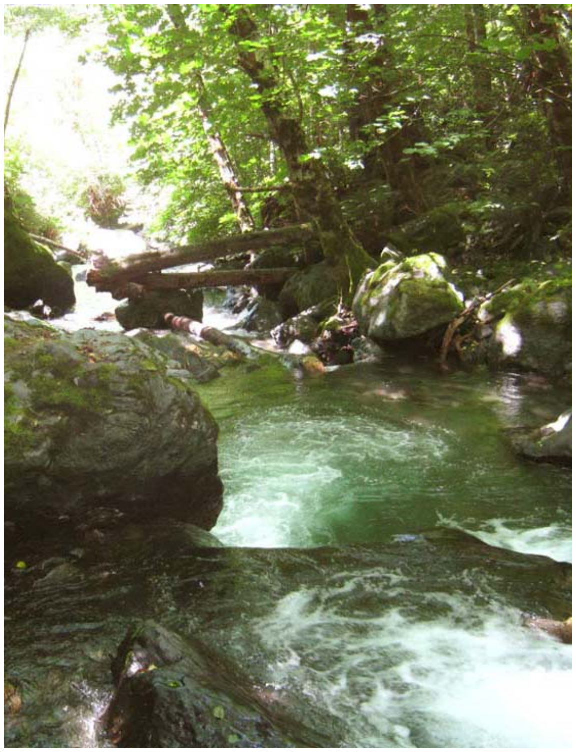
Figure A-9. Cappell Creek (downstream) 2012

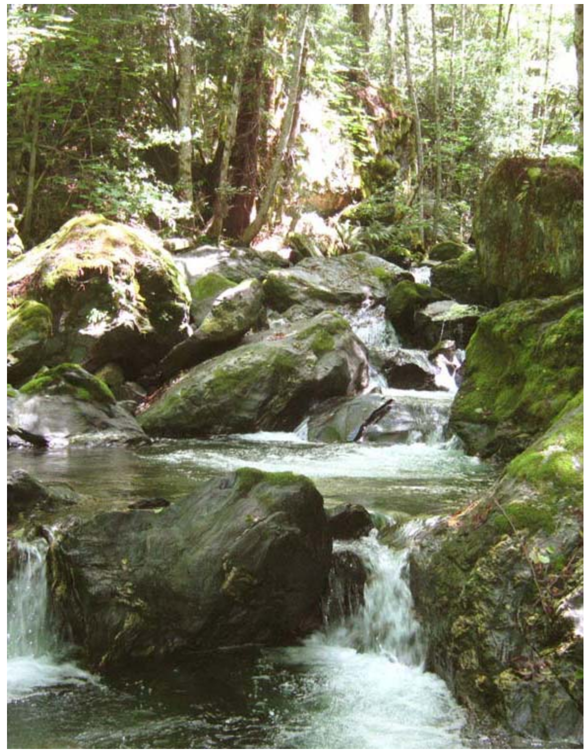
Figure A-10. Cappell Creek (upstream) 2012

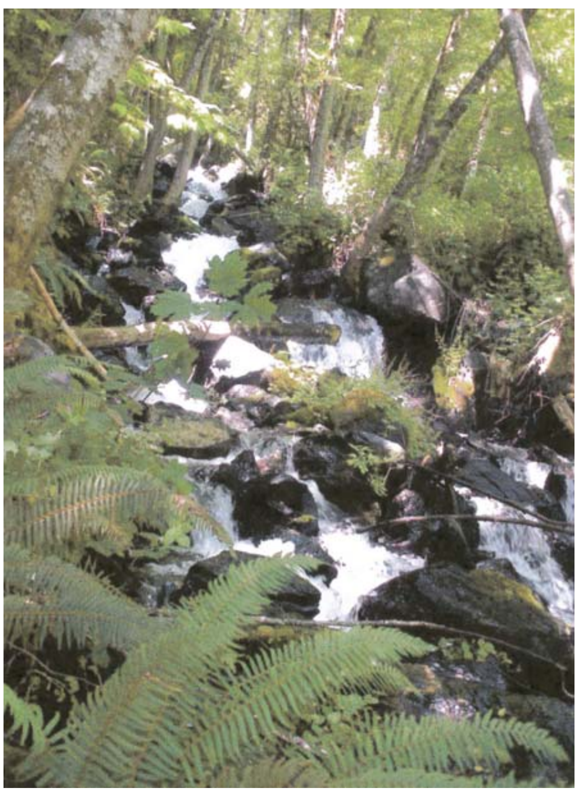
Figure A-11. Mawah Creek (downstream) 2009

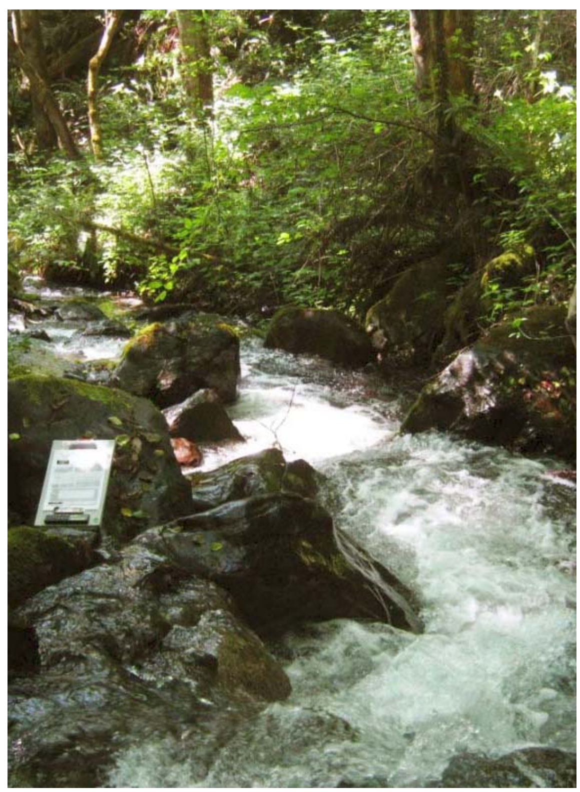
Figure A-12. Mawah Creek (downstream) 2011

Figure A-13. Mawah Creek (upstream) 2009

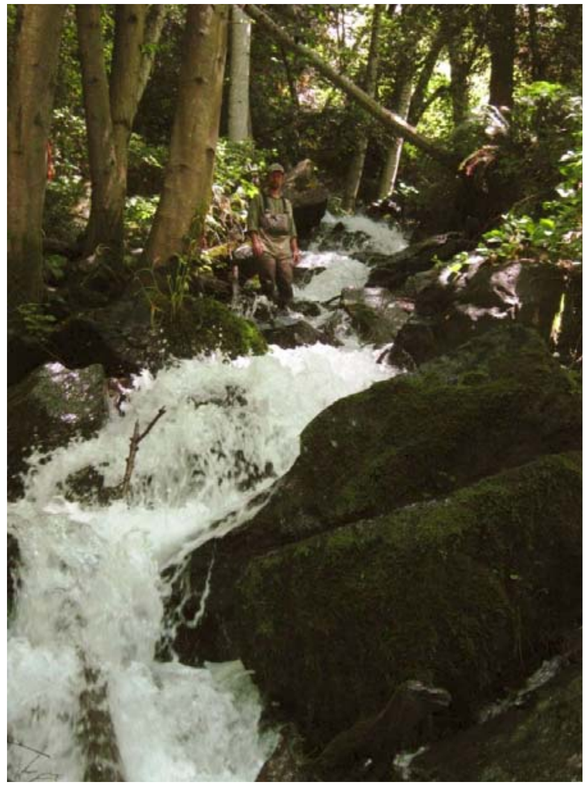

Figure A-14. Mawah Creek (upstream) 2011

*****Pre construction photos of Cappell Creek survey locations could not be located.

III. Methods

CalTrans' consultants sampled benthic macroinvertebrate populations in selected tributaries of the Lower Klamath River during June of 2009, May of 2010, July of 2011, and July of 2012. Sampling was performed using the multi-habitat methods located in the State of CA Surface Water Ambient Monitoring Program (SWAMP) *Standard Operating Procedures for Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California.* A link to this protocol is located in Appendix B. This protocol also includes the collection of water quality parameters and physical habitat conditions in the channel and the riparian zone. This report does not contain this information. The parameters measured include:

- Stream Chemistry
- Instream Habitat Complexity
- Canopy Cover
- Human Influence
- Substrate Size Class
- Cobble Embeddedness
- Riparian Vegetation Classes
- Bank Stability
- Depth Regimes
- Bankfull Width
- Microalgae Thickness
- Macroalgae (Attached, Unattached)
- Macrophytes
- CPOM
- Epifaunal Substrate/Cover
- Sediment Deposition
- Channel Alteration

A qualified professional collected specimens which were sent to a lab where a certified taxonomist identified and calculated the number and types of species. After processing the samples, the biological matrices are received from the taxonomist in an Excel spreadsheet format identifying the sample ID and the breakdown of BMI species into standard taxonomic levels.

Table B-1. Cal Trans Four Bridges Project macroinvertebrate metrics pre-replacement.

Site	Date	Total # of Specimens	Taxa Richness	EPT Richness	Sensitive EPT	% Dominant Taxon	Tolerance Value	Shannon's D.I.	Estimated Rel. Abundance
Rube Ranch Creek-DS	5/12/2010	512	55	25	30.47	26.17	3.95	2.98	1267
Rube Ranch Creek-US	5/12/2010	545	57	29	24.40	21.47	4.30	2.87	1680
School Creek- DS	5/12/2010	522	42	20	25.67	33.72	4.43	2.63	2626
School Creek - US	5/12/2010	519	44	24	18.69	32.95	5.06	2.49	2324
Cappell Creek- DS	6/10/2009	501	42	24	25.35	46.51	4.27	2.35	1373
Cappell Creek - US	6/12/2009	508	57	32	45.67	25.59	3.22	2.86	676
Mawah Creek - DS	6/15/2009	526	47	23	28.90	36.88	4.22	2.60	1385
Mawah Creek - US	6/18/2009	518	48	27	38.03	23.17	3.78	2.85	877

Table B-2. Cal Trans Four Bridges Project macroinvertebrate metrics post-replacement.

Site	Date	Total # of Specimens	Taxa Richness	EPT Richness	Sensitive EPT	% Dominant Taxon	Tolerance Value	Shannon's D.I.	Estimated Rel. Abundance
Rube Ranch Creek - DS	7/2/2012	500	55	22	37.20	18.40	3.77	3.06	909
Rube Ranch Creek - US	7/2/2012	500	52	25	37.00	25.60	4.10	2.81	2585
School Creek- DS	7/2/2012	500	44	24	46.80	22.40	3.95	2.67	1557
School Creek - US	7/2/2012	500	47	25	27.60	20.80	4.67	2.76	2007
Cappell Creek- DS	7/3/2012	500	49	25	31.40	24.80	3.74	2.78	1456
Cappell Creek - US	7/3/2012	505	56	31	47.92	19.41	3.01	3.04	1385
Mawah Creek - DS	7/27/2011	504	55	27	33.73	23.61	4.17	3.11	1210
Mawah Creek - US	7/27/2011	521	54	29	37.43	19.00	3.85	3.04	1737

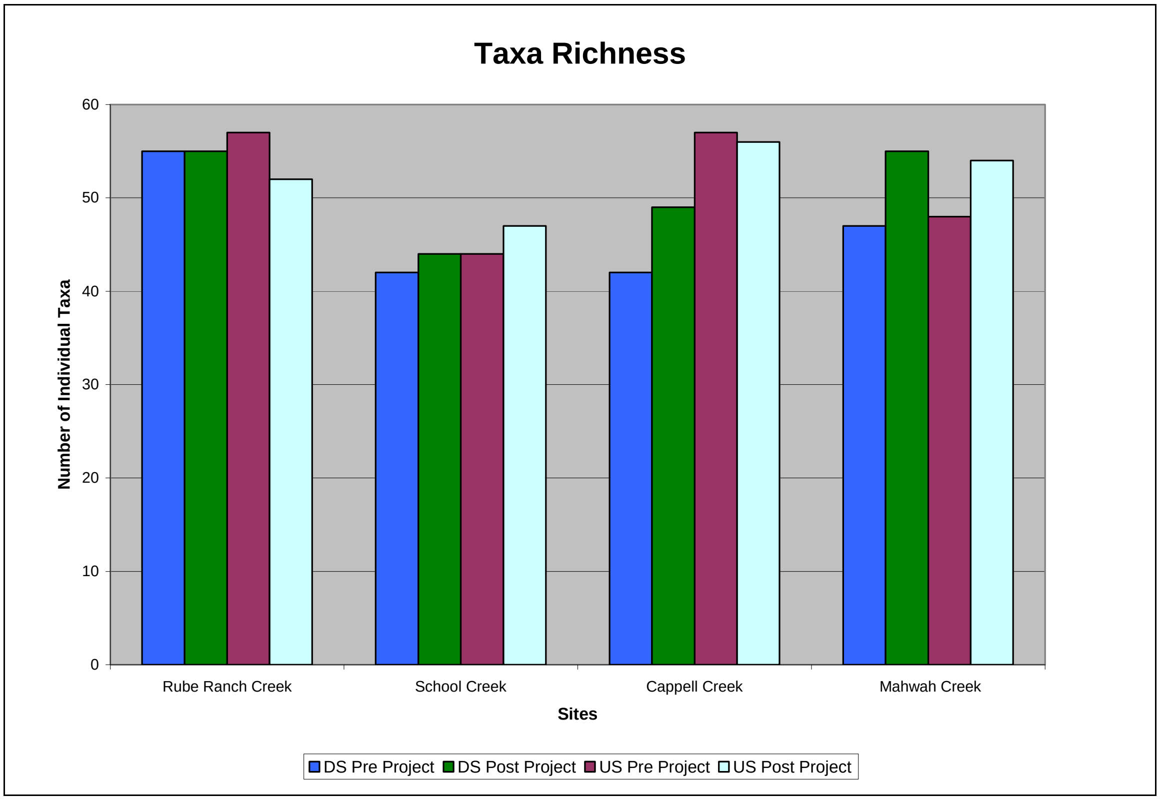

Figure B-1. Taxa Richness for Cal Trans Four Bridges Project streams (Pre and Post Construction)

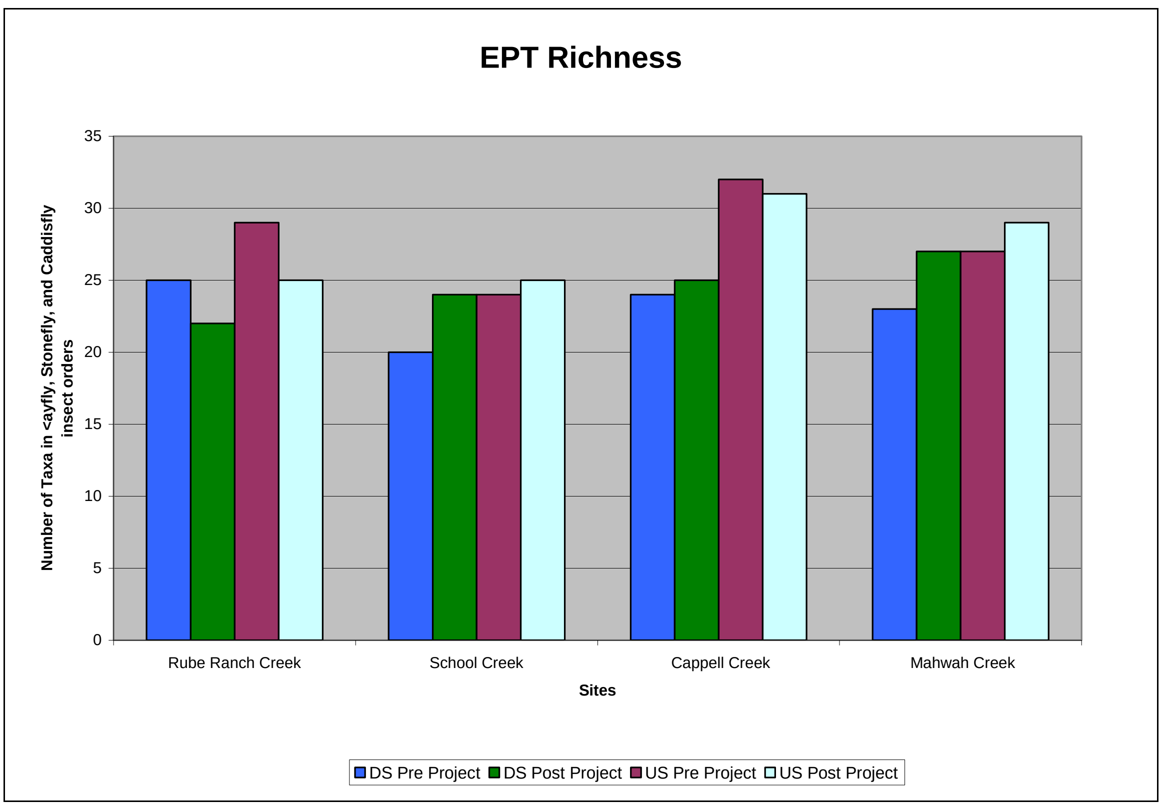

Figure B-2. EPT Richness for Cal Trans Four Bridges Project streams (Pre and Post Construction)

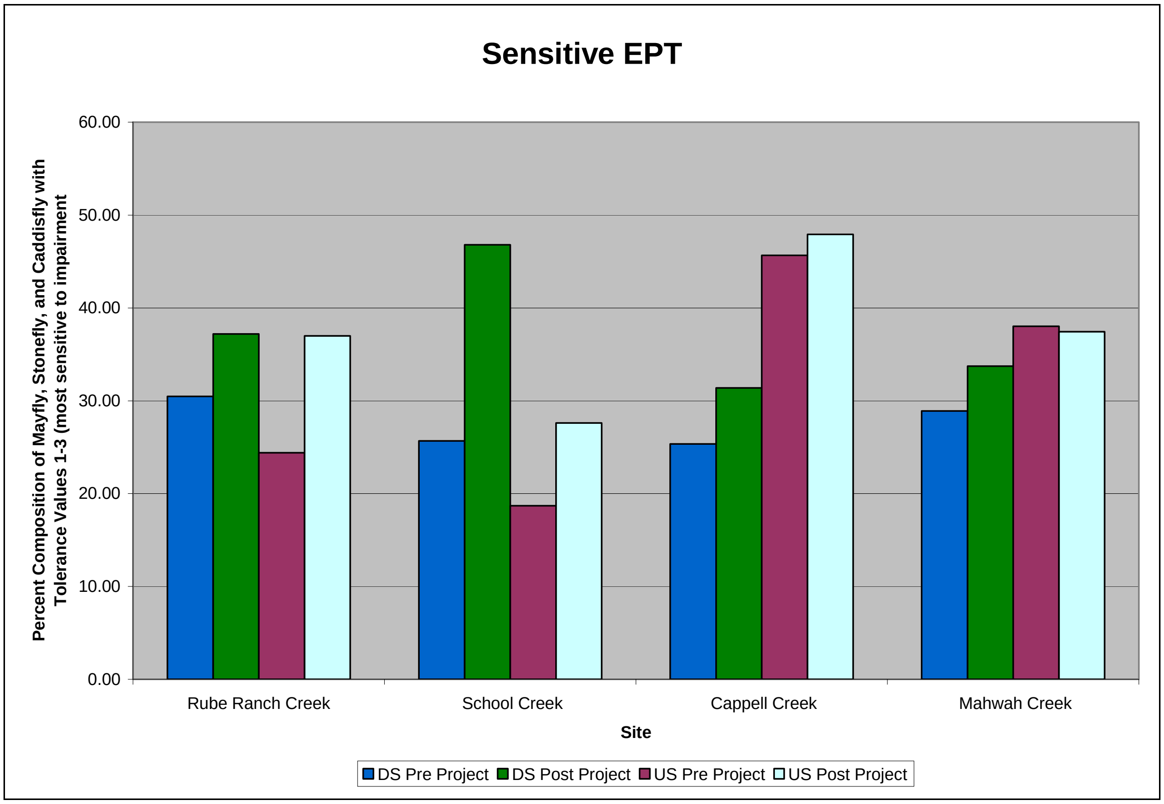

Figure B-3. Sensitive EPT for Cal Trans Four Bridges Project streams (Pre and Post Construction)

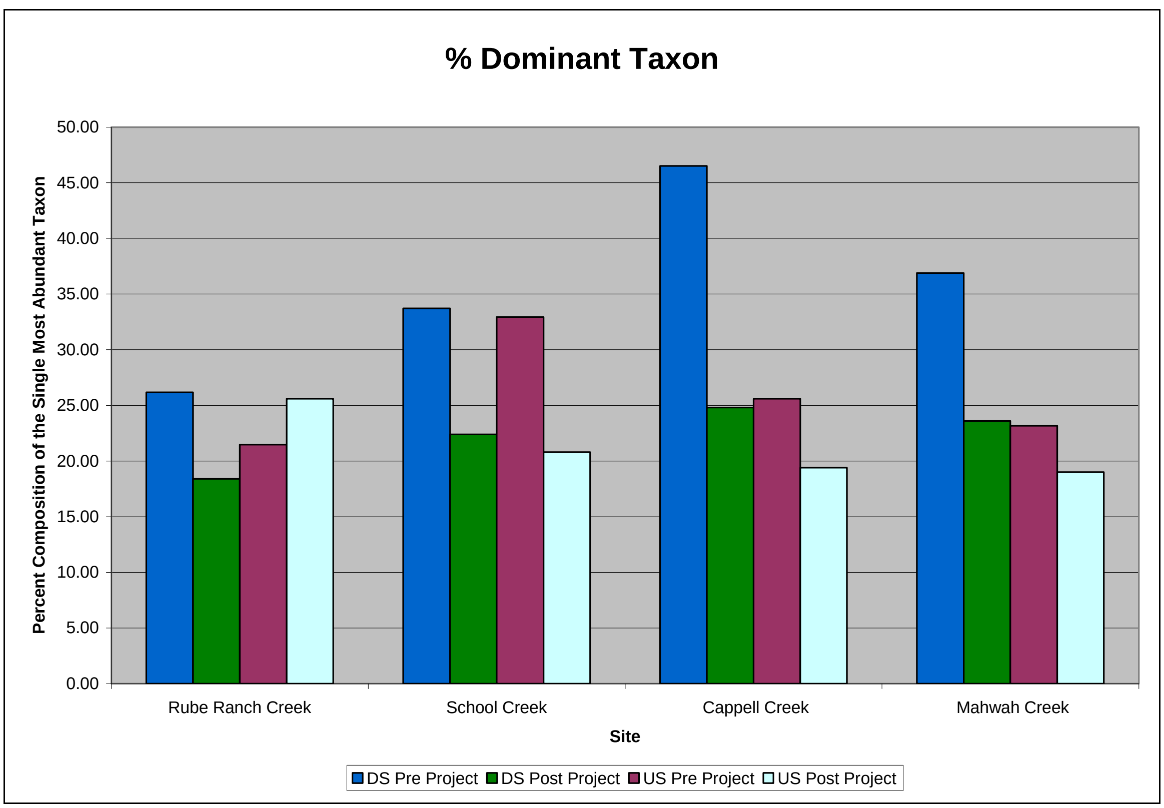

Figure B-4. % Dominant Taxon for Cal Trans Four Bridges Project streams (Pre and Post Construction)

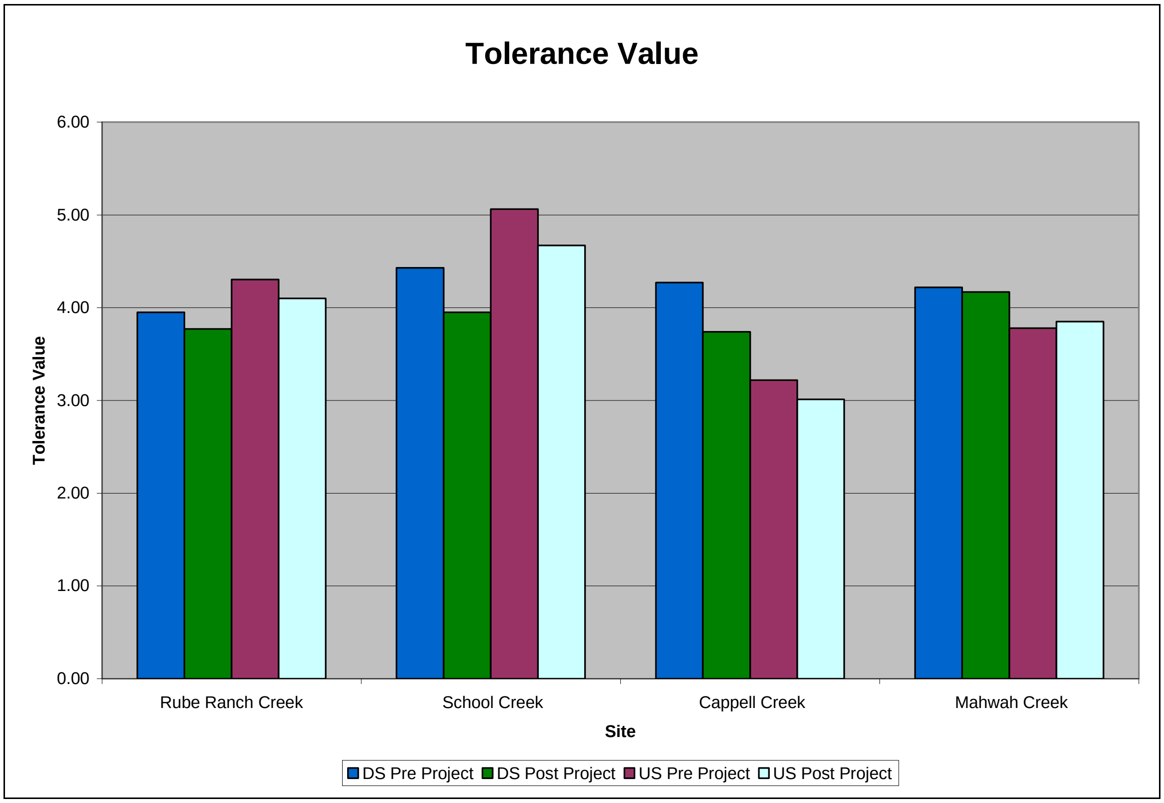

Figure B-5. Tolerance Value for Cal Trans Four Bridges Project streams (Pre and Post Construction)

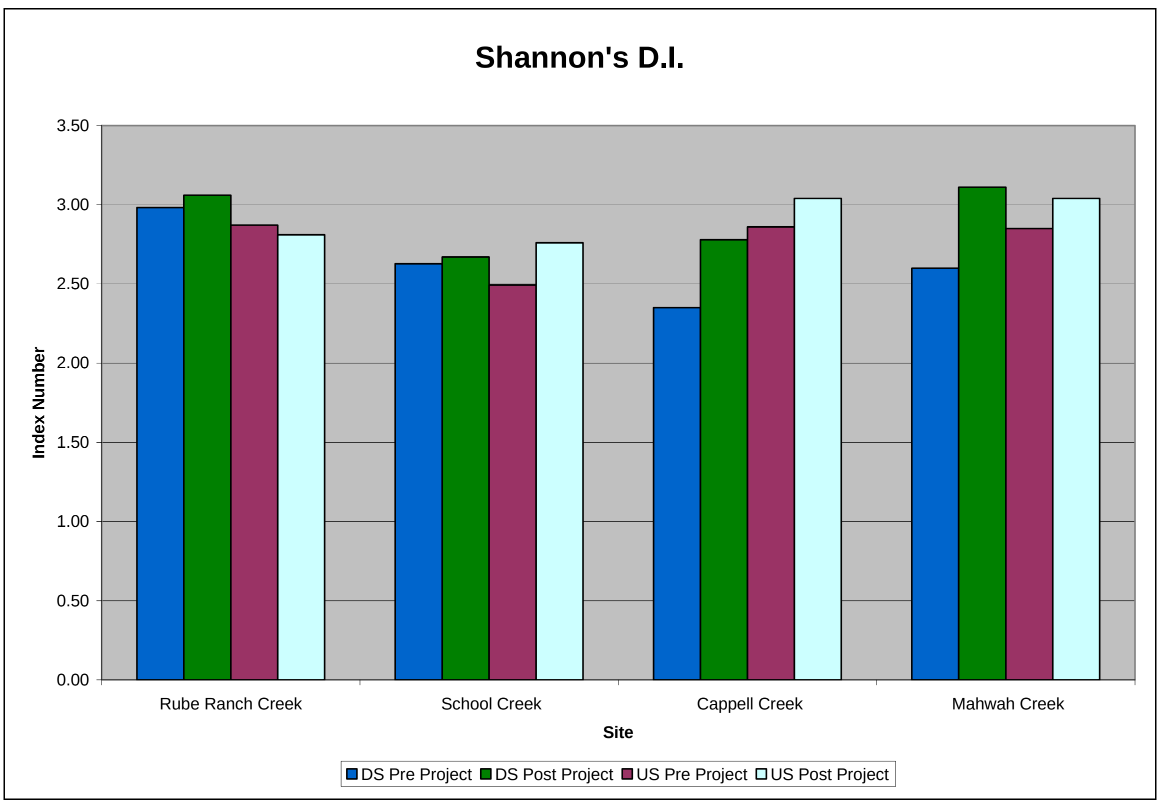

Figure B-6. Shannon's D.I. for Cal Trans Four Bridges Project streams (Pre and Post Construction)

Table B-3. IBI Scoring Key

Total metric score	Value
0-20	very poor
21-40	poor
41-60	fair
61-80	good
81-100	very good

Table B-4. Cal Trans Four Bridges Project, North Coast IBI Scores pre- construction

Site	Date	EPT Richness	Coleoptera Richness	Diptera Richness	% Intolerant Individuals	% non-Gastropod Scrapers	% Predator Individuals	% Shredder Taxa	% non-Insect Taxa	NorCal B-IBI Score
Rube Ranch Creek - DS	5/12/2010	9	10	10	7	10	5	10	8	86.25
Rube Ranch Creek - US	5/12/2010	10	10	10	6	6	5	10	8	81.25
School Creek-DS	5/12/2010	7	0	10	6	10	3	10	7	66.25
School Creek - US	5/12/2010	9	3	10	5	6	3	9	8	66.25
Cappell Creek-DS	6/10/2009	9	7	7	6	7	5	9	8	72.5
Cappell Creek - US	6/12/2009	10	10	10	10	10	6	10	9	93.75
Mawah Creek - DS	6/15/2009	9	7	10	6	9	5	10	7	78.75
Mawah Creek-US	6/18/2009	10	3	10	7	10	6	10	8	80

Table B-5. Cal Trans Four Bridges Project, North Coast IBI Scores post- construction

Site	Date	EPT Richness	Coleoptera Richness	Diptera Richness	% Intolerant Individuals	% non-Gastropod Scrapers	% Predator Individuals	% Shredder Taxa	% non-Insect Taxa	NorCal B-IBI Score
Rube Ranch Creek - DS	7/2/2012	8	10	10	9	5	7	10	7	82.5
Rube Ranch Creek - US	7/2/2012	9	10	9	8	6	6	8	7	78.75
School Creek-DS	7/2/2012	9	1	9	7	10	5	9	7	71.25
School Creek - US	7/2/2012	9	3	10	6	9	4	7	7	68.75
Cappell Creek-DS	7/3/2012	9	10	7	7	6	5	8	7	73.75
Cappell Creek - US	7/3/2012	10	9	10	10	10	5	10	8	90
Mawah Creek - DS	7/27/2011	10	5	10	6	8	10	10	7	82.5
Mawah Creek-US	7/27/2011	10	5	10	7	8	9	10	7	82.5

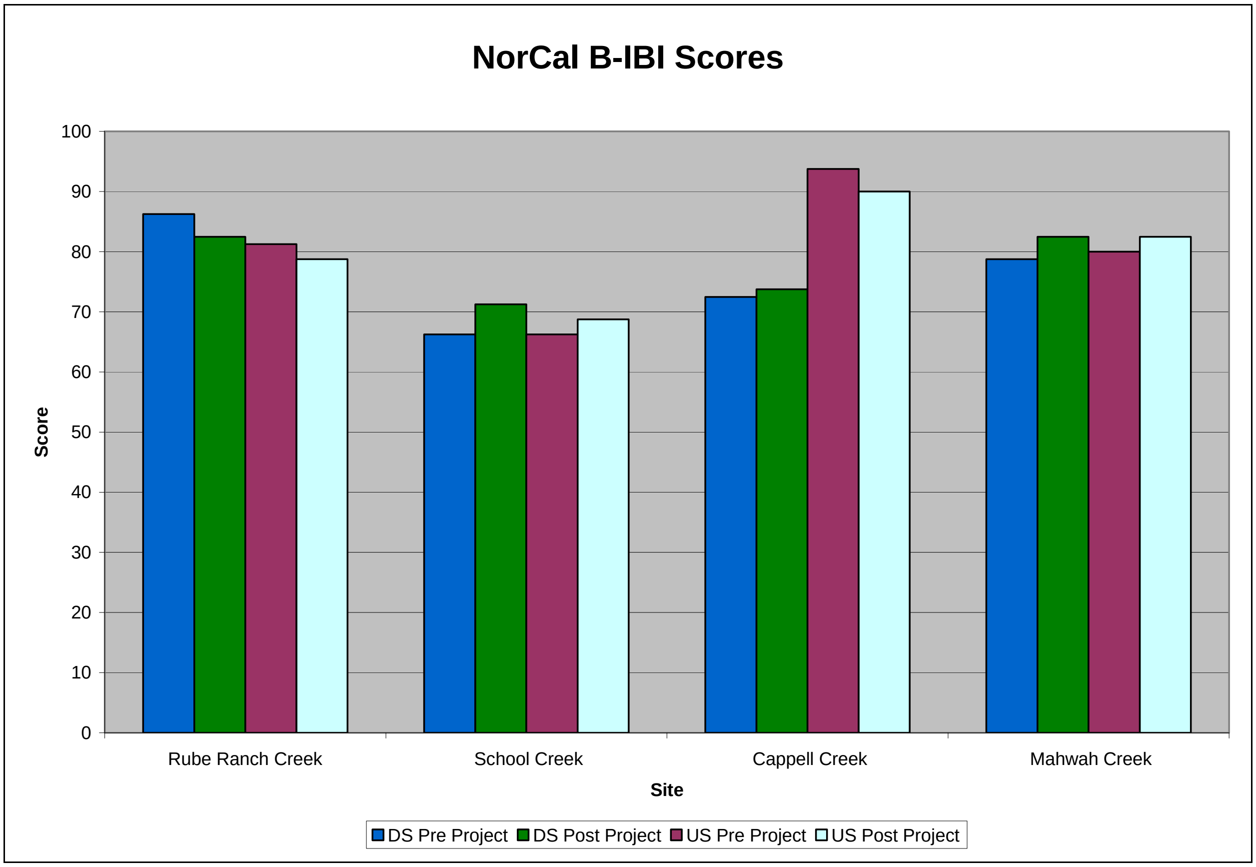

Figure B-7. NorCal B-IBI Scores for Cal Trans Four Bridges Project streams (Pre and Post Construction)

IV. Discussion

As indicated by the North Coast IBI scores, the four tributaries that had the bridges replaced fell within the “good” or “very good” stream health categories prior to construction. After the construction project was completed, the tributaries were surveyed again and were found to be within good health. Each stream was found to be within the “good” or “very good” value category according to the North Coast IBI scores.

Rube Ranch Creek prior to the bridge construction was recorded as “very good” for both upstream and downstream sampling sites. After construction the downstream site was still recorded as “very good,” while the upstream sampling site’s health decreased slightly and was recorded as “good.” School Creek’s downstream and upstream sampling sites were both recorded as “good” prior to construction. After construction, the IBI scores increased slightly for both upstream and downstream sampling sites and were recorded as “good.” Cappell Creek was recorded as “good” for both upstream and downstream sampling sites before construction. After construction, the stream was still categorized as “good” for both upstream and downstream sampling sites, with very little change within their IBI scores. Mawah Creek increased in stream health after the construction project. Prior to construction, the tributary was recorded as “good” for both upstream and downstream sampling sites. After construction the stream’s IBI scores increased and was recorded as “very good” for both upstream and downstream sampling sites.

The metrics for each tributary slightly varied, but generally remained around the same level before and after construction. The metrics that were affected the most by the bridge construction project were Sensitive EPT and % Dominant Taxon. The survey results for both metrics varied the most downstream of the sampling sites. Although % Dominant Taxon and Sensitive EPT was found to vary in pre and post construction scores, the four other metric categories presented similar numbers prior to and after the bridge construction for each tributary. Due to the high IBI scores and consistency with most of the macroinvertebrate metrics, the Cal Trans bridge construction projects preserved each of the four tributaries health with little environmental impact.

Appendix B

To view the sampling protocol that YTEP employed in collecting its macroinvertatbrate samples in 2012 please view the pdf titled “Standard Operating Procedures for Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California”. Or follow link: http://swamp.mpsl.mlml.calstate.edu/wp-content/uploads/2009/04/swamp_sop_bioassessment_collection_020107.pdf