FINAL
2012 Klamath River Nutrient Summary Report

Yurok Tribe Environmental Program:
Water Division

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Acknowledgements

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I. **Introduction**

This report summarizes the presence and concentration of commonly occurring nutrients and associated analytes on the Klamath and Trinity Rivers during the 2012 sampling season. The Yurok Tribe Environmental Program (YTEP) collected monthly water samples at several monitoring sites from Weitchpec to the Klamath River Estuary in mid-February through mid-April, moved to a bi-weekly interval starting in mid-May and ending in mid-October, followed by monthly sampling in November and December. This sampling was performed in an effort to track both temporal and spatial patterns on the lower reaches of the Klamath and Trinity Rivers during the sampling period. This data was added to previous years' nutrient data as part of an endeavor to build a multi-year database on the Lower Klamath River. This nutrient 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. Sample events were coordinated with the Karuk and Hoopa Tribes, PacifiCorp, and the Bureau of Reclamation to collect samples during the same day and with comparable methods to expand our understanding of the nutrient dynamics in the Klamath basin.

II. Background

The Klamath River Watershed

The Klamath River system drains much of northwestern California and south-central Oregon (Figure 2-1). Thus, even activities taking place on land hundreds miles off the Yurok Indian Reservation (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 because of 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 in particular reaches.

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.

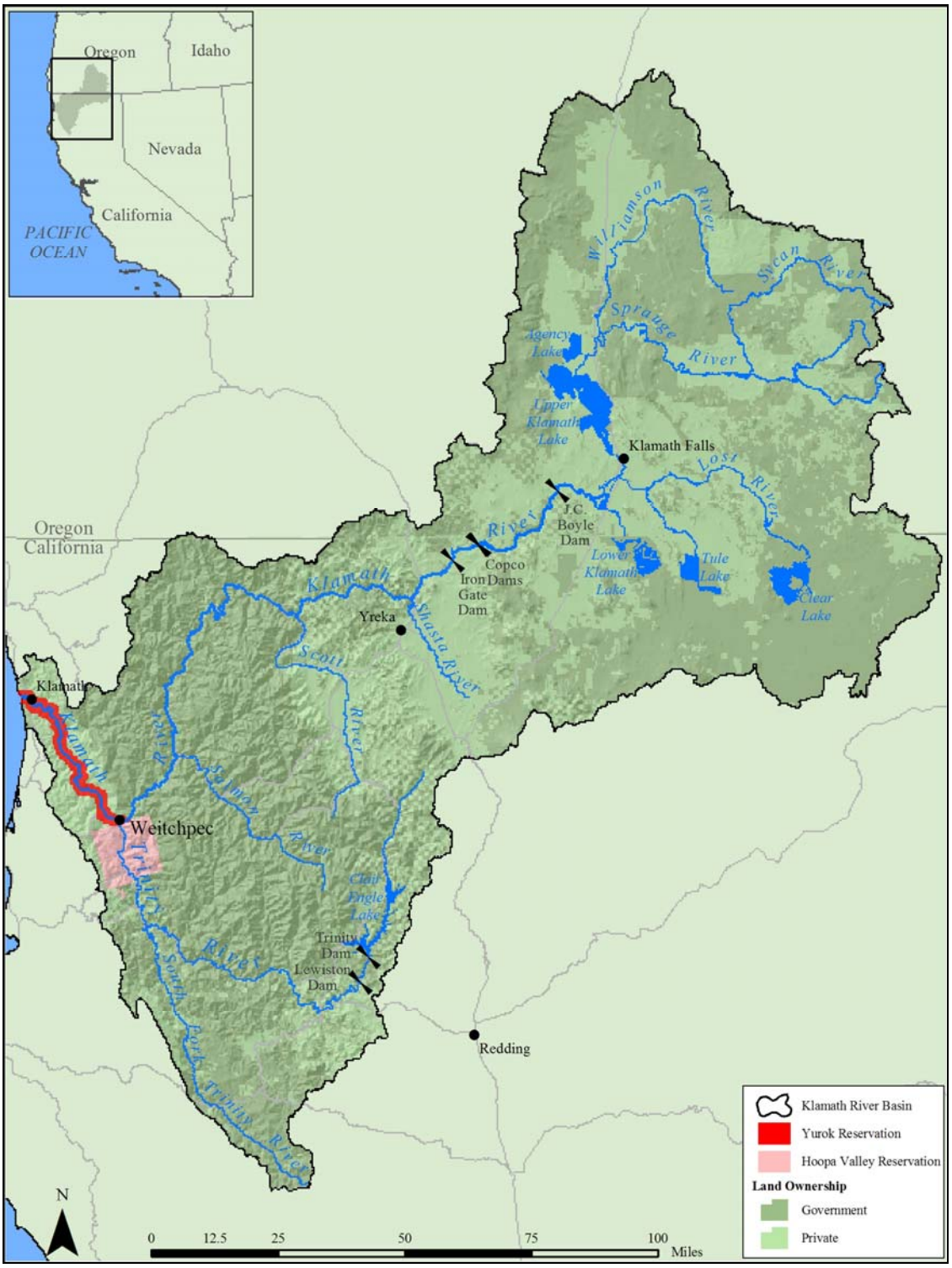

Figure 2-1. Klamath River Basin Map

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 just upstream of the Trinity River confluence to the Pacific Ocean, including the channel and the bed of the river (Figure 2-2). 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.

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 NCRWQCB, and the United States Geological Survey (USGS). A USEPA General Assistance Program (GAP) Grant and funding allocated under the Clean Water Act Section 106 and funding from PacifiCorp primarily fund YTEP's water monitoring activities.

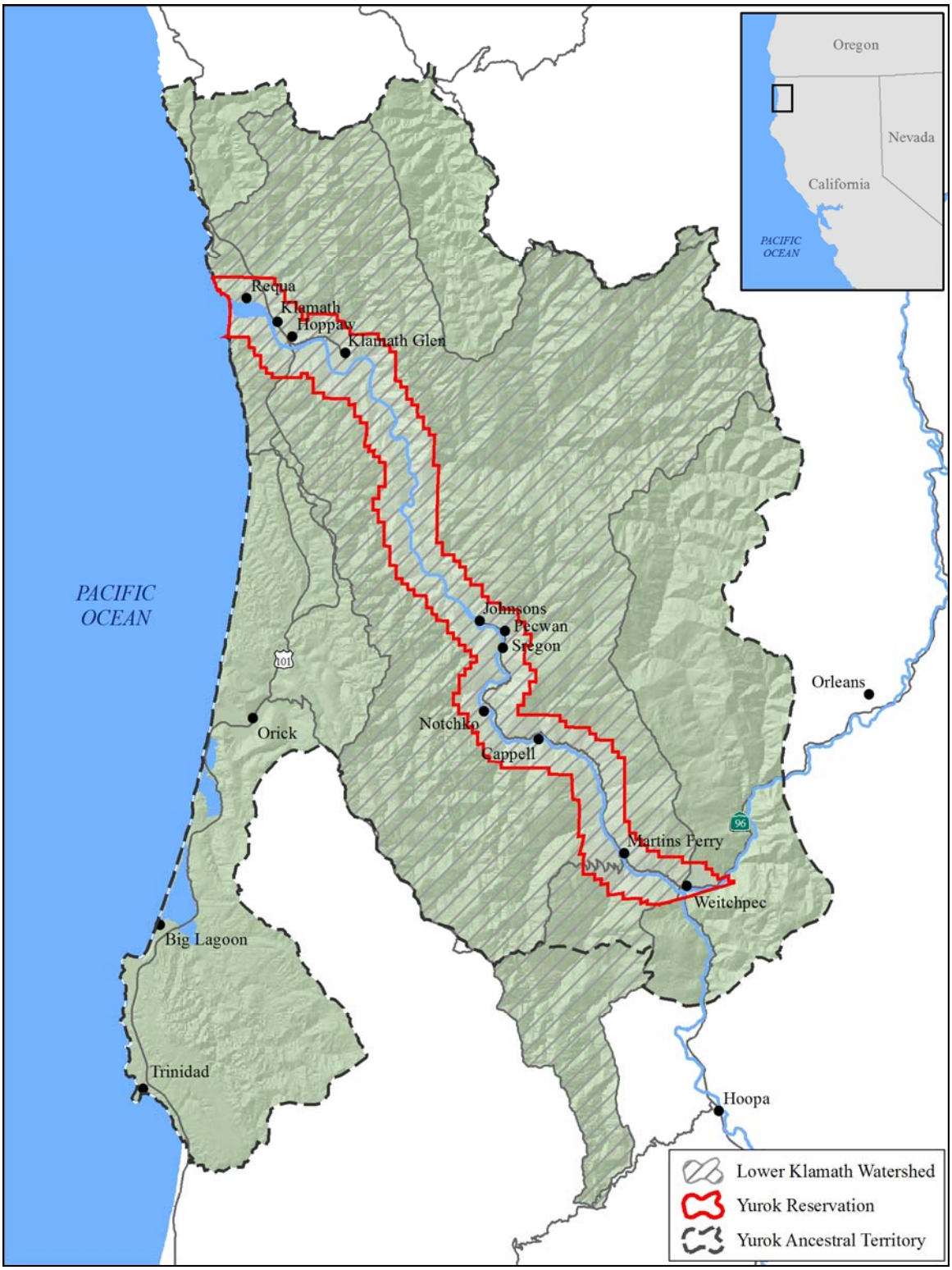

Figure 2-2. Yurok Indian Reservation and Yurok Ancestral Territory Map

III. Methods

The Yurok Tribe Environmental Program (YTEP) collected water samples at several monitoring sites from Weitchpec to the Klamath River Estuary monthly from February to April, moved to a bi-weekly interval starting in mid-May and ending in mid-October, followed by monthly sampling in November and December. Samples were delivered to the same lab during the 2013 season in an effort to maintain consistency in laboratory methods. All samples except particulate carbon and particulate nitrogen were delivered to Aquatic Research Inc. in Seattle, WA. Particulate carbon and nitrogen samples were delivered to Chesapeake Biological Laboratory in Solomons, MD. The parameters sampled are shown in Table 3-1.

Standard and consistent methods were utilized at each sampling site throughout the sampling season by following an established protocol; this protocol is available in Appendix A. Upon arrival at each site, a sampling churn was rinsed three times with distilled water. After rinsing with distilled water, the churn was rinsed three times with stream water. The churn was then fully submerged into the stream and filled to the lid with sample water. Completely filling the churn allowed for all samples to be filled from one churn; thereby minimizing differences in water properties and quality between samples.

Proper use of the churn guaranteed the water was well mixed before the sample was collected. The churn was stirred at a uniform rate by raising or lowering the splitter at approximately 9 inches per second. Ten complete cycles of stirring were completed before sample bottles were filled. This mixing continued while the bottles were being filled. If filling had stopped for some reason, the stirring rate was resumed before the next sample was drawn from the churn.

The sample bottles used were provided by the contract lab and were considered sterile prior to field usage. Sample bottles were rinsed with stream water from the churn three times before filling with sample water. Collected samples were placed immediately in coolers on wet ice for transport to the Fed Ex office in Arcata, CA and then mailed overnight to the contract lab for analysis. The particulate carbon and nitrogen analyses required water samples to be filtered once the crew returned from the field. Once the samples were filtered the filters were frozen in tin foil wrapped in Whirl Pack bags and later shipped overnight to the lab for analysis.

Table 3- 1. Parameters sampled on the Klamath River during 2012

Analytes
Nitrate + Nitrite
Total Nitrogen
Ammonia
Total Phosphorus
Soluble Reactive Phosphorous
Total Alkalinity
Chlorophyll-a
Pheophytin-a
Non-Filterable Residue/Total Suspended Solids
Volatile Suspended Solids
Turbidity
Dissolved Organic Carbon
Particulate Carbon and Nitrogen

Chain-of-custody (COC) sheets were filled out to document the handling of the samples from the time of collection to the time of laboratory analysis. This is a standard procedure for handling samples. Additional quality control measures were included in the sampling. At one site during the March, May, July, August, September, and November sampling events duplicate split samples were sent to the laboratory blindly to assess laboratory precision and to gain improved confidence in the data. Additionally, during one May, and the August, September, and October sampling events, blank samples were sent to the laboratory blindly to assess contamination and analytical procedures at the laboratory. The blank samples collected were "true blanks," meaning the samples were collected by pouring distilled water directly from the container containing the distilled water into the sample bottles. The sample bottles were rinsed three times with distilled water before being filled with distilled water.

Discrete environmental information was also recorded at the time water samples were collected. This information was collected using YSI 6600EDS multiparameter sondes equipped with specific conductivity/temperature, pH, ROX and phycocyanin probes. ROX probes detect concentrations of dissolved oxygen in bodies of water, while phycocyanin probes are designed to detect the presence of an accessory pigment known to occur in *Microcystis aeurginosa*. The data included water temperature, pH, specific conductance, dissolved oxygen and blue-green algae, as well as other observational notes.

IV. Site Selection

The sampling area includes the lower 44 river miles of the mainstem Klamath River on the YIR and the Trinity River above its convergence with the Klamath near the southern boundary of the YIR. In general, the various sampling locations were chosen in order to represent the average ambient water conditions throughout the water column. The sites listed below in bold indicate established sampling locations for the collection of water samples for nutrient analysis May through December.

YTEP collected water samples for nutrient analysis at the following mainstem Klamath River locations (Figure 4-1) (river miles are approximate):

- **LES - Lower Estuary Surface – RM 0.5**
  (Figures 4-2 and 4-3)
- **TG - Klamath River at Turwar Boat Ramp – RM 6**
  (Figures 4-4 and 4-5)
- **TC - Klamath River above Tully Creek – RM 38.5**
  (Figures 4-6 and 4-7)
- **WE - Klamath River at Weitchpec (upstream of Trinity River) – RM 43.5**
  (Figures 4-8 and 4-9)

YTEP collected water samples for nutrient analysis at the following major tributary locations:

- **TR - Trinity River near mouth (above Klamath River confluence) – RM 0.5**
  (Figures 4-10 and 4-11)

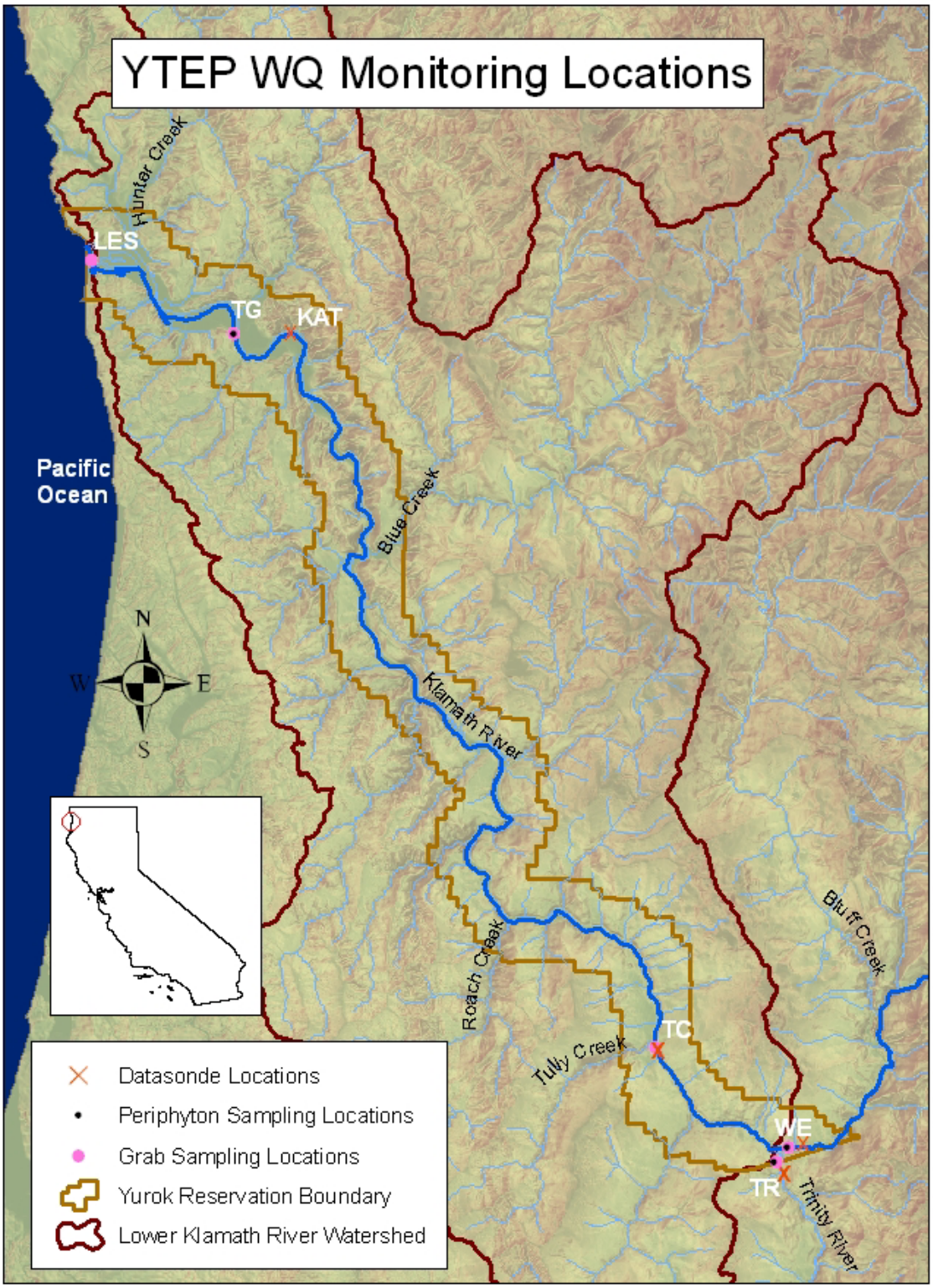

Figure 4-1. Nutrient "Grab" Sampling Sites for 2012 (as indicated by the pink dots)

Figure 4-2. LES Looking Downstream

Figure 4-3. LES Looking Upstream

Figure 4-4. TG Looking Downstream

Figure 4-5. TG Looking Upstream

Figure 4-6. TC Looking Downstream

Figure 4-7. TC Looking Upstream

Figure 4-8. WE Looking Downstream

Figure 4-9. WE Looking Upstream

Figure 4-10. TR Looking Downstream

Figure 4-11. TR Looking Upstream

V. Quality Assurance

During this study, many quality assurance and quality control (QA/QC) measures were undertaken to ensure the grab sample data that was collected was of the highest quality. YTEP performs all surface water quality monitoring activities consistent with its Quality Assurance Program Plan that was approved by the USEPA in April 2001. In June of 2008 USEPA approved YTEP's *Lower Klamath River Nutrient, Periphyton, Phytoplankton and Algal Toxin Sampling and Analysis Plan (SAP)* and was subsequently revised with minor changes and approved by USEPA in May of 2012. This document characterizes the quality control of the collection, preparation and analysis of water samples for presence of nutrients and related analytes. QA/QC was achieved by following a standard water sample collection protocol using a churn sampler and submitting samples to labs that follow strict protocol that have QA/QC measures.

All field personnel that were involved in collection of water samples have been trained appropriately by the Water Division Program Manager and are properly supervised to ensure proper protocol is followed consistently throughout the monitoring season. Each field visit requires that staff fill out field data sheets and label samples appropriately in the field. Sampling is always conducted by at least two staff for safety reasons and to maintain consistency. Field crews collecting samples ensured representativeness of samples by selecting sites that have free-flowing water from established sampling locations and using a churn splitter to mix sample water once collected. All samples were transported to the appropriate laboratories following chain of custody procedures to ensure proper handling of the samples.

Field duplicates were collected by splitting samples in the field using the churn splitter. One of the split samples was sent to the laboratory with a different ID code for analysis of both nutrients and related analytes so as to not alert lab staff of the fact that the samples were duplicates. A relative percent difference (RPD) of the initial and duplicate samples was calculated to determine the acceptability of the results. The lab was asked to reanalyze if the RPD or the difference was not within the criteria. Criteria used to evaluate acceptable nutrient duplicate samples is defined as if the initial or duplicate value >5x reporting limit (RL) then RPD should be within ± 20% or if the initial or duplicate value ≤5x RL then the difference of the two should be within ± RL. Duplicate sample results indicate the lab's precision is within the stated goals of this sampling project with 90% of samples meeting the relative percent difference of +/- 20%.

True blank samples were prepared in 2012 by pouring distilled water into sample containers provided by the laboratory and sent with a different ID code for analysis of both nutrients and related analytes so as to not alert lab staff of the fact that the samples were a true blank. True blank sample results from the 2012 sampling season indicate that there is no significant issue with contamination of samples in the field or laboratory. Equipment blank samples were prepared in 2012 by rinsing the churn according to the cleaning protocol, pouring distilled water into the churn, then filling the containers provided by the laboratory following the stirring protocol. As with true duplicates, blanks were sent with a different ID code so as not to alert lab staff that the samples were blanks.

Data is thoroughly reviewed once received from the laboratory. YTEP is the primary organization responsible for data review, although the professional laboratories analyzing water quality samples will also note potential problems with outliers or other anomalies in sample results. Information regarding QA/QC procedures for the laboratory is available upon request. One hundred percent of laboratory-generated data was checked on receipt by the Water quality

Specialist for consistency and acceptability, including whether duplicates are within specified targets and meet data quality objectives. Data is reviewed and finalized once data are merged or entered into a database.

The Water Quality Specialist will visually inspect all entered data sets to check for inconsistencies with original field or laboratory data sheets. Where inconsistencies are encountered, data will be re-entered and re-inspected until the entered data is found to be satisfactory or results will be discarded. Any unusual values outside the range of norm will be flagged and all aspects of field data sheets, shipping handling and laboratory handling and testing will be reviewed. Outliers will be identified and removed from the dataset if deemed necessary by the QA Officer. The Water Quality Specialist maintains field datasheets and notebooks in the event that the, Program Manager and/or the QA Officer needs to review any aspect of sampling for QA/QC purposes. Water temperature, conductivity, pH and dissolved oxygen are measured in the field when samples are collected and values of these hand-held measurements can be used to check field conditions at the time of sampling.

The Yurok Tribe received a grant under the Environmental Information Exchange Network Program and used it to develop the Yurok Tribe Environmental Data Storage System (YEDSS). Nutrient data covered in this report have been entered in YEDSS, and is uploaded to USEPA's WQX database. The metadata associated with each data type are also stored within the system and can be easily accessed when questions arise.

VI. Results

Sampling Results

Total Phosphorous

Total phosphorous trends for the 2012 sampling season were similar for all sites, with elevated concentrations in March and April (Table 6-1, Figure 6-1). After April, concentrations at all sites tended to decline gradually until mid July. After mid July, results at LES, TG, TC, and WE slowly increased until late October, then gradually declined until December. Concentration levels for TR increased in March and remained well below the reporting limit until mid-June. Concentration levels at TR hovered near the reporting limit from June until a small spike in mid-December.

Total phosphorous concentrations at 2012 monitoring sites ranged from a low of 0.005 mg/L at TR on July 11, to a high of 0.100 mg/L at WE on September 5. Upriver sites, except for TR, tended to yield higher concentrations than downriver sites, especially during the summer months, with WE exhibiting the highest concentrations and TR the lowest concentrations. The highest concentrations of all sites, except TR, were recorded in September and October. The highest concentration level for TR was in late March. No sites produced results below the reporting limit of 0.002 mg/L for this parameter.

Soluble Reactive Phosphorous (SRP)

SRP for all sites, except TR, exhibited comparable trends yielding a slow increase from February until mid-September (Table 6-1, Figure 6-2). In late September all sites except TR experienced a decrease in concentrations until mid-December. Concentrations at TR fluctuated very little throughout the sampling season. All results were below or slightly above the reporting limit of 0.001 mg/L.

SRP concentrations at the 2012 sites ranged from below 0.001 mg/L to 0.074 mg/L. WE yielded the highest concentration during the 2012 season on September 19, 2012, with a result of 0.074 mg/L, while TR produced the lowest reportable concentration of 0.001 mg/L on October 17, 2012. Throughout the sampling year upriver sites, except TR, generally yielded higher SRP concentrations than downriver sites, with WE yielding the highest concentrations. As with most parameters the exception was TR, which returned the lowest results at every sampling event throughout the year with concentrations hovering around the reporting limit of 0.001 mg/L for most of the season. The highest concentration at LES, TG, WE, and TC were recorded in late September. The highest concentration at TR was recorded in mid-December. If a site generated a result below the reporting limit, ND (No Detect) was entered into the database for this date and parameter, indicating that the results were below the minimum reporting value. For graphing purposes, ½ of the reporting limit (0.0005 mg/L) was used when this occurred.

Ammonia

Ammonia results for all sites exhibited concentrations below the reporting limit, ND, for the majority of the year (Table 6-1, Figure 6-3). If a site generated a result below the reporting limit, ND (No Detect) was entered into the database for this date and parameter, indicating that the results were below the reporting limit. For graphing purposes, ½ of the reporting limit (0.005 mg/L) was used when this occurred. The sampling site that most commonly produced reportable quantities of ammonia was LES. The results at LES were low in March, April, and May, but greatly increased throughout the sampling season, exhibiting higher concentrations in October, November and December.

The greatest quantity of results above the reporting limit occurred during the month of December. Ammonia concentrations at the 2012 monitoring sites ranged from less than 0.010 mg/L to 0.050 mg/L. The highest concentration for the sampling season was 0.050 mg/L at LES on October 17, 2012. The lowest reportable concentration for the 2012 season was 0.010 mg/L on February 22 at LES and TC and on December 12 at TR.

Nitrite + Nitrate

Nitrite plus nitrate trends varied among upstream and downstream, except for TR, during the 2012 sampling year (Table 6-1, Figure 6-4). Concentrations for TC and WE rose during March and April and then decreased until early September. Levels continued to rise until December, yielding one of the highest months of concentration levels for all sites with TR showing the most prolific rise. TR had several recordings under the reporting limit and garnered the lowest levels during the entire sampling year. Concentration levels of downriver sites (LES and TG) increased in late March and then slowly decreased until early July. In late July a small spike in concentration levels was recorded, but levels soon began to fall again in early August and continued to fall until early September. Concentration levels rose in mid-September and decreased in early October. Concentrations dramatically rose in mid-October and fluctuated through mid-December.

Nitrite plus nitrate concentrations at 2012 monitoring sites ranged from less than 0.010 mg/L to 0.135 mg/L. The lowest reportable concentration was 0.010 mg/L at TR on September 19 and on November 14. The site that yielded the highest concentration was the Klamath River at Weitchpec on February 22, with a result of 0.150 mg/L. Throughout much of the monitoring season, downriver sites (LES and TG) tended to have higher concentrations than upriver sites (WE and TC). As with many parameters, the exception was TR, which consistently returned

some of the lowest concentrations throughout the monitoring season. The highest concentrations at LES and TG were recorded in October and the highest results at TC, WE, and TR were recorded in November, February, and December. The reporting limit for nitrate plus nitrite was 0.010 mg/L. If a site generated a result below this number, ND (No Detect) was entered into the database for this date and parameter, indicating that the results were below the reporting limit. For graphing purposes, ½ of the reporting limit (0.005 mg/L) was used when this occurred.

Total Nitrogen

Nitrogen concentration levels were high for all sites, except TR, for the entire 2012 sampling year. High concentration levels began during the first sampling month of February for all sites, except TR. After February, concentrations slightly declined until early August, sometimes exceeding the standard (Table 6-1, Figure 6-5). Concentration levels began to spike after August, reaching the highest monthly recordings for all sites, except TR, in September and October. After October, concentration levels began to decline until December.

Concentration levels ranged from 0.572 at WE on September 5, to 0.053 at TR on October 3. WE recorded the highest concentration levels during the 2012 sampling year. TR consistently returned some of the lowest concentrations of all sites during the 2012 monitoring year. On April 18, June 13, and October 17, TR was recorded as ND. If a site generated a result below the reporting limit, ND (No Detect) was entered into the database for this date and parameter, indicating that the results were below the minimum reporting value. For graphing purposes, ½ of the reporting limit (0.025 mg/L) was used when this occurred.

Chlorophyll-a

Chlorophyll-*a* trends were similar for all sites except TR, with an increase in concentrations from February to mid-April (Table 6-2, Figure 6-6). In May results fell, then fluctuated through early July. In July there was a spike only for LES. In early September concentrations for all sites spiked only to drop in mid-September and then continually increase into mid-October. Results fell again in November and December. At TR results increased from mid-February to mid-April then decreased into August. After August results climbed again through October, decreasing again for the remainder of the season

Chlorophyll-*a* concentrations for the 2012 sampling season ranged from 0.5 µg/L to 15 µg/L. WE produced the highest concentration of 15 µg/L on September 5, 2012, while TR yielded the lowest concentration of 0.5 µg/L on August 8, 2012. The highest concentrations for WE, TG, and TC were recorded during early September. For LES the highest concentration was reported in mid-July. As with most parameters, TR consistently yielded the lowest results throughout the year with its highest concentration occurring in mid-April. No sites produced results below the reporting limit of 0.1 µg/L for this parameter during 2012.

Pheophytin-a

Pheophytin-*a* results and trends were broadly similar for all sites, except TR, during the 2012 sampling year (Table 6-2, Figure 6-7). Concentrations for all sites, except WE, began the 2012 sampling year below the reporting limit. Concentrations for LES, TG, and TR increased from mid-February to mid-March, dropping again in mid-April. TC and WE increased slightly but generally remained at a steady level. From April until late July concentration levels for these sites fluctuated, but generally remained at a steady level. For LES, TG, TC, and WE Concentrations increased from early August until mid-October and then gradually decreased

until December. TR also increased starting in early August but by mid-September its concentration was below the reporting limit again. It came up slight in mid-October only to drop again in November. December yielded its highest concentration for the season.

Pheophytin-*a* concentrations for the 2012 sampling year ranged from less than 0.1 µg/L to 9.0µg/L. The lowest reportable concentration was 0.1 µg/L and it was recorded at every sight, at least once during the 2012 sampling year. The highest concentration of 9.0 µg/L was returned at TG on October 17, 2012. The highest concentration for LES was recorded in late March, while the highest concentrations recorded for TG, TC, and WE was in mid-October. The highest concentration level at TR was in mid-March. Except for during periods of rain, TR consistently yielded some of the lowest concentrations throughout the sampling year. The reporting limit for pheophytin-*a* was 0.1 µg/L. If a site generated a result below the reporting limit, ND (No Detect) was entered into the database for this date and parameter, indicating that the results were below the minimum reporting value. For graphing purposes, ½ of the reporting limit (0.05 µg /L) was used when this occurred.

Alkalinity

Trends and results for alkalinity concentrations during the 2012 monitoring year were similar for all sites (Table 6-2, Figure 6-8). All sites were sampled for Alkalinity once a month and the first sample was taken on May 30, 2012. Concentration levels increased from late May to late July. Concentrations decreased in late August and then increased from mid-September until sampling was completed in mid-October.

Alkalinity concentrations at the 2012 sites ranged from a low of 63.2 mg/L $CaCO_3$ at TC on May 30, to a high of 89.8 mg/L $CaCO_3$ at WE on September19. The highest concentrations of alkalinity for all sites, except WE, were recorded in mid-October. The highest concentration for WE was recorded in mid-September. No sites produced results below the reporting limit of 1.0 mg/L $CaCO_3$ for this parameter during the 2012 sampling year.

Particulate Carbon (PC)

Particulate carbon concentrations exhibited similar trends for all sites, except TR, during the 2012 sampling year (Table 6-2, Figure 6-9). Concentrations began to climb from late February to mid-May. After mid-May results began to decrease for all sites, excluding WE, until early August. WE Concentrations decreased from mid-May to late May. Concentrations rose for the month of June, and then decreased until early August. For all sites concentration levels increased in early September resulting in the highest monthly levels for all sites on the Klamath. Levels decreased from late September until the final sampling date in mid-December. For TR concentrations fluctuated around 0.200 mg/L from September through October. PC concentrations at the 2012 sites ranged from a low of 0.0923 mg/L at TR on November 14th to a high of 1.8200 mg/L at WE on September 5, 2012. The highest concentrations for all sites except TR were recorded on September 5. The highest concentration at TR was recorded on March 21. TR consistently yielded some of the lowest results throughout the sampling year.

Dissolved Organic Carbon (DOC)

Dissolved organic carbon concentrations showed similar trends for all sites during the 2012 sampling year (Table 6-2, Figure 6-10). Concentrations for LES, TG, TC, and TR initially increased from late-February to mid-May. A slight decrease in concentration levels occurred for all sites from mid-May to late May. Concentrating for LES, TG, and TC held steady from late

May to late July. During this time concentrations slightly increased for WE, while concentrations slightly decreased for TR. In late May WE reached a usually high number that was determined to be an outlier. In early August concentrations for all sites increased until their peak in early September. Concentration levels decreased from late September until the final sampling date in mid-December. The only exception to this is TR which in early October concentration levels began to rise until the last sampling month of December.

DOC concentrations for the 2012 sampling season ranged from a low of 0.408 mg/L at TR on February 22, to a high of 3.61 mg/L at WE on September 5, 2012. Upriver sites tended to yield higher results then downriver sites, while TR consistently produced the lowest concentrations throughout the sampling year. The highest concentration level for LES was recorded in mid-October, while TG and TC concentration levels peaked in the beginning of September. The highest concentration level for all sites was found at WE. The highest concentration at TR was recorded in early September; this site recorded the lowest concentration levels during the 2012 sampling year. No sites produced concentrations below the reporting limit of 0.250 mg/L during the 2012 sampling year. By looking at previous year's data sets a sample from WE from May 5th was determined to be an outlier and was omitted from the data set.

Particulate Nitrogen (PN)

The only site sampled during 2012 for Particulate Nitrogen was TG from late February to mid-October (Table 6-2, Figure 6-11). Concentration levels fluctuated every month between 0.0172 mg/L and 0.2070 mg/L. The lowest concentration level was recording of 0.0172 mg/L was recorded on February 22 and the highest concentration level, 0.2070 mg/L was recorded on September 5, 2012.

Concentration levels increased from late February to mid-April and decreased from May to early June. In mid-June a small increase in concentration levels was recorded, but concentrations began to fall again later in the month until early July. Concentration levels increased in late July and decreased again in early August. In late August to early September concentration levels rose again, but began to decrease in late September. An increase in concentration levels was recorded in early October and then declined for the last date in mid-October of the 2012 sampling year.

Non-Filterable Residue (TSS)

Non-filterable residue, also known as total suspended solids (TSS), trends for all sites were similar for the 2012 sampling year (Table 6-2, Figure 6-12). Concentrations increased greatly in late-March. In mid-April all sites dramatically decreased until late May, from late May to mid-November, results stayed low and fluctuated very little, except for a slight increase in early September. Concentrations then rose sharply in mid-December.

TSS concentrations for the 2012 sampling year ranged from less than 0.63 mg/L to 41 mg/L. The lowest reportable concentration for the sampling period was 0.63 mg/L at TR on October 3 and on November 14, 2012, while the highest concentration was 41 mg/L at TC on March 21, 2012. The highest concentrations for all sites were recorded in late-March. The reporting limit for TSS was 0.50 mg/L. If a site generated a result below this number, ND (No Detect) was entered into the database for this date and parameter, indicating that the results were below the reporting limit. For graphing purposes, ½ of the reporting limit (0.25 mg/L) was used

when this occurred. No sites produced concentrations below the reporting limit of 0.250 mg/L during the 2012 sampling year.

Volatile Suspended Solids (VSS)

Trends and results for volatile suspended solids concentrations during the 2012 sampling year were broadly similar among all sites (Table 6-2, Figure 6-13). For all sites concentrations increased from late-February to late-March. All sites except TC then decreased in mid-April. In early May, results increased slightly, then dramatically decreased in late May. TC decreased for both sampling events in May. In early June concentration levels began to increase until early July. Concentrations then gradually decreased into early August, increased in late August, and continued to increase into early September. In late September results decreased slightly. For October the sites results varied. WE increased significantly in early October, and then decreased in late October. LES, TG, and TC slightly increased in early October and then decreased in late October. TR decreased in early October and then increased in late October. WE, TG, TC and TR decreased in November while LES increased. LES, TG, and TR then increased slightly in mid-December, while TC and WE decreased. TR generally followed the concentration trends of LES, TG, TC, and WE, but its concentration levels were interrupted by several sampling dates that were found to be below the reporting limit. This caused TR to have inconsistent concentration levels throughout the 2012 sampling year.

Volatile suspended solids concentrations for the 2012 sampling year ranged from less than 0.50 mg/L to 5.3 mg/L. WE returned the highest concentration of 5.3 mg/L on September 5, 2012, while TR returned the lowest reportable concentration of 0.50 mg/L on February, 22, June 13, July 25, and on August 22, 2012. The highest concentrations for LES, TG, TC, and WE were recorded in early September. TR recorded its highest level in late March. Except for periods of rain, TR tended to have the lowest concentrations for all sights. If a site generated a result below the reporting limit, ND (No Detect) was entered into the database for this date and parameter, indicating that the results were below the minimum reporting value. For graphing purposes, ½ of the reporting limit (0.25 mg/L) was used when this occurred. All sites, except TC, have received at least one concentration level below the reporting limit during the 2012 sampling year.

Turbidity

Trends for turbidity among all sites were similar during the 2012 sampling year (Table 6-2, Figure 14). Concentrations at all sites increased from mid-February to late-March, decreased in mid-April, and continued to decrease until early September. Concentration levels increased in early September and began to decrease in late September. In early October concentrations increased and then decreased from late October until mid-November. Levels increased dramatically during December.

Turbidity results for the 2012 sampling year ranged from 0.16 NTU to 21 NTU. TR returned the highest result of 21 NTU on March 21, 2012, while also yielding the lowest result of 0.16 NTU on October 17, 2012. The highest concentrations at all sites were recorded in late-March. No sites produced concentrations below the reporting limit of 0.10 NTU during the 2012 sampling year.

Discrete Sonde Measurements

Below is a summary of the discrete sonde measurements that were taken at the sampling sites when surface water samples were collected.

Water Temperature

Water temperature at all sites during the 2012 season displayed similar trends (Table 6-3, Figure 6-15). Measurements at all sites showed steadily increasing temperatures from late February to late August. This was followed by generally decreasing temperatures until the end of the sampling year in mid-December. Water temperature at LES, TG, TC, and TR was at its lowest in late March. The lowest temperature for WE was in December. Temperatures for the 2012 sampling season ranged from a low 7.19 °C on December 12, to a high of 22.12 °C on July 25, 2012. Both of these temperatures were recorded at WE.

Dissolved Oxygen (mg/L)

Dissolved oxygen (DO) measured in mg/L during the 2012 sampling season showed similar trends at all sites throughout the season (Table 6-3, Figure 6-16). DO at all sites generally increased from late February to mid-March. After a peak in March DO slowly declined through August. In late August DO started to slightly increase until November where it climbed. The highest DO concentrations of the year were recorded in late March at all sites. Throughout the sampling season, upriver sites tended to return higher concentrations of DO than downriver sites. Concentrations of DO during the 2012 sampling season ranged from a low of 7.30 mg/L at TG on July 25 and August 8, to a high of 12.35 mg/L at WE on March 21, 2012.

Dissolved Oxygen (%)

DO concentrations measured in percent for the 2012 sampling year exhibited similar trends for upriver sites, while downriver sites returned different patterns (Table 6-3, Figure 6-17). TC, WE, and TR all showed slightly decreasing DO percentages from late-February to mid-March, followed by an increase in percentages from mid-April to mid- May. From late May until late June DO percentages decreased then increased through early July. DO percentages then decreased through late July. In early August TC and WE decreased, while TR increased. DO percentages decreased at WE, TC, and TR in late August and increased in early September. In mid-September TC and WE decreased while TR increased. DO percentages at WE, TC, and TR decreased in early October and then increased until mid-November. DO percentages decreased at WE, TC, and TR in mid-December. At LES and TG, DO percentages increased slightly from mid-February to mid-May then decreased from Late May until late July. DO percentages then climbed during the month of August. In early September DO percentages at LES decreased, while at TG readings increased. DO percentages at LES and TG increased in mid-September. In early October, TG decreased while LES slightly increased, both sites decreased late October. In mid-November, DO percentages were not recorded for LES, but DO percentages increased for TG. DO percentages for both sites increased during the last sampling day on December 12, 2012.

Throughout the sampling season, upriver sites tended to return higher percentages of DO than downriver sites, with WE and TR returning the highest results and LES and TG the lowest. The highest percentage of DO measured during the 2012 sampling year was 104.9% at WE on May 16, while the lowest DO percentage measured was 77.7% at TG on October 17, 2012.

Specific Conductivity

Specific conductivity at all sites except LES exhibited similar trends during the 2012 sampling year (Table 6-3, Figures 6-18 and 6-19). Specific conductivity readings at all sites decreased from mid-February to mid-March, increased in mid-April and decreased in early May. From late May through early August values increased and held steady. In late August all sites decreased until early September. In mid-September all sites increased. In early October all sites except LES increased, but by late October all sites increased and continued to increase until late October. In mid-November LES was not recorded for specific conductivity, LES, TG, TC increased and WE decreased. During the last sampling date in mid-December, all sites had decreased.

Measurements for specific conductivity for the 2012 sampling year ranged from a low of 91 microSiemens per centimeter (µS/cm) at WE on May 16, to a high of 4009 µS/cm at LES on October 17, 2010. LES contained the highest readings of specific conductivity during the 2012 sampling year, reporting extremely high readings during the months of August, September, and October.

pH

pH trends during the 2012 sampling year were generally similar among all sites (Table 6-3, Figure 6-20). pH steadily increased from mid-February to late April. In early May LES, TG, and TC increased, while WE and TR decreased. In Late May all sites increased and remained steady with slight fluctuations until late August. In late August, pH slightly decreased for all sites and remained steady until early October. In late October, pH decreased at all sites and then remained around the same levels until mid-December. The highest pH reading for all sites was recorded during the months of August, September, October, and December.

The lowest pH was measured during the 2012 sampling season was 7.76 at WE on May 16, while the highest pH measured was also recorded at WE at 8.55 on August 8, 2012. As with many other parameters, upriver sites tended to return higher pH measurements than downriver sites.

Blue-green Algae

Blue-green algae probe readings from the data sonde exhibited a fluctuation in trends for all sites during the 2012 sampling season (Table 6-3, Figure 6-21). In late February all sites except WE were well below zero. All sites were not sampled during the month of March and April due to low water temperature. BGA does not grow in colder water temperatures, thus there was no need to sample during March and April. Due to an increase in water temperature, all sites dramatically increased in BGA levels during mid-May. During late May and mid-June, WE and TR exhibited extremely high BGA levels and were deleted as outliers. It was determined that the reference sonde would sometimes park the wiper on the phycocyanin probe distorting the value. In mid-June, LES, TG, and TC BGA levels began to decrease and continued to decrease except TG until the end of June. During the month of July all sites increased except TG. Levels for TG decreased during the month of July. In early August all sites except TC increased, while later in August all sites decreased in levels except TC. TC decreased in early August and increased in late August. In early September all sites increased except TR. In late September BGA levels decreased for all sites. All sites except LES increased in early October, all sites decreased in levels in mid-October. Levels continued to drop for all sites except TR in mid-November. During the final sampling month all sites except TG and LES decreased in BGA

levels. The lowest reading for blue-green algae during the 2012 sampling season was -1550 cells/mL at TG on February 22, while the highest reading was 8,000 cells/mL at LES on August 8, 2012

Table 6-1. Nutrient Results, Yurok Reservation 2012

Nutrients

Total Phosphorous mg/L; Report Limit: 0.002	Site	2/22/2012	3/21/2012	4/18/2012	5/16/2012	5/30/2012	6/13/2012	6/27/2012	7/11/2012	7/25/2012	8/8/2012	8/22/2012	9/5/2012	9/19/2012	10/3/2012	10/17/2012	11/14/2012	12/12/2012
	LES	0.015	0.056	0.041	0.034	0.021	0.020	0.016	0.018	0.023	0.024	0.028	0.046	0.044	0.049	0.050	0.037	0.039
	TG	0.017	0.049	0.041	0.025	0.023	0.021	0.017	0.013	0.025	0.028	0.032	0.056	0.049	0.050	0.047	0.044	0.032
	TC	0.019	0.042	0.041	0.029	0.024	0.024	0.020	0.019	0.026	0.033	0.037	0.058	0.054	0.060	0.068	0.044	0.030
	WE	0.023	0.040	0.043	0.034	0.049	0.035	0.036	0.033	0.038	0.045	0.060	0.100	0.086	0.086	0.087	0.059	0.031
	TR	0.006	0.045	0.038	0.018	0.015	0.008	0.007	0.005	0.007	0.006	0.008	0.006	0.007	0.007	0.007	0.007	0.026

Soluble Reactive Phosphorous mg/L; Report Limit: 0.001	Site	2/22/2012	3/21/2012	4/18/2012	5/16/2012	5/30/2012	6/13/2012	6/27/2012	7/11/2012	7/25/2012	8/8/2012	8/22/2012	9/5/2012	9/19/2012	10/3/2012	10/17/2012	11/14/2012	12/12/2012
	LES	0.010	0.011	0.013	0.012	0.006	0.010	0.009	0.007	0.015	0.018	0.016	0.023	0.037	0.026	0.030	0.032	0.014
	TG	0.010	0.012	0.013	0.010	0.007	0.011	0.009	0.007	0.012	0.016	0.018	0.026	0.036	0.028	0.020	0.038	0.015
	TC	0.011	0.010	0.013	0.011	0.008	0.013	0.012	0.018	0.018	0.027	0.025	0.032	0.046	0.040	0.042	0.037	0.015
	WE	0.015	0.013	0.017	0.015	0.012	0.015	0.022	0.032	0.027	0.036	0.044	0.054	0.074	0.056	0.059	0.048	0.020
	TR	0.003	0.008	0.006	0.004	ND	0.003	0.007	0.002	0.002	0.002	ND	ND	0.006	0.002	0.001	0.004	0.008

Ammonia Nitrogen mg/L; Report Limit: 0.010	Site	2/22/2012	3/21/2012	4/18/2012	5/16/2012	5/30/2012	6/13/2012	6/27/2012	7/11/2012	7/25/2012	8/8/2012	8/22/2012	9/5/2012	9/19/2012	10/3/2012	10/17/2012	11/14/2012	12/12/2012
	LES	ND	0.010	0.011	0.011	ND	ND	ND	ND	0.014	ND	ND	ND	0.011	ND	0.050	0.020	0.013
	TG	ND	0.011	ND	ND	ND	ND	ND	ND	0.016	ND	ND	ND	ND	ND	0.016	ND	0.011
	TC	ND	0.010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.011
	WE	ND	ND	ND	ND	ND	ND	ND	0.013	ND	ND	ND	ND	ND	ND	ND	ND	ND
	TR	ND	0.016	0.012	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.010

Nitrate +Nitrite mg/L; Report Limit: 0.010	Site	2/22/2012	3/21/2012	4/18/2012	5/16/2012	5/30/2012	6/13/2012	6/27/2012	7/11/2012	7/25/2012	8/8/2012	8/22/2012	9/5/2012	9/19/2012	10/3/2012	10/17/2012	11/14/2012	12/12/2012
	LES	0.119	0.103	0.089	0.023	0.011	0.013	ND	ND	0.032	0.025	ND	ND	0.026	0.013	0.129	0.118	0.126
	TG	0.119	0.076	0.096	0.036	0.019	0.019	0.024	0.034	0.081	0.070	ND	ND	0.032	0.018	0.135	0.135	0.111
	TC	0.103	0.047	0.084	0.021	ND	0.011	ND	0.013	ND	0.011	ND	ND	0.044	0.021	0.066	0.104	0.092
	WE	0.150	0.049	0.109	0.027	ND	ND	ND	ND	ND	0.011	0.010	ND	0.079	0.041	0.092	0.138	0.108
	TR	ND	0.042	0.037	ND	ND	ND	ND	ND	ND	0.012	ND	ND	0.010	ND	ND	0.010	0.064

Total Nitrogen mg/L; Report Limit 0.050	Site	2/22/2012	3/21/2012	4/18/2012	5/16/2012	5/30/2012	6/13/2012	6/27/2012	7/11/2012	7/25/2012	8/8/2012	8/22/2012	9/5/2012	9/19/2012	10/3/2012	10/17/2012	11/14/2012	12/12/2012
	LES	0.193	0.166	0.182	0.192	0.117	0.119	0.117	0.169	0.179	0.176	0.205	0.306	0.292	0.382	0.394	0.292	0.243
	TG	0.206	0.124	0.202	0.221	0.133	0.124	0.149	0.180	0.262	0.224	0.223	0.339	0.257	0.325	0.323	0.415	0.219
	TC	0.205	0.098	0.153	0.170	0.146	0.128	0.141	0.133	0.159	0.184	0.284	0.336	0.289	0.320	0.307	0.269	0.151
	WE	0.250	0.104	0.210	0.234	0.205	0.161	0.179	0.230	0.227	0.216	0.387	0.572	0.481	0.566	0.419	0.364	0.192
	TR	0.093	0.082	ND	0.092	0.078	ND	0.063	0.097	0.072	0.068	0.133	0.056	0.055	0.053	ND	0.059	0.092

ND= No Detect
OUT= Outlier

Table 6-2. Other Analytes Results, Yurok Reservation 2012

Other Analytes

Chlorophyll a
µg/L; Report Limit: 0.1

Site	2/22/2012	3/21/2012	4/18/2012	5/16/2012	5/30/2012	6/13/2012	6/27/2012	7/11/2012	7/25/2012	8/8/2012	8/22/2012	9/5/2012	9/19/2012	10/3/2012	10/17/2012	11/14/2012	12/12/2012
LES	0.9	3.2	2.7	3.7	2.7	1.6	2.1	9.9	1.6	1.6	2.7	6.8	3.7	6.1	2.1	1.3	2.1
TG	1.3	2.1	2.7	2.1	2.9	1.9	3.2	2.9	3.2	2.4	2.7	9.8	5.3	6.7	8.5	2.1	1.5
TC	1.7	2.1	4.3	2.1	1.6	1.6	2.7	1.9	1.7	1.3	2.1	8.5	3.2	4.3	7.5	2.4	1.1
WE	1.6	2.1	2.7	3.0	2.1	2.4	3.5	2.4	1.6	2.9	2.9	15	5.1	5.9	9.6	2.7	0.7
TR	1.7	1.1	3.2	1.5	1.0	0.8	0.6	0.9	0.7	0.5	0.6	0.8	0.7	0.9	1.3	1.1	1.1

Pheophytin a
µg/L; Report Limit: 0.1

Site	2/22/2012	3/21/2012	4/18/2012	5/16/2012	5/30/2012	6/13/2012	6/27/2012	7/11/2012	7/25/2012	8/8/2012	8/22/2012	9/5/2012	9/19/2012	10/3/2012	10/17/2012	11/14/2012	12/12/2012
LES	ND	2.4	0.1	0.4	0.1	0.6	0.3	1.3	0.6	0.6	1.4	2.2	2.1	1.5	2.0	1.5	0.1
TG	ND	3.5	0.1	1.2	0.2	0.6	0.2	0.8	1.8	1.9	2.2	2.9	4.0	2.5	9.0	2.3	ND
TC	ND	0.1	0.2	0.5	ND	1.4	0.1	0.7	ND	1.3	1.8	2.3	2.4	1.7	6.7	2.1	ND
WE	0.3	0.5	0.7	ND	0.1	1.7	0.8	0.4	ND	0.6	1.4	4.1	2.8	4.6	7.6	3.1	ND
TR	ND	2.3	0.2	ND	ND	0.1	0.3	ND	ND	0.2	0.7	0.3	ND	ND	0.1	ND	0.8

Alkalinity
mg/L CaCO3; Report Limit: 1.0

Site	2/22/2012	3/21/2012	4/18/2012	5/16/2012	5/30/2012	6/13/2012	6/27/2012	7/11/2012	7/25/2012	8/8/2012	8/22/2012	9/5/2012	9/19/2012	10/3/2012	10/17/2012	11/14/2012	12/12/2012
LES	DNS	DNS	DNS	DNS	63.4	DNS	66.0	DNS	77.7	DNS	75.8	DNS	85.0	DNS	85.0	DNS	DNS
TG	DNS	DNS	DNS	DNS	65.8	DNS	69.8	DNS	80.4	DNS	73.8	DNS	81.5	DNS	86.3	DNS	DNS
TC	DNS	DNS	DNS	DNS	63.2	DNS	69.2	DNS	78.8	DNS	73.0	DNS	79.8	DNS	85.6	DNS	DNS
WE	DNS	DNS	DNS	DNS	64.0	DNS	69.5	DNS	80.2	DNS	78.9	DNS	89.8	DNS	89.6	DNS	DNS
TR	DNS	DNS	DNS	DNS	64.6	DNS	67.2	DNS	77.7	DNS	64.0	DNS	67.0	DNS	83.0	DNS	DNS

Dissolved Organic Carbon (DOC)
mg/L; Report Limit: 0.250

Site	2/22/2012	3/21/2012	4/18/2012	5/16/2012	5/30/2012	6/13/2012	6/27/2012	7/11/2012	7/25/2012	8/8/2012	8/22/2012	9/5/2012	9/19/2012	10/3/2012	10/17/2012	11/14/2012	12/12/2012
LES	0.544	1.14	1.28	1.54	1.12	1.05	1.12	1.08	1.11	1.48	1.92	1.88	1.95	2.01	2.20	1.52	1.11
TG	0.606	0.867	1.40	1.45	1.03	1.28	1.13	0.964	1.12	1.08	1.77	2.63	1.88	1.93	1.54	1.59	1.07
TC	0.610	0.780	1.50	1.24	1.14	1.04	1.22	1.11	1.37	1.72	2.38	2.97	2.14	2.27	2.00	1.92	1.40
WE	0.805	1.04	2.32	1.55	Out	1.38	1.65	1.69	1.75	2.32	2.91	3.61	2.85	2.82	2.51	2.08	1.31
TR	0.408	0.609	0.795	1.10	0.704	0.601	0.661	0.588	0.457	0.859	0.949	1.20	0.822	0.868	0.738	0.804	0.919

Particulate Carbon (PC)
mg C/L

Site	2/22/2012	3/21/2012	4/18/2012	5/16/2012	5/30/2012	6/13/2012	6/27/2012	7/11/2012	7/25/2012	8/8/2012	8/22/2012	9/5/2012	9/19/2012	10/3/2012	10/17/2012	11/14/2012	11/15/2012
LES	0.1880	0.4970	0.4880	0.6660	0.2820	0.294	0.256	0.422	0.194	0.217	0.3150	0.8330	0.5000	0.5820	0.394	0.2600	0.5350
TG	0.1890	0.5930	0.4590	0.1760	0.3200	0.299	0.299	0.270	0.377	0.314	0.3680	1.2000	0.6990	0.6080	0.569	0.2800	0.1250
TC	0.2280	0.5740	0.5860	0.5370	0.4390	0.409	0.337	0.292	0.194	0.253	0.4080	1.1100	0.4050	0.5160	0.599	0.2670	0.2510
WE	0.2380	0.6380	0.4340	0.6280	0.4230	0.532	0.568	0.330	0.305	0.226	0.4170	1.8200	0.6420	0.9210	0.584	0.4130	0.2350
TR	0.1480	0.5950	0.2990	0.2960	0.2690	0.192	0.174	0.221	0.098	0.111	0.1650	0.1760	0.1580	0.1390	0.172	0.0923	0.2070

Particulate Nitrogen (PN)
mg N/L

Site	2/22/2012	3/21/2012	4/18/2012	5/16/2012	5/30/2012	6/13/2012	6/27/2012	7/11/2012	7/25/2012	8/8/2012	8/22/2012	9/5/2012	9/19/2012	10/3/2012	10/17/2012	11/14/2012	11/15/2012
LES	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS
TG	0.0172	0.0630	0.0625	0.0362	0.0368	0.0522	0.0322	0.0325	0.0602	0.0359	0.0506	0.2070	0.0946	0.1040	0.0706	0.0307	0.0239
TC	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS
WE	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS
TR	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS

Total Organic Carbon (TOC)
Add PC and DOC

Site	2/22/2012	3/21/2012	4/18/2012	5/16/2012	5/30/2012	6/13/2012	6/27/2012	7/11/2012	7/25/2012	8/8/2012	8/22/2012	9/5/2012	9/19/2012	10/3/2012	10/17/2012	11/14/2012	12/12/2012
LES	0.732	1.63	1.77	2.21	1.40	1.34	1.38	1.50	1.30	1.70	2.24	2.71	2.45	2.59	2.59	1.52	1.11
TG	0.795	1.460	1.86	1.63	1.35	1.58	1.43	1.234	1.50	1.39	2.14	3.83	2.58	2.54	2.11	1.59	1.07
TC	0.838	1.354	2.09	1.78	1.58	1.45	1.56	1.40	1.56	1.97	2.79	4.08	2.55	2.79	2.60	1.92	1.40
WE	1.043	1.67	2.75	2.18	6.66	1.91	2.22	2.02	2.06	2.55	3.33	5.43	3.49	3.74	3.09	2.08	1.31
TR	0.556	1.204	1.094	1.40	0.973	0.793	0.835	0.809	0.555	0.970	1.114	1.38	0.980	1.007	0.910	0.804	0.919

ND= No Detect
DNS= Did Not Sample
NS= No Sample for this date
OUT=Outlier

Table 6-2 (contd.). Other Analytes Results, Yurok Reservation 2012

Non-Filterable Residue (TSS) mg/L; Report Limit: 0.50	Site	2/22/2012	3/21/2012	4/18/2012	5/16/2012	5/30/2012	6/13/2012	6/27/2012	7/11/2012	7/25/2012	8/8/2012	8/22/2012	9/5/2012	9/19/2012	10/3/2012	10/17/2012	11/14/2012	12/12/2012
	LES	2.6	39	22	18	6.0	2.8	2.0	3.1	1.9	1.3	1.4	3.5	2.1	2.1	1.6	1.6	17
	TG	4.3	29	19	12	5.3	4.0	2.1	1.6	5.3	2.5	2.3	5.8	4.2	3.1	8.3	2.0	13
	TC	3.5	41	24	18	7.5	4.9	3.3	2.0	1.8	2.1	2.1	3.8	2.0	2.1	5.8	2.0	8.5
	WE	3.3	18	11	14	8.3	4.1	4.0	2.0	1.8	1.9	2.3	6.3	2.5	5.7	4.3	3.0	6.7
	TR	1.8	39	25	18	3.5	2.9	1.6	1.3	1.3	1.0	1.0	1.0	1.0	0.63	1.1	0.63	12

Volatile Suspended Solids (VSS) mg/L; Report Limit: 0.50	Site	2/22/2012	3/21/2012	4/18/2012	5/16/2012	5/30/2012	6/13/2012	6/27/2012	7/11/2012	7/25/2012	8/8/2012	8/22/2012	9/5/2012	9/19/2012	10/3/2012	10/17/2012	11/14/2012	12/12/2012
	LES	1.0	3.0	1.8	3.0	ND	0.1	0.8	0.88	0.87	0.75	0.87	1.8	0.75	1.1	0.62	1.3	2.0
	TG	0.87	2.7	2.0	2.0	ND	0.9	0.6	0.87	1.20	0.50	0.87	2.8	1.5	1.5	1.8	1.1	2.5
	TC	1.3	2.5	2.8	1.8	1.0	1.3	1.0	0.87	1.10	0.75	1.0	1.8	1.0	1.5	1.8	0.87	0.83
	WE	0.63	2.0	ND	3.0	1.2	0.9	1.4	0.50	0.87	0.63	1.1	5.3	1.5	3.2	1.8	1.5	0.83
	TR	0.50	1.5	1.3	2.0	ND	0.50	ND	0.62	0.50	0.75	0.50	0.75	0.63	ND	1.1	0.63	1.5

Turbidity NTU; Report Limit: 0.10	Site	2/22/2012	3/21/2012	4/18/2012	5/16/2012	5/30/2012	6/13/2012	6/27/2012	7/11/2012	7/25/2012	8/8/2012	8/22/2012	9/5/2012	9/19/2012	10/3/2012	10/17/2012	11/14/2012	12/12/2012
	LES	0.80	20	8.1	6.1	2.8	0.94	0.64	0.98	0.86	0.45	0.44	1.5	0.59	0.76	0.61	0.43	6.2
	TG	0.83	9.9	7.3	4.6	2.5	0.98	0.63	0.39	0.62	0.65	0.47	2.0	1.5	0.87	0.71	0.41	4.8
	TC	0.68	8.5	6.4	5.2	2.4	1.6	0.52	0.54	0.39	0.40	0.53	2.0	0.48	0.68	0.37	0.47	3.5
	WE	0.72	4.8	4.2	3.5	2.3	0.93	0.72	0.49	0.44	0.27	0.36	2.6	0.68	0.80	0.54	0.53	2.4
	TR	0.59	21	8.3	5.4	2.4	0.91	0.53	0.47	0.41	0.34	0.27	0.21	0.24	0.25	0.16	0.16	5.1

ND= No Detect

ratio of VSS to TSS	Site	2/22/2012	3/21/2012	4/18/2012	5/16/2012	5/30/2012	6/13/2012	6/27/2012	7/11/2012	7/25/2012	8/8/2012	8/22/2012	9/5/2012	9/19/2012	10/3/2012	10/17/2012	11/14/2012	12/12/2012
	LES	38.1	7.8	8.2	16.9	4.2	1.8	37.5	28.4	45.8	57.7	62.1	51.4	35.7	52.4	38.8	81.3	11.8
	TG	20.6	9.5	10.5	17.4	4.8	22.0	30.0	54.4	22.6	20.0	49.2	48.3	35.7	48.4	21.7	55.0	19.2
	TC	35.7	6.1	11.7	9.9	13.3	26.5	30.3	43.5	61.1	35.7	88.2	47.4	50.0	71.4	31.0	43.5	9.8
	WE	19.2	11.1	2.3	21.4	14.0	21.2	35.0	25.0	48.3	33.2	79.0	84.1	60.0	56.1	41.9	50.0	12.4
	TR	28.6	3.9	5.2	11.3	7.1	17.2	15.6	47.7	38.5	75.0	50.0	75.0	63.0	39.7	100.0	100.0	12.5
	0*= No Detect for both parameters																	

ratio of DOC to TOC	Site	2/22/2012	3/21/2012	4/18/2012	5/16/2012	5/30/2012	6/13/2012	6/27/2012	7/11/2012	7/25/2012	8/8/2012	8/22/2012	9/5/2012	9/19/2012	10/3/2012	10/17/2012	11/14/2012	12/12/2012
	LES	74.3	69.5	72.4	69.8	79.9	78.1	81.4	71.9	85.1	87.2	85.9	69.3	79.6	77.5	84.8	85.4	67.5
	TG	76.2	59.4	75.3	89.2	76.3	81.1	79.1	78.1	74.8	77.5	82.8	68.7	72.9	76.0	73.0	85.0	89.5
	TC	72.8	57.6	71.9	69.8	72.3	71.8	78.4	79.2	87.6	87.2	85.4	72.8	84.1	81.5	77.0	87.8	84.8
	WE	77.2	61.9	84.2	71.2	93.6	72.2	74.4	83.7	85.2	91.1	87.5	66.5	81.6	75.4	81.1	83.4	84.8
	TR	73.4	50.6	72.7	78.8	72.3	75.8	79.2	72.7	82.3	88.6	85.2	87.2	83.9	86.2	81.1	89.7	81.6
	DNS*= Did Not Sample Particulate Carbon NS* = No Sample for Particulate Carbon on this date																	

ratio of PC to TOC	Site	2/22/2012	3/21/2012	4/18/2012	5/16/2012	5/30/2012	6/13/2012	6/27/2012	7/11/2012	7/25/2012	8/8/2012	8/22/2012	9/5/2012	9/19/2012	10/3/2012	10/17/2012	11/14/2012	12/12/2012
	LES	25.7	30.5	27.6	30.2	20.1	21.9	18.6	28.1	14.9	12.8	14.1	30.7	20.4	22.5	15.2	14.6	32.5
	TG	23.8	40.6	24.7	10.8	23.7	18.9	20.9	21.9	25.2	22.5	17.2	31.3	27.1	24.0	27.0	15.0	10.5
	TC	27.2	42.4	28.1	30.2	27.7	28.2	21.6	20.8	12.4	12.8	14.6	27.2	15.9	18.5	23.0	12.2	15.2
	WE	22.8	38.1	15.8	28.8	6.4	27.8	25.6	16.3	14.8	8.9	12.5	33.5	18.4	24.6	18.9	16.6	15.2
	TR	26.6	49.4	27.3	21.2	27.7	24.2	20.8	27.3	17.7	11.4	14.8	12.8	16.1	13.8	18.9	10.3	18.4
	DNS= Did Not Sample NS = No Sample for this date																	

ratio of PN to TN	Site	2/22/2012	3/21/2012	4/18/2012	5/16/2012	5/30/2012	6/13/2012	6/27/2012	7/11/2012	7/25/2012	8/8/2012	8/22/2012	9/5/2012	9/19/2012	10/3/2012	10/17/2012	11/14/2012	12/12/2012
	LES	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS
	TG	8.4	50.7	30.9	16.4	27.7	42.1	21.6	18.1	23.0	16.0	22.7	61.1	36.8	32.0	21.9	7.4	10.9
	TC	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS
	WE	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS
	TR	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS

DNS= Did not sample

Table 6-3. Discrete Datasonde Measurements, Yurok Reservation 2012

Discrete Datasonde Results

Temperature °C	Site	2/22/2012	3/21/2012	4/18/2012	5/16/2012	5/30/2012	6/13/2012	6/27/2012	7/11/2012	7/25/2012	8/8/2012	8/22/2012	9/5/2012	9/19/2012	10/3/2012	10/17/2012	11/14/2012	12/12/2012
	LES	8.57	7.63	10.34	14.19	14.07	16.31	16.11	20.35	21.22	20.54	20.45	19.27	17.71	16.93	15.05	DNR	7.89
	TG	8.79	7.69	10.41	14.16	14.23	16.50	15.61	19.37	19.95	20.37	21.13	19.38	18.23	17.22	15.40	10.54	7.89
	TC	8.46	7.33	9.94	13.73	13.87	16.64	15.72	20.88	21.45	21.76	20.76	19.12	18.00	17.63	16.43	10.18	7.43
	WE	8.19	7.37	9.80	14.19	14.80	17.42	16.66	22.07	22.12	21.91	21.49	19.85	18.61	17.28	16.40	10.20	7.19
	TR	9.16	7.39	10.08	13.71	13.60	15.95	14.25	19.79	21.04	21.76	19.77	18.28	17.05	16.70	16.18	10.54	7.84

Dissolved Oxygen mg/L	Site	2/22/2012	3/21/2012	4/18/2012	5/16/2012	5/30/2012	6/13/2012	6/27/2012	7/11/2012	7/25/2012	8/8/2012	8/22/2012	9/5/2012	9/19/2012	10/3/2012	10/17/2012	11/14/2012	12/12/2012
	LES	11.54	11.84	11.02	10.19	10.05	9.34	9.42	7.94	7.96	7.96	8.10	8.03	8.60	8.75	8.71	DNR	11.47
	TG	11.38	11.80	10.91	10.09	10.01	9.37	9.46	8.16	7.30	7.30	7.85	8.21	8.47	8.16	7.76	9.88	11.35
	TC	11.99	12.22	11.46	10.66	10.45	9.74	9.89	9.01	8.65	8.55	8.65	9.35	9.40	9.12	9.46	11.38	11.91
	WE	12.16	12.35	11.65	10.77	10.52	9.75	9.88	9.14	8.94	8.86	8.84	9.40	9.40	9.39	9.51	11.56	12.10
	TR	11.85	12.04	11.33	10.62	10.59	10.04	10.30	9.35	9.06	8.99	9.21	9.66	9.91	9.77	9.93	11.61	11.73

Percent Dissolved Oxygen	Site	2/22/2012	3/21/2012	4/18/2012	5/16/2012	5/30/2012	6/13/2012	6/27/2012	7/11/2012	7/25/2012	8/8/2012	8/22/2012	9/5/2012	9/19/2012	10/3/2012	10/17/2012	11/14/2012	12/12/2012
	LES	98.7	99.1	98.5	99.3	97.7	95.3	95.6	88.0	89.9	89.1	90.5	87.2	91.2	91.3	88.8	DNR	96.6
	TG	98.0	99.0	97.5	98.2	97.6	96.0	95.1	88.6	80.2	80.6	88.3	89.2	89.9	84.9	77.7	88.7	95.6
	TC	102.4	101.5	101.4	102.8	101.1	100.0	99.7	100.8	98.0	97.4	96.8	101.1	99.2	95.6	96.7	101.2	99.2
	WE	103.1	102.6	102.7	104.9	103.9	101.8	101.5	104.7	102.5	101.2	100.2	103.1	100.6	97.3	97.2	102.9	100.2
	TR	102.9	100.2	100.6	102.5	101.9	101.6	100.6	102.4	101.9	102.4	100.8	102.6	102.7	100.5	101.1	104.2	98.6

Table 6-3 (contd.). Discrete Datasonde Measurements, Yurok Reservation 2012

Specific Conductivity µS/cm	Site	2/22/2012	3/21/2012	4/18/2012	5/16/2012	5/30/2012	6/13/2012	6/27/2012	7/11/2012	7/25/2012	8/8/2012	8/22/2012	9/5/2012	9/19/2012	10/3/2012	10/17/2012	11/14/2012	12/12/2012
	LES	141	111	135	103	123	137	141	354	786	2405	1198	810	3232	3128	4009	DNR	132
	TG	142	113	136	104	122	130	137	149	162	169	158	155	159	172	173	176	128
	TC	146	119	136	97	118	127	134	146	160	166	155	152	158	173	176	180	134
	WE	142	115	133	91	120	131	141	156	164	168	171	168	178	182	184	182	128
	TR	156	132	141	106	115	121	126	131	154	163	134	129	129	151	154	175	149

pH	Site	2/22/2012	3/21/2012	4/18/2012	5/16/2012	5/30/2012	6/13/2012	6/27/2012	7/11/2012	7/25/2012	8/8/2012	8/22/2012	9/5/2012	9/19/2012	10/3/2012	10/17/2012	11/14/2012	12/12/2012
	LES	7.82	8.04	7.91	8.24	8.41	8.16	8.18	8.15	8.21	8.33	8.20	8.20	8.14	8.19	7.82	DNR	7.91
	TG	7.99	7.85	7.90	8.19	8.36	8.18	8.03	7.97	7.75	7.89	8.22	8.28	8.23	8.15	7.76	7.93	8.02
	TC	8.04	8.02	8.09	8.06	8.35	8.30	8.22	8.30	8.34	8.50	8.26	8.35	8.29	8.36	8.38	8.38	8.09
	WE	8.12	8.02	8.08	7.81	8.40	8.27	8.29	8.36	8.40	8.55	8.33	8.39	8.29	8.29	8.35	8.50	8.08
	TR	8.25	8.06	8.12	7.76	8.20	8.19	8.14	7.98	8.13	8.21	8.14	8.20	8.15	8.32	8.35	8.47	8.14

Blue-green Algae cells/mL	Site	2/22/2012	3/21/2012	4/18/2012	5/16/2012	5/30/2012	6/13/2012	6/27/2012	7/11/2012	7/25/2012	8/8/2012	8/22/2012	9/5/2012	9/19/2012	10/3/2012	10/17/2012	11/14/2012	12/12/2012
	LES	-1050	DNR	DNR	4250	3000	750	691	750	800		865	3500	3350	750	310	DNR	98
	TG	-1550	DNR	DNR	550	650	600		1300	750	4500	1060	3250	1320	2450	475	-315	-295
	TC	-1150	DNR	DNR	800	950	850	635	750	850	750	1050	4438	878	1200	740	-35	-75
	WE	-1150	DNR	DNR	1450		800	650	725	900	1550	1000	2050	1802	1850	850	63	-185
	TR	DNR	DNR	DNR	850			650	750	600	800	725	450	42	100	75	125	DNR

DNR= Did Not Record Deleted as an outlier

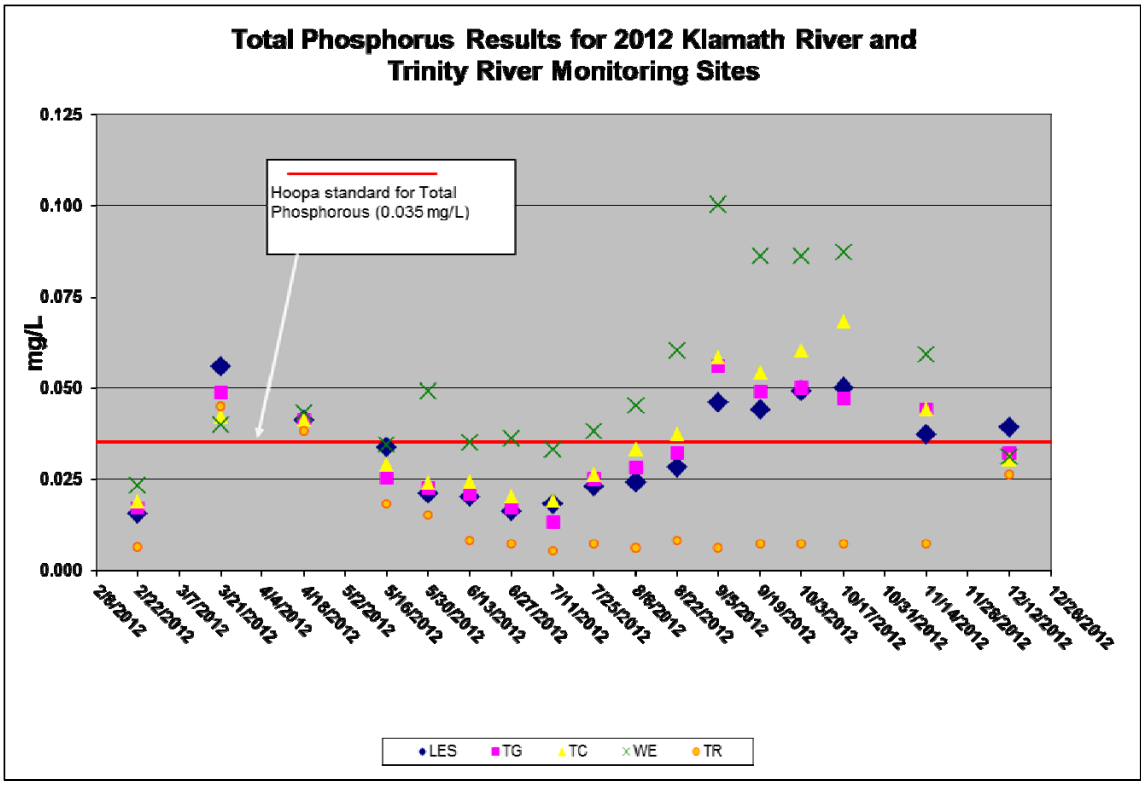

Figure 6-1. Total Phosphorus Results 2012

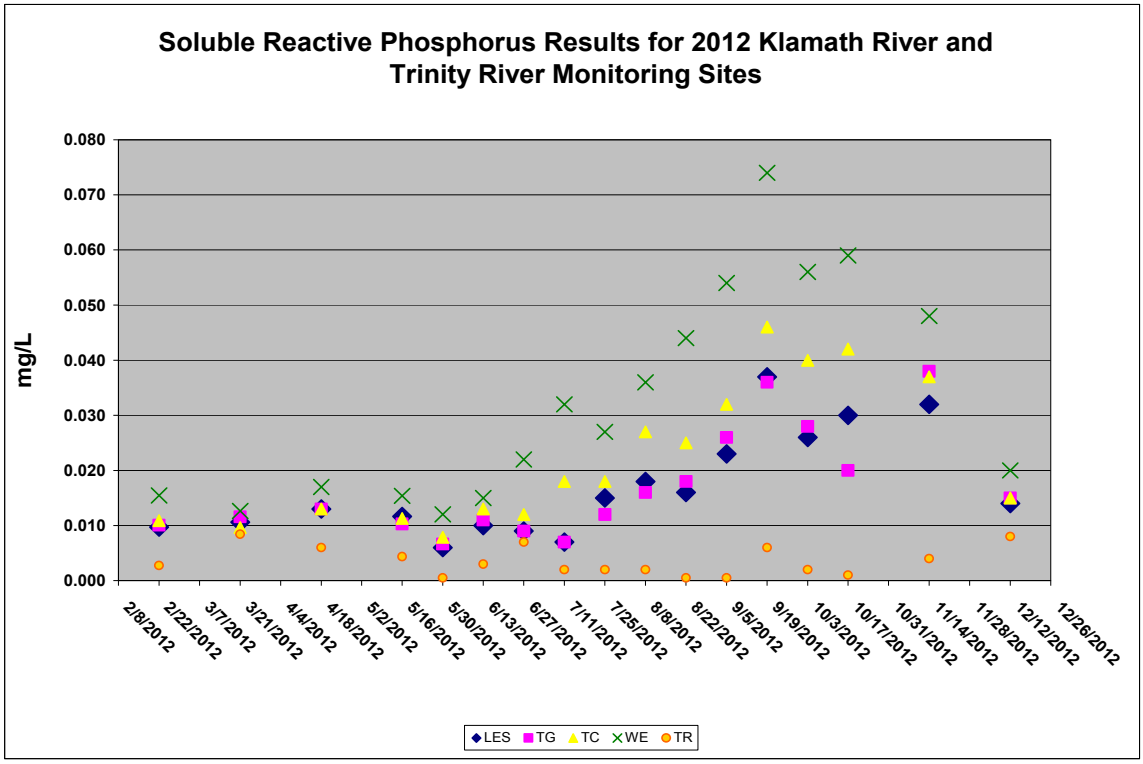

Figure 6-2. Soluble Reactive Phosphorus Results 2012

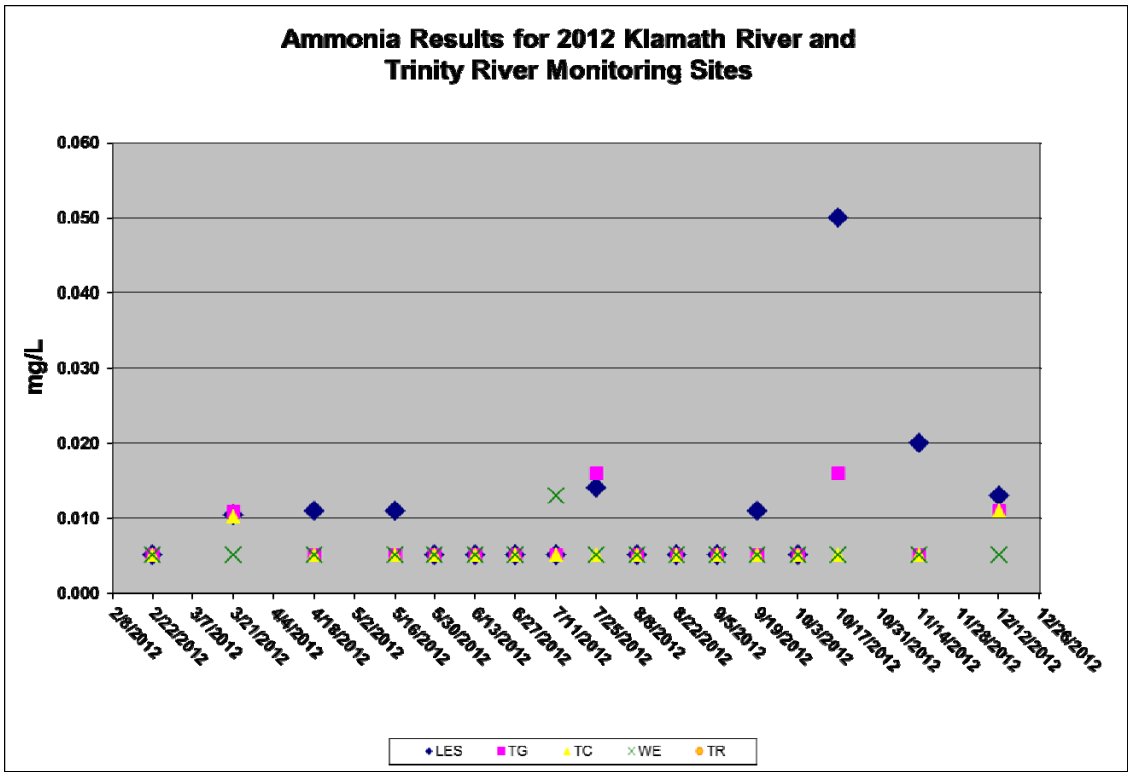

Figure 6-3. Ammonia Results 2012

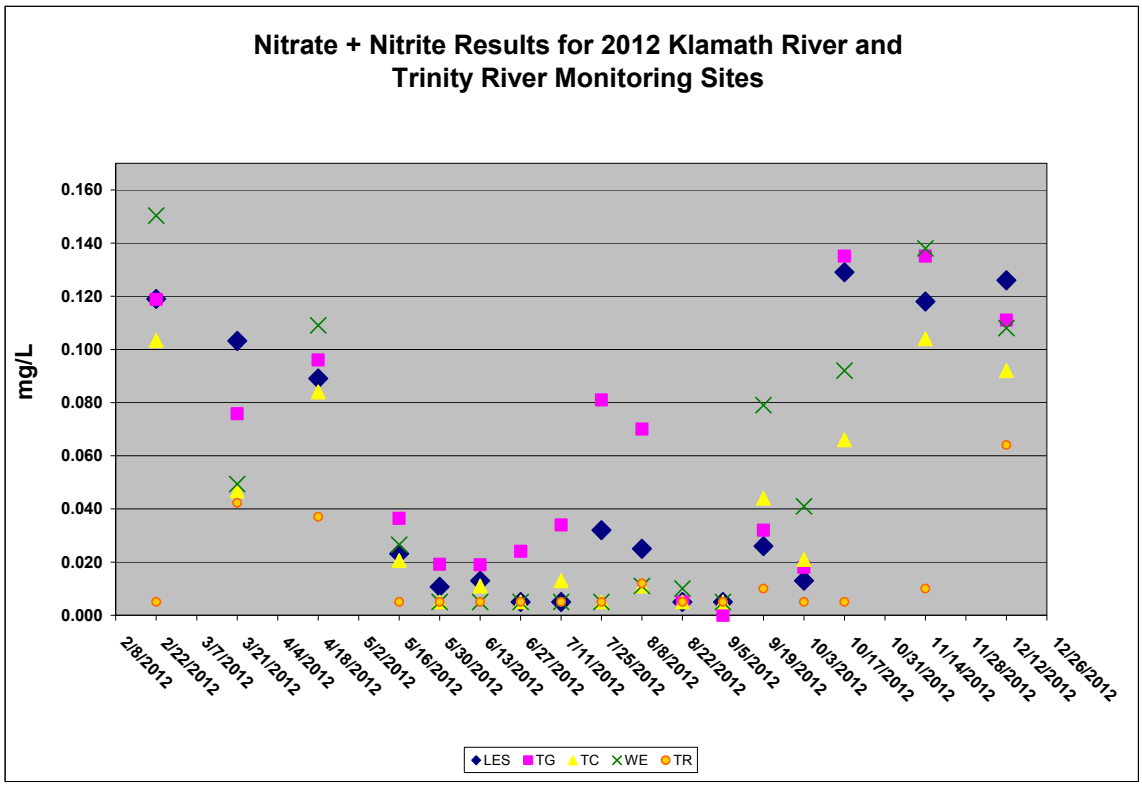

Figure 6-4. Nitrate + Nitrite Results 2012

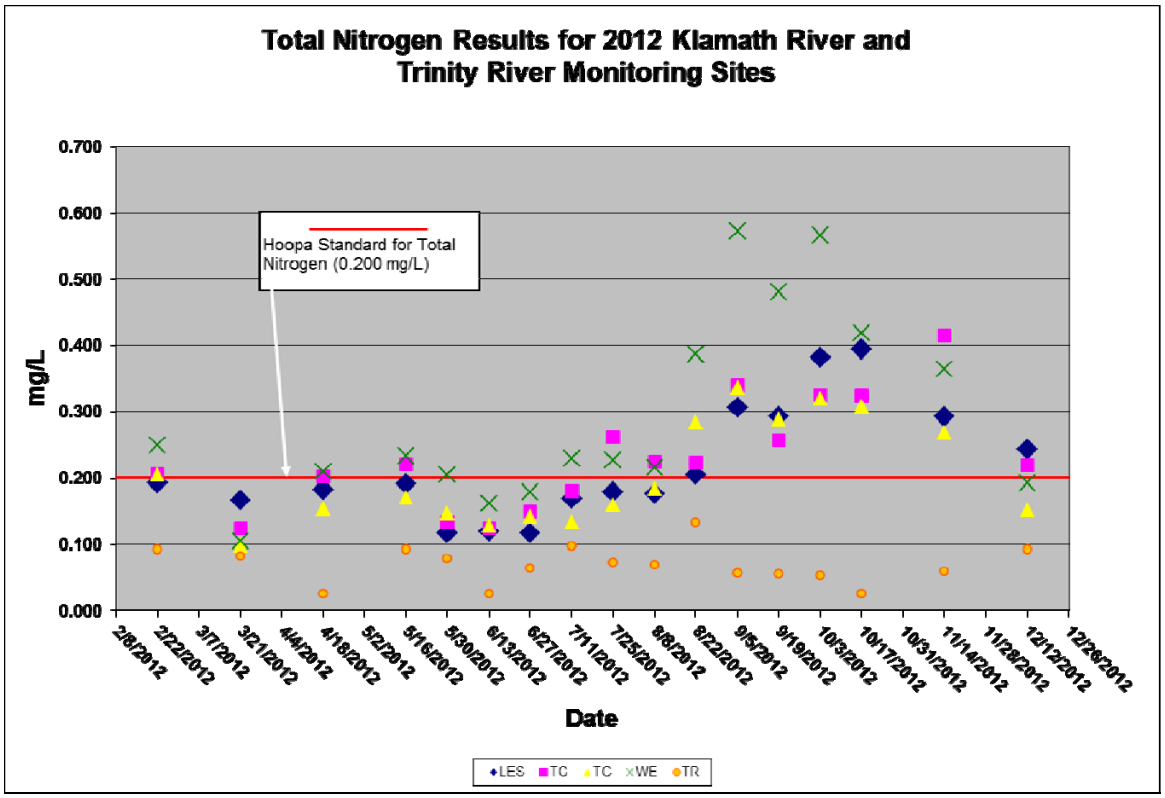

Figure 6-5. Total Nitrogen Results 2012

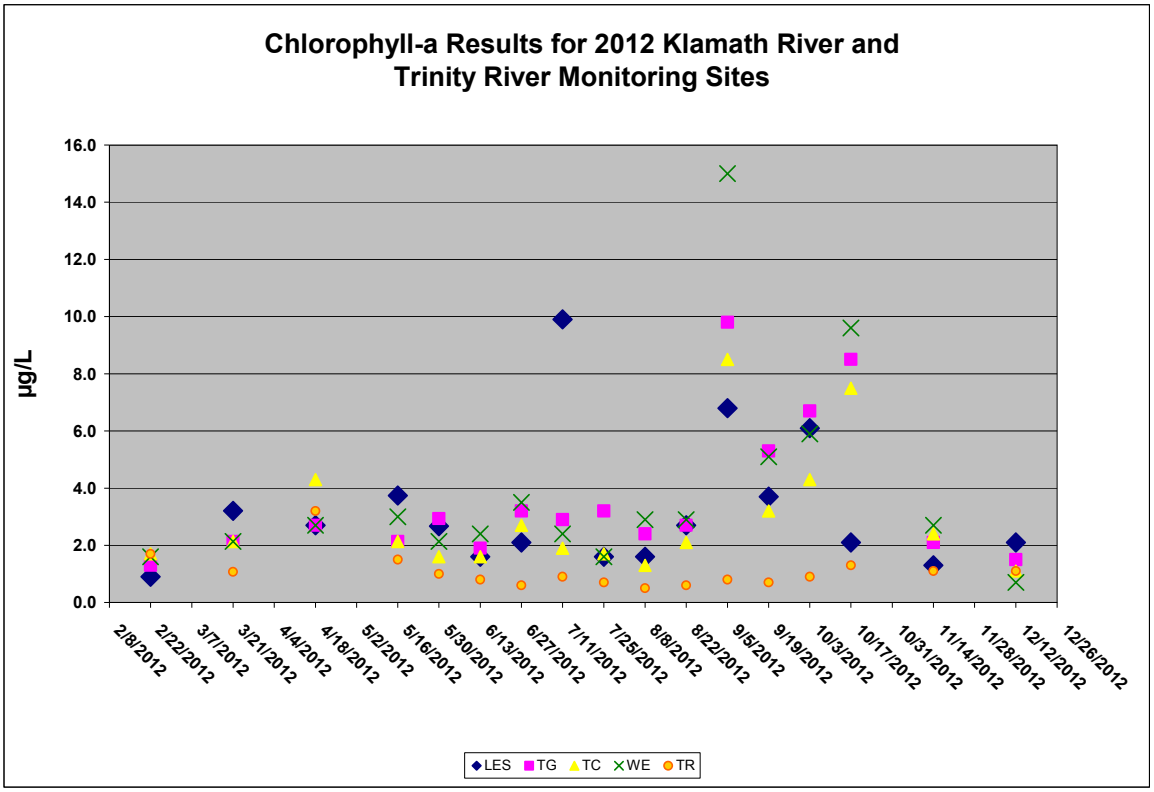

Figure 6-6. Chlorophyll-a Results 2012

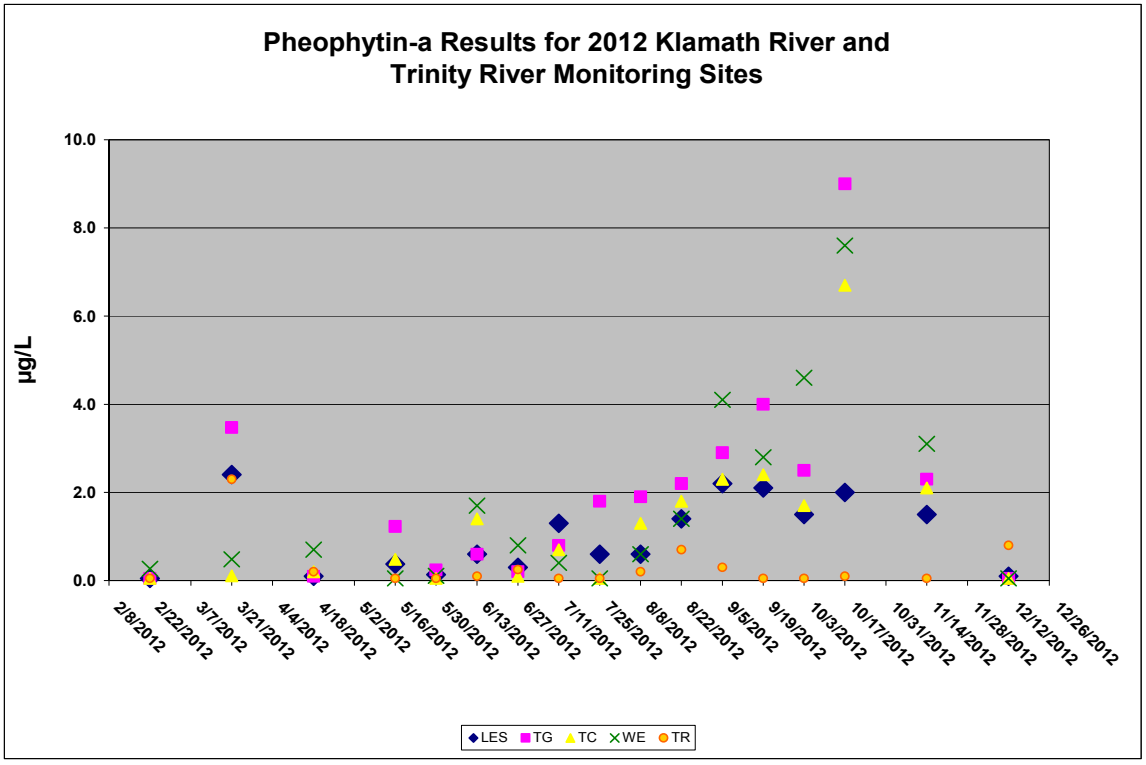

Figure 6-7. Pheophytin-a Results 2012

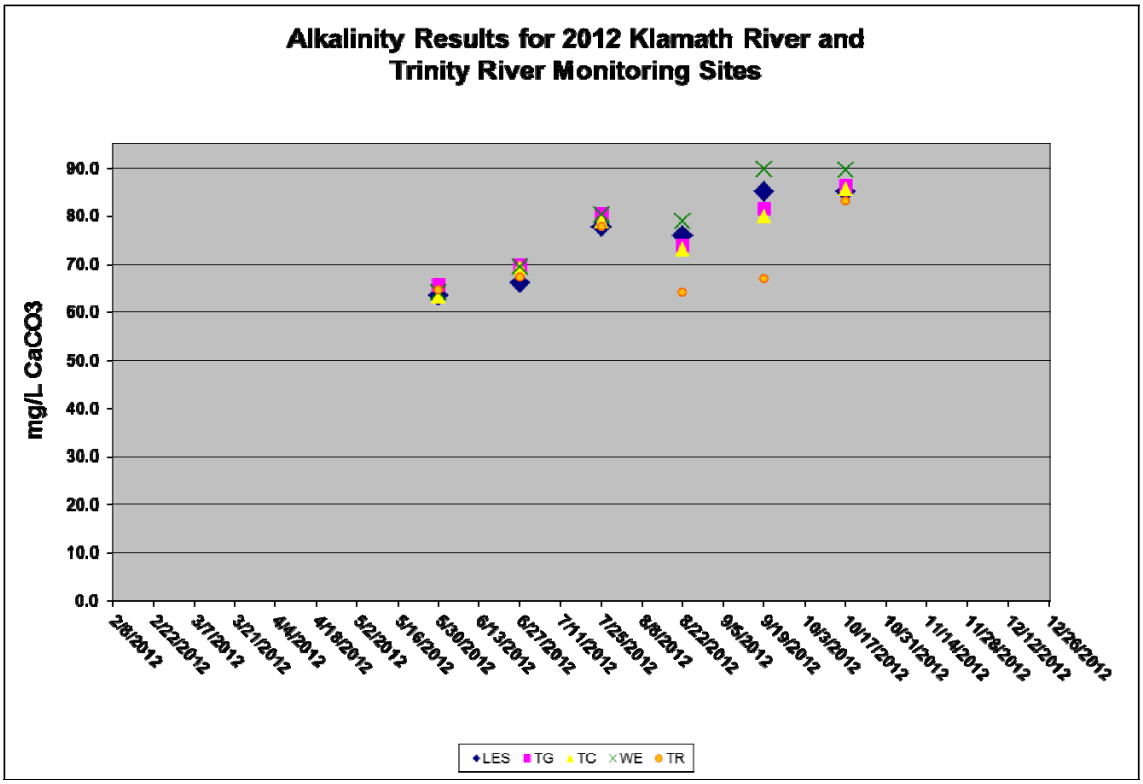

Figure 6-8. Alkalinity Results 2012

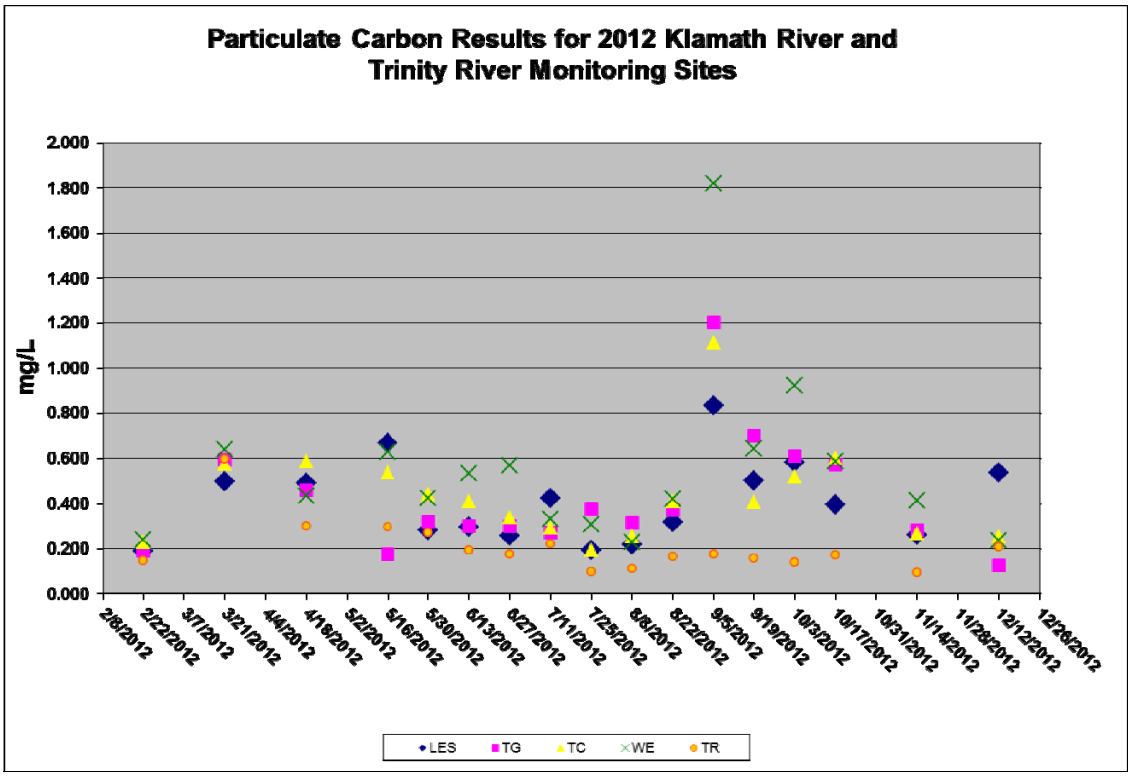

Figure 6-9. Particulate Carbon Results 2012

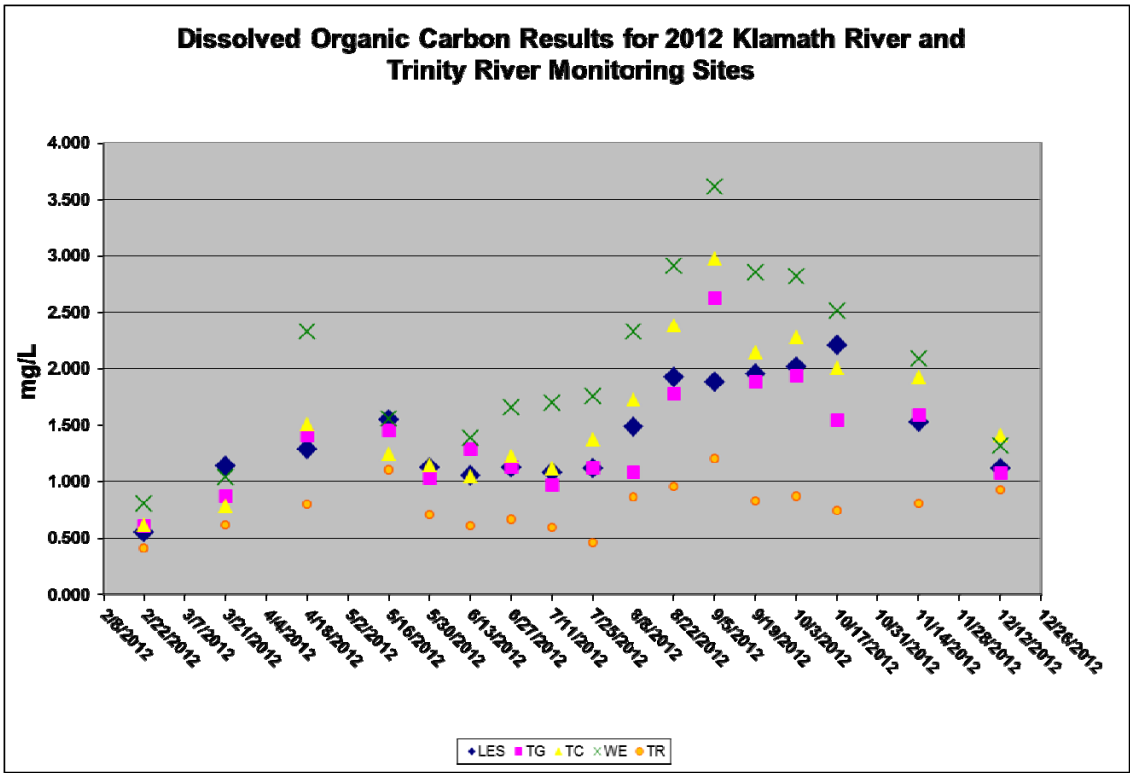

Figure 6-10. Dissolved Organic Carbon Results 2012

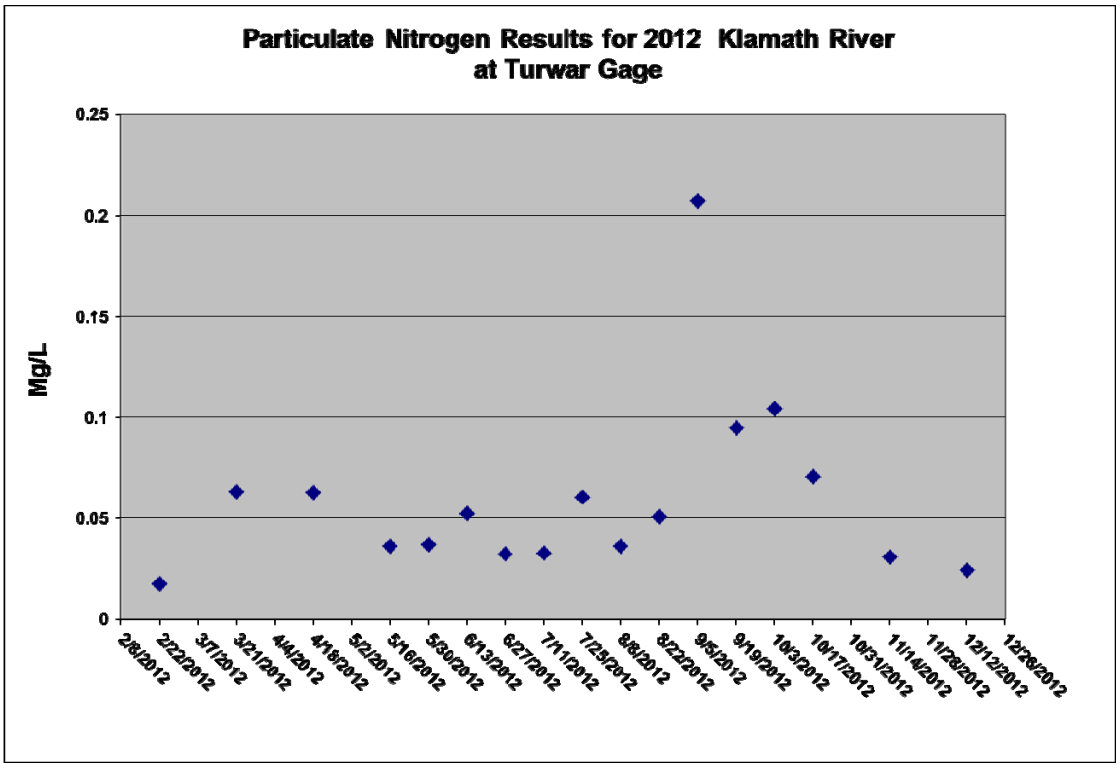

Figure 6-11. Particulate Nitrogen Results 2012

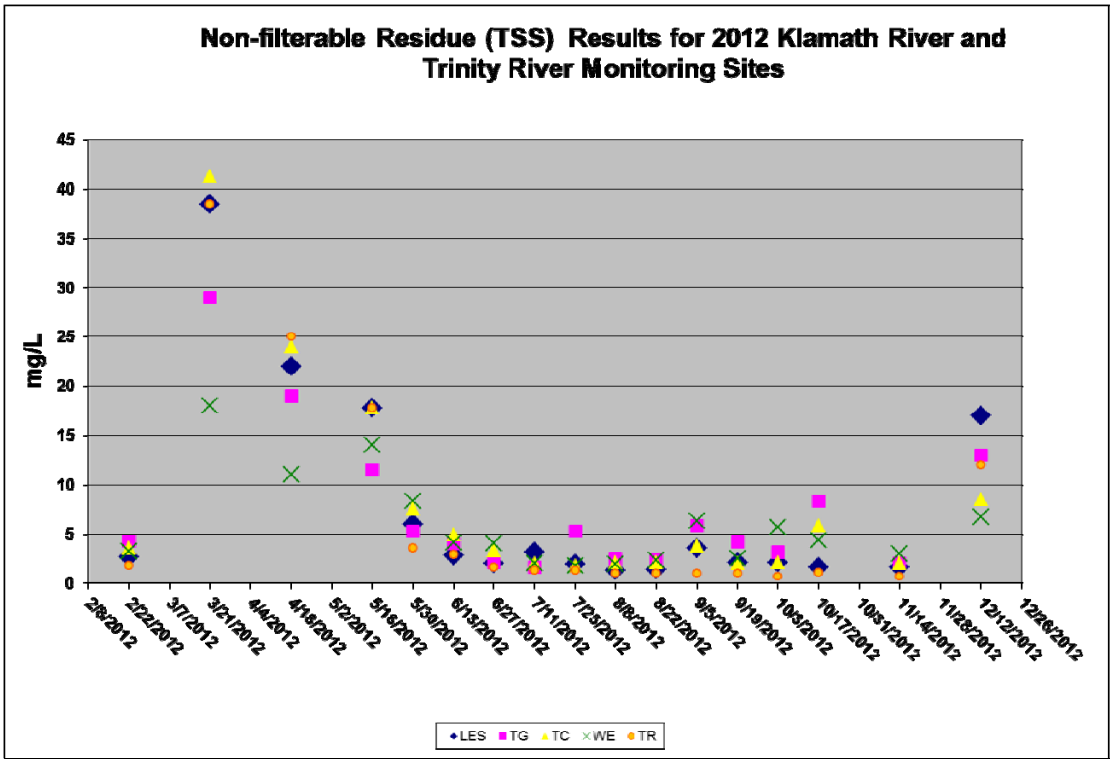

Figure 6-12. Non-filterable Residue Results 2012

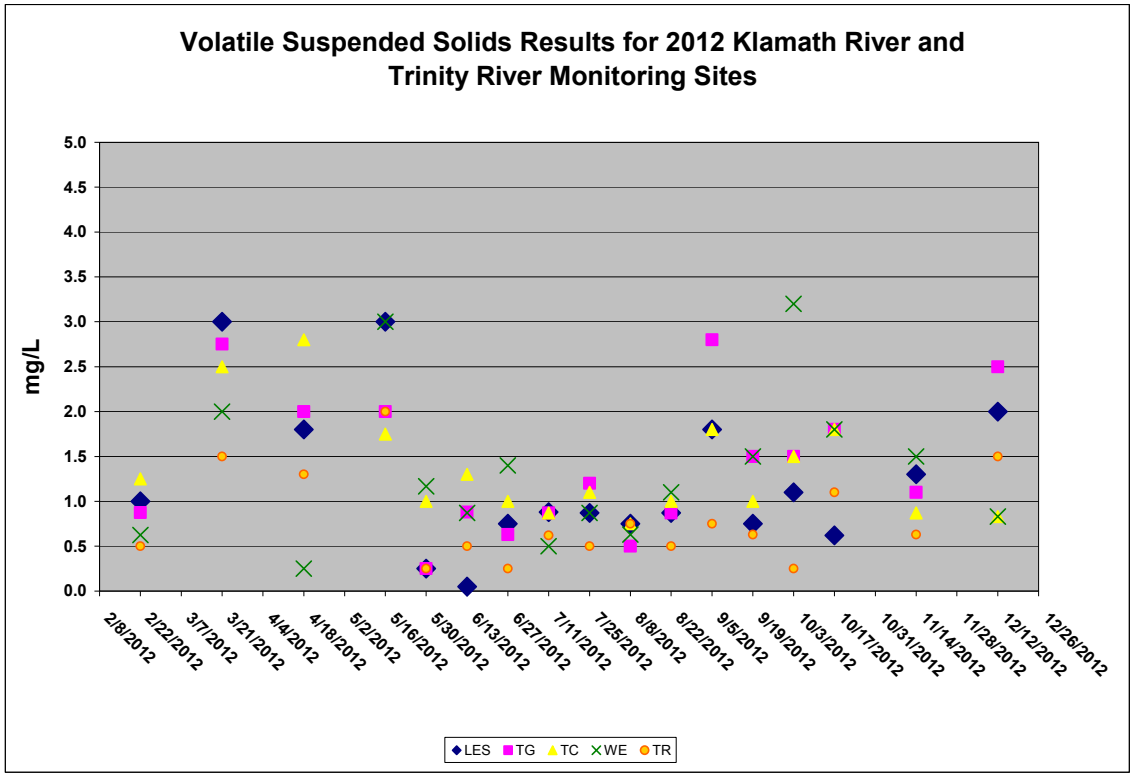

Figure 6-13. Volatile Suspended Solids Results 2012

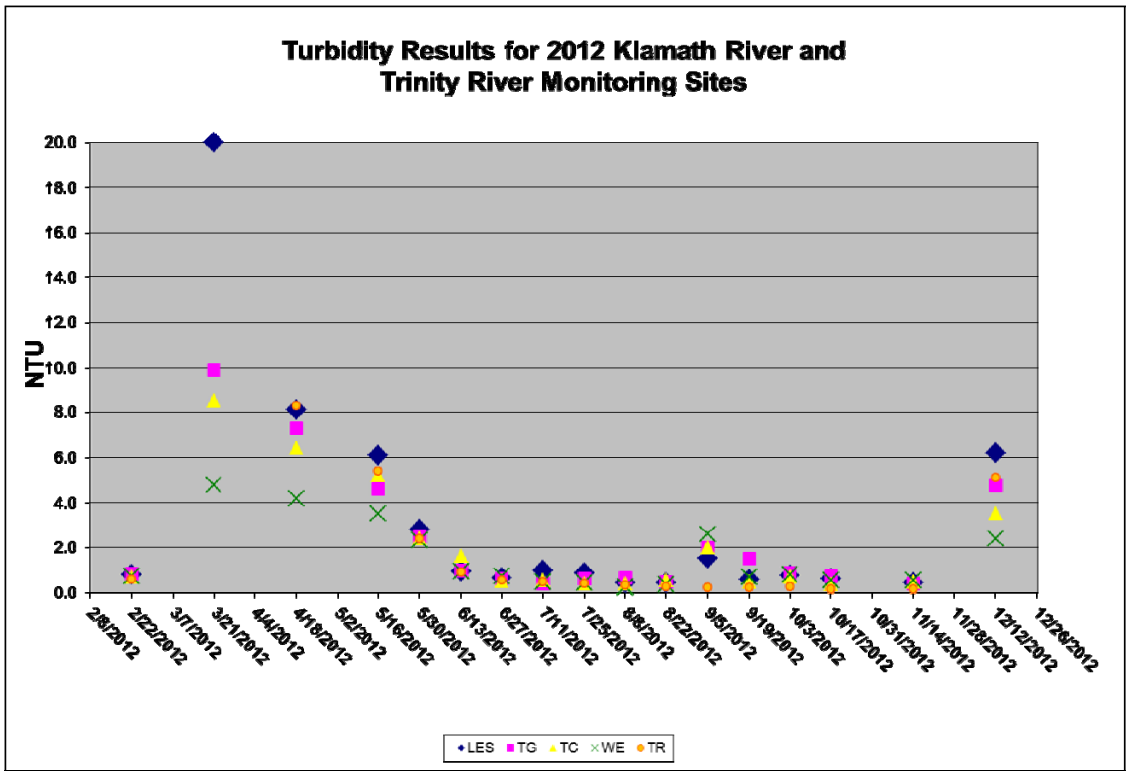

Figure 6-14. Turbidity Results 2012

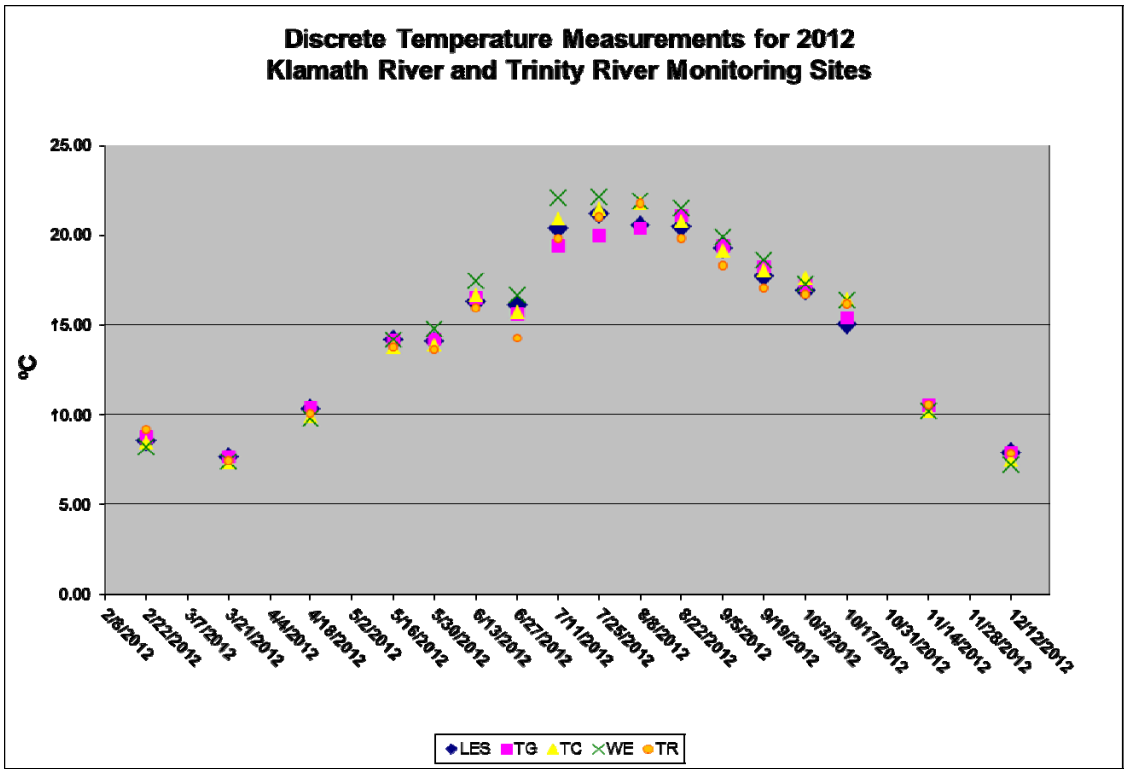

Figure 6-15. Discrete Water Temperature Measurements 2012

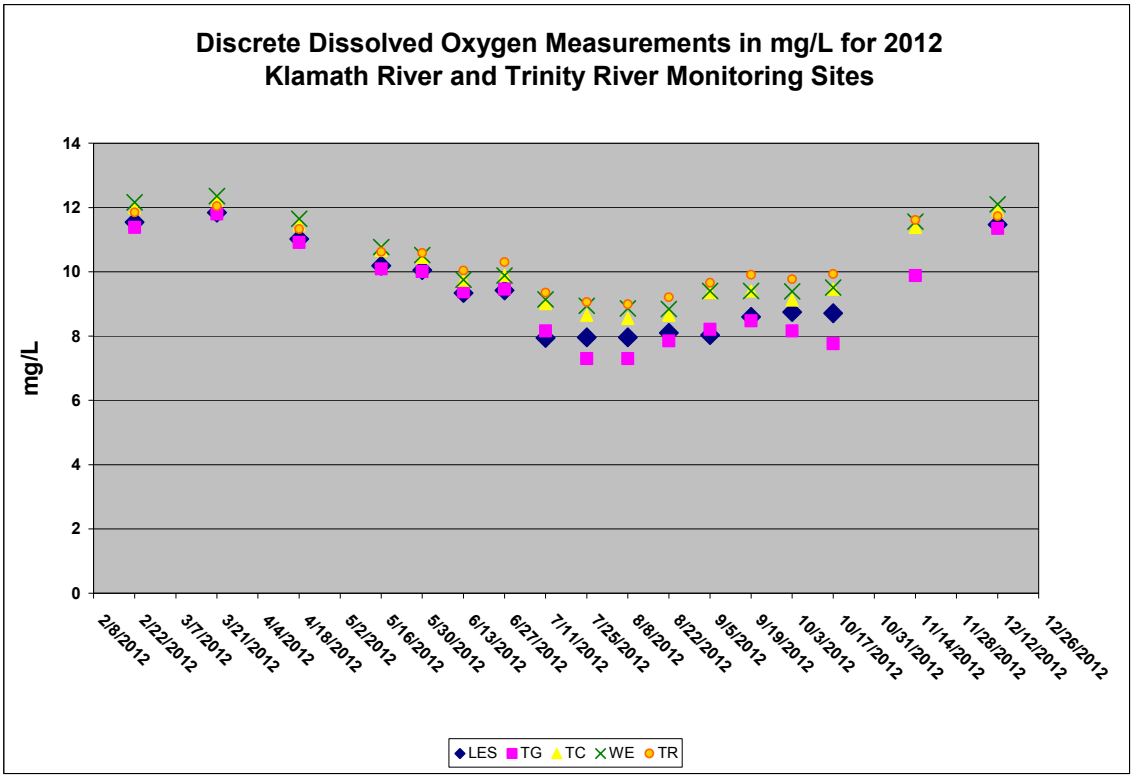

Figure 6-16. Discrete Dissolved Oxygen Measurements in mg/L 2012

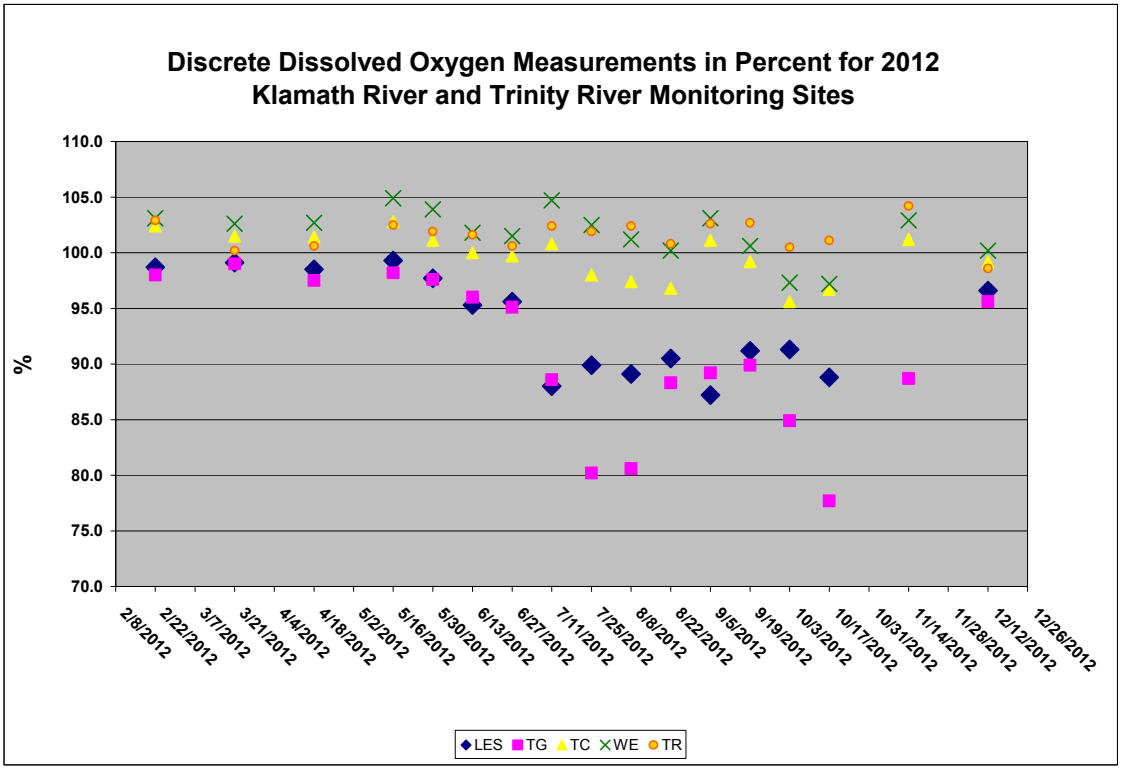

Figure 6-17. Discrete Dissolved Oxygen Measurements in Percent 2012

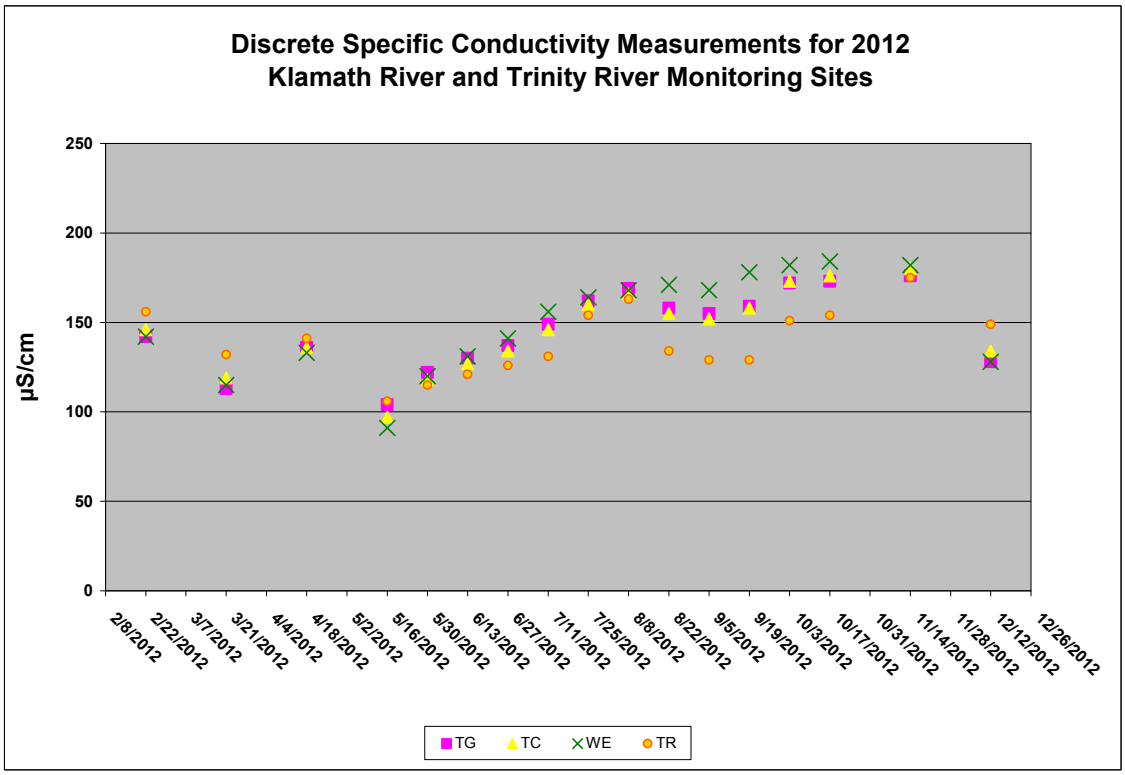

Figure 6-18. Discrete Specific Conductivity Measurements 2012

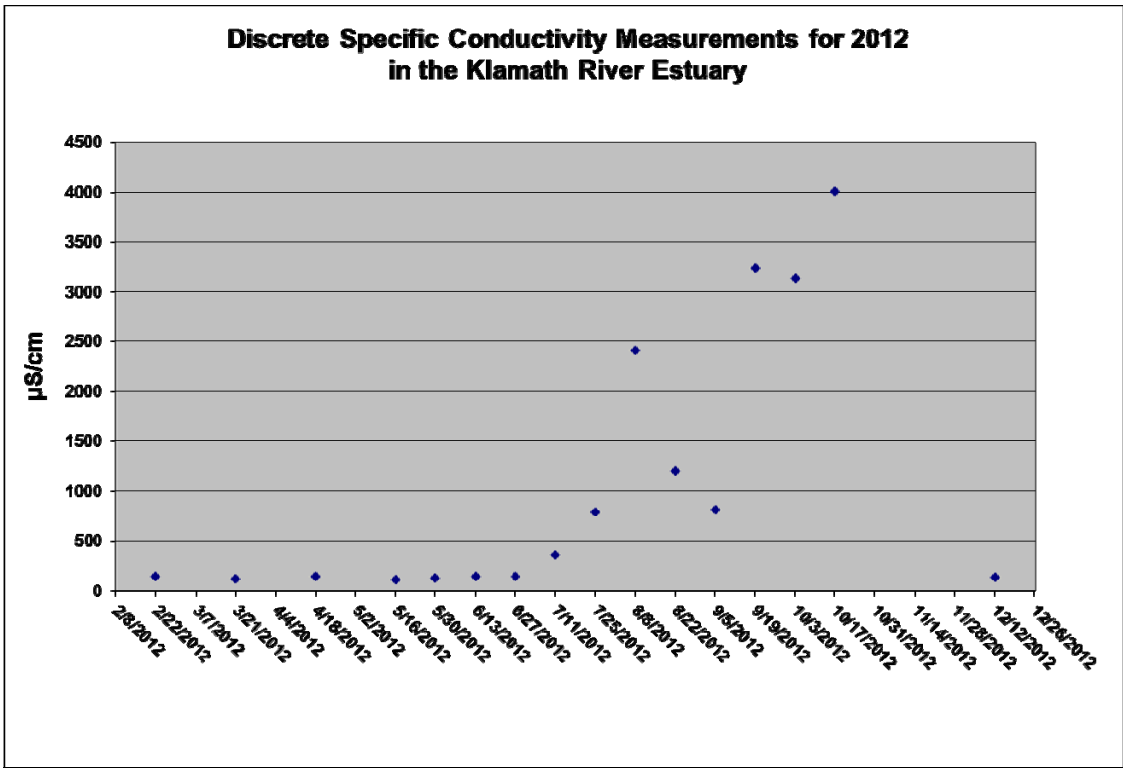

Figure 6-19. Discrete Specific Conductivity Measurements in the Klamath River Estuary 2012

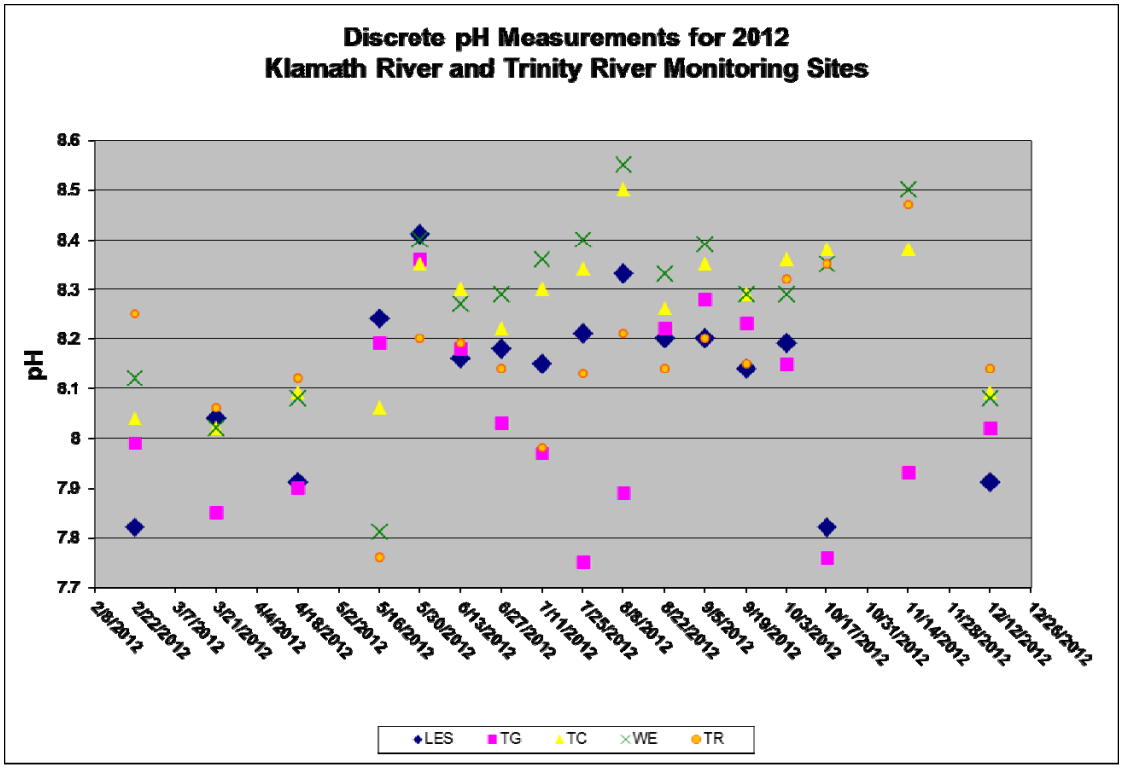

Figure 6-20. Discrete pH Measurements 2012

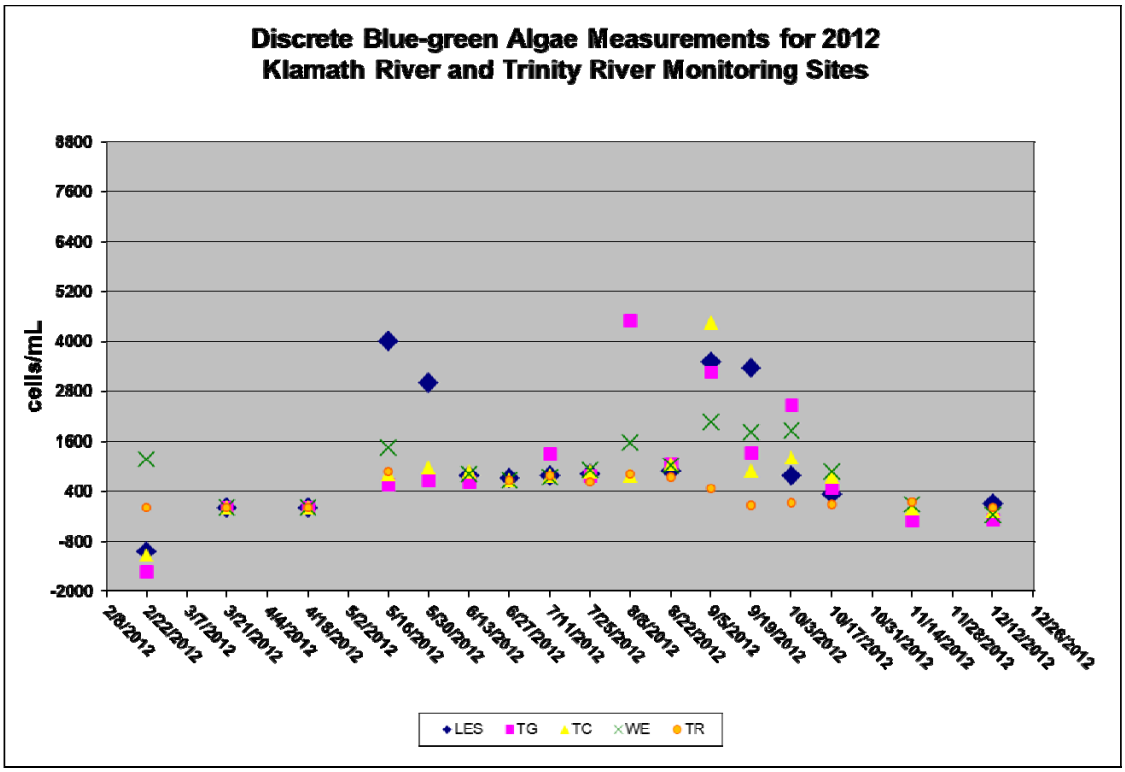

Figure 6-21. Discrete BGA Measurements 2012

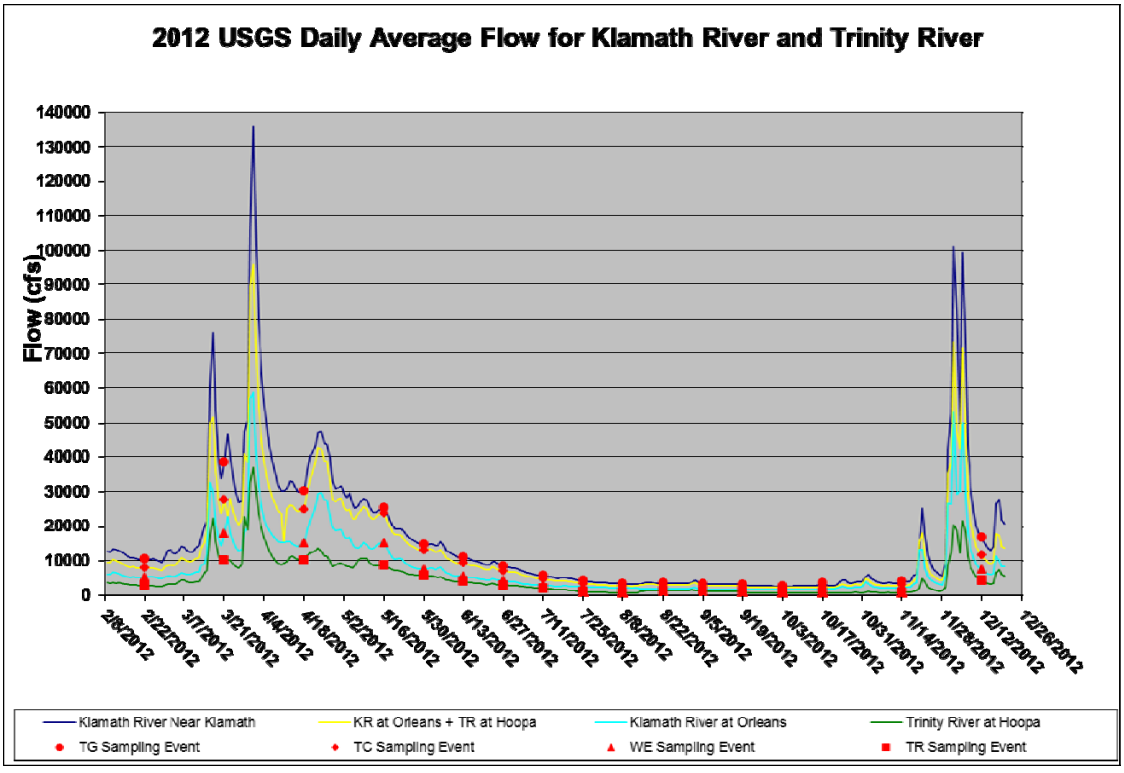

Figure 6-22. Daily Average Flow 2012 (From USGS) with sites superimposed onto flow on dates sampled

VII. Discussion

Organic Carbon

Organic matter plays a major role in aquatic systems. It affects biogeochemical processes, nutrient cycling, biological availability, and chemical transport and interactions. For the 2012 sampling year YTEP calculated total organic carbon (TOC) in house. The change was made in collaboration with other entities in the Klamath Basin that YTEP coordinates sampling events with (Karuk Tribe, Watercourse Engineering, Inc., BOR, PacifiCorp). This decision was made due to the variation involved in analyzing for TOC, which was leading to results which the sampling entities could not be confident in, regardless of the laboratory that analyzed the samples. In YTEP's case, during certain sampling events, dissolved organic carbon (DOC) results were slightly higher than TOC results (see YTEP's 2009 and 2010 Nutrient Summary Report). While not only inaccurate, this prevented YTEP from determining the fraction of particulate organic carbon in the sample.

On May 10, 2011, YTEP began sampling for particulate carbon (PC), which was analyzed by Chesapeake Biological Laboratory in Solomons, MD, while Aquatic Research continued to analyze samples for DOC. Samples were collected in bottles following the standard grab sample protocol (Appendix A), stored on ice, then filtered following the PC filtration protocol (Appendix B) when all samples from all sites had been collected.

Dissolved organic carbon is organic carbon that can pass through a filter. Particulate carbon is carbon in particulate form that is too large to pass through a filter. Except in watersheds dominated by carbonate bedrock, nearly all particulate carbon has found to be organic. Results from samples in the Klamath River, a non-carbonate system, concur with this conclusion. PC was added to DOC to determine TOC for each sampling event in which both parameters were analyzed.

The ratio of PC to TOC fluctuated throughout the year (Table 7-1, Figure 7-1). In February ratios for all sites were close knit from 22 – 27 %. In March ratios showed their largest range, from 30.5% at LES to 49.4% at TR. From April to early July ratios tended to fluctuated between 20-40%. In early July, ratios at all sites except TG dropped into early August. At TG the ratio of PC to TOC dropped in late July, joining other sites at below 20% by late August. From late August to early September ratios increased, decreased slightly in late September. In early October half of the sites increased while the other half decreased, overall forming a tighter grouping. The ratio of PC to TOC declined from early October to mid-November. In December all sites except TR and LES decreased which alternatively rose, LES more than doubled. The highest ratio of PC to TOC was 49.4% at TR on March 21 while the lowest ratio was 8.9% at WE on August 8, 2012. One result for May 30th at WE was discarded due to an outlier for DOC.

The ratio of DOC to TOC fluctuated throughout the year (Table 7-2, Figure 7-2).In February results showed about 75% DOC in TOC. In March results dropped, then rose again in April. From early May to early July results gradually increases, fluctuating around 75% in May to around 80% in July. From late July to early August the ratio of DOC to TOC at all sites except TG increased. From late July to early August TG initially dropped, then increased to the percentage of other sites. . Ratios decreased from late August to early September, increased in late September, then fluctuated around 80% through October. From early October to mid-December the ratio of DOC to TOC increased at all sites except LES, which experience a

significant drop from November to December. The highest ratio of DOC to TOC was 91.1% at WE on August 8, while the lowest ratio of DOC to TOC was 50.6% on March 21, 2012.

Suspended Solids

Suspended solids refer to small solid particles which remain in suspension in water due to the motion of the water. Total suspended solids (TSS) are the amount of filterable solids in a water sample. Samples are run through a filter, which is then dried and weighed to determine the amount of total suspended solids in mg/L of sample. Volatile suspended solids (VSS) are those suspended solids lost on ignition (heating to 550 degrees C). They give an indication of the amount of organic matter present in the solid, suspended fraction of water. Both of these procedures were performed by Aquatic Research Inc. for the 2012 sampling year.

The ratio of VSS to TSS fluctuated throughout the year (Table 7-3, Figure 7-3). Results began ranging from 20%-40% in mid-February. Then for March to early May, ratios were low, fluctuating around 10%. Starting in mid-May the proportion of VSS increased, only to drop again to around 10% in late May. Then in June the percent composition of VSS began to rise until late August/early September. During this period, VSS percentage topped out at 84% for WE, but was around 50% for TC, TG, and LES.After early September, the ratio decreased until early October, then increased in November, dropping to around 10% in mid-December.TR is the exception to this behavior, which had ratios of 100% for VSS in mid-October and November, but dropping to 12.5% in December.

This temporal pattern is to be expected as the quantity of organic matter in suspended solids increases in the summer due to increased biological activity of aquatic organisms and then decreases as the activity of those organisms decreases in the fall and winter. The rain events on March 15th, March 30th and December 4th had considerable impacts on the ratio of VSS to TSS for their subsequent sampling events. While the total amount of both VSS and TSS in the water increased, the ratio decreased, indicating that a smaller portion of the suspended solids in the system was coming from volatile suspended solids.

The highest ratio of VSS to TSS was 100% at TR on October 17 and November 14, while the lowest ratio was 1.8% at LES on June 13 2012. 0

Spatial Patterns

In a large watershed such as the Klamath Basin, in which water coming out of Upper Klamath Lake and that being released from upriver dams in the summer is of low quality, full of organic matter that is live and dead, and high in nutrients; nutrient concentrations decline as the river flows downstream. This decline in nutrient concentration occurs for three reasons: dilution, periphyton growth, and denitrification.

Dilution

This process has the largest effect on the concentration of nutrients in the Klamath River. In general, nutrient concentrations decline as the river flows downstream due to an influx of cleaner, cooler, higher-quality water from tributaries downstream of Iron Gate Dam.

Table 7-1. Ratio of PC to TOC, Yurok Reservation 2012

ratio of PC to TOC	Site	2/22/2012	3/21/2012	4/18/2012	5/16/2012	5/30/2012	6/13/2012	6/27/2012	7/11/2012	7/25/2012	8/8/2012	8/22/2012	9/5/2012	9/19/2012	10/3/2012	10/17/2012	11/14/2012	12/12/2012
	LES	25.7	30.5	27.6	30.2	20.1	21.9	18.6	28.1	14.9	12.8	14.1	30.7	20.4	22.5	15.2	14.6	32.5
	TG	23.8	40.6	24.7	10.8	23.7	18.9	20.9	21.9	25.2	22.5	17.2	31.3	27.1	24.0	27.0	15.0	10.5
	TC	27.2	42.4	28.1	30.2	27.7	28.2	21.6	20.8	12.4	12.8	14.6	27.2	15.9	18.5	23.0	12.2	15.2
	WE	22.8	38.1	15.8	28.8	NS	27.8	25.6	16.3	14.8	8.9	12.5	33.5	18.4	24.6	18.9	16.6	15.2
	TR	26.6	49.4	27.3	21.2	27.7	24.2	20.8	27.3	17.7	11.4	14.8	12.8	16.1	13.8	18.9	10.3	18.4

Table 7-2. Ratio of DOC to TOC, Yurok Reservation 2012

ratio of DOC to TOC	Site	2/22/2012	3/21/2012	4/18/2012	5/16/2012	5/30/2012	6/13/2012	6/27/2012	7/11/2012	7/25/2012	8/8/2012	8/22/2012	9/5/2012	9/19/2012	10/3/2012	10/17/2012	11/14/2012	12/12/2012
	LES	74.3	69.5	72.4	69.8	79.9	78.1	81.4	71.9	85.1	87.2	85.9	69.3	79.6	77.5	84.8	85.4	67.5
	TG	76.2	59.4	75.3	89.2	76.3	81.1	79.1	78.1	74.8	77.5	82.8	68.7	72.9	76.0	73.0	85.0	89.5
	TC	72.8	57.6	71.9	69.8	72.3	71.8	78.4	79.2	87.6	87.2	85.4	72.8	84.1	81.5	77.0	87.8	84.8
	WE	77.2	61.9	84.2	71.2	NS	72.2	74.4	83.7	85.2	91.1	87.5	66.5	81.6	75.4	81.1	83.4	84.8
	TR	73.4	50.6	72.7	78.8	72.3	75.8	79.2	72.7	82.3	88.6	85.2	87.2	83.9	86.2	81.1	89.7	81.6

Table 7-3. Ratio of VSS to TSS, Yurok Reservation 2012

ratio of VSS to TSS	Site	2/22/2012	3/21/2012	4/18/2012	5/16/2012	5/30/2012	6/13/2012	6/27/2012	7/11/2012	7/25/2012	8/8/2012	8/22/2012	9/5/2012	9/19/2012	10/3/2012	10/17/2012	11/14/2012	12/12/2012
	LES	38.1	7.8	8.2	16.9	4.2	1.8	37.5	28.4	45.8	57.7	62.1	51.4	35.7	52.4	38.8	81.3	11.8
	TG	20.6	9.5	10.5	17.4	4.8	22.0	30.0	54.4	22.6	20.0	49.2	48.3	35.7	48.4	21.7	55.0	19.2
	TC	35.7	6.1	11.7	9.9	13.3	26.5	30.3	43.5	61.1	35.7	88.2	47.4	50.0	71.4	31.0	43.5	9.8
	WE	19.2	11.1	2.3	21.4	14.0	21.2	35.0	25.0	48.3	33.2	79.0	84.1	60.0	56.1	41.9	50.0	12.4
	TR	28.6	3.9	5.2	11.3	7.1	17.2	15.6	47.7	38.5	75.0	50.0	75.0	63.0	39.7	100.0	100.0	12.5

Table 7-4. Ratio of PN to TN, Yurok Reservation 2012

ratio of PN to TN	Site	2/22/2012	3/21/2012	4/18/2012	5/16/2012	5/30/2012	6/13/2012	6/27/2012	7/11/2012	7/25/2012	8/8/2012	8/22/2012	9/5/2012	9/19/2012	10/3/2012	10/17/2012	11/14/2012	12/12/2012
	LES	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS
	TG	8.4	50.7	30.9	16.4	27.7	42.1	21.6	18.1	23.0	16.0	22.7	61.1	36.8	32.0	21.9	7.4	10.9
	TC	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS
	WE	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS
	TR	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS	DNS

DNS= Did Not Sample
NS = No Sample for this date

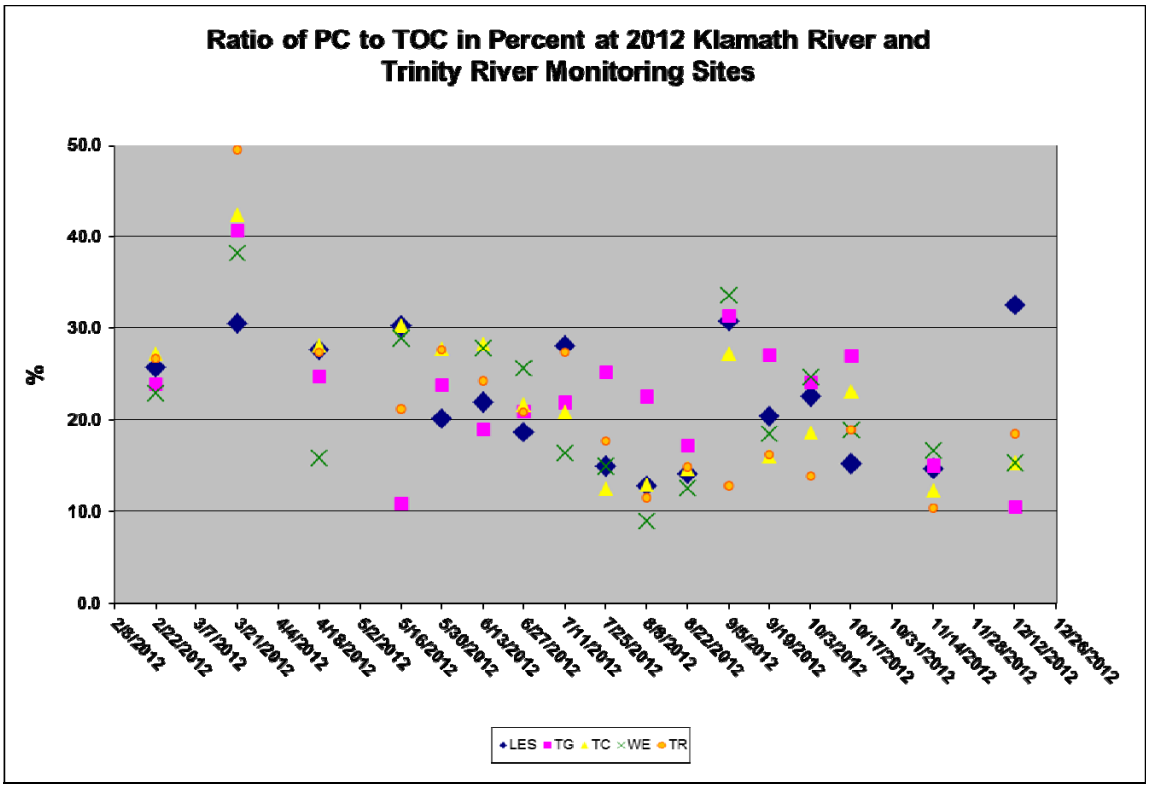

Figure 7-1. Ratio of PC to TOC 2012

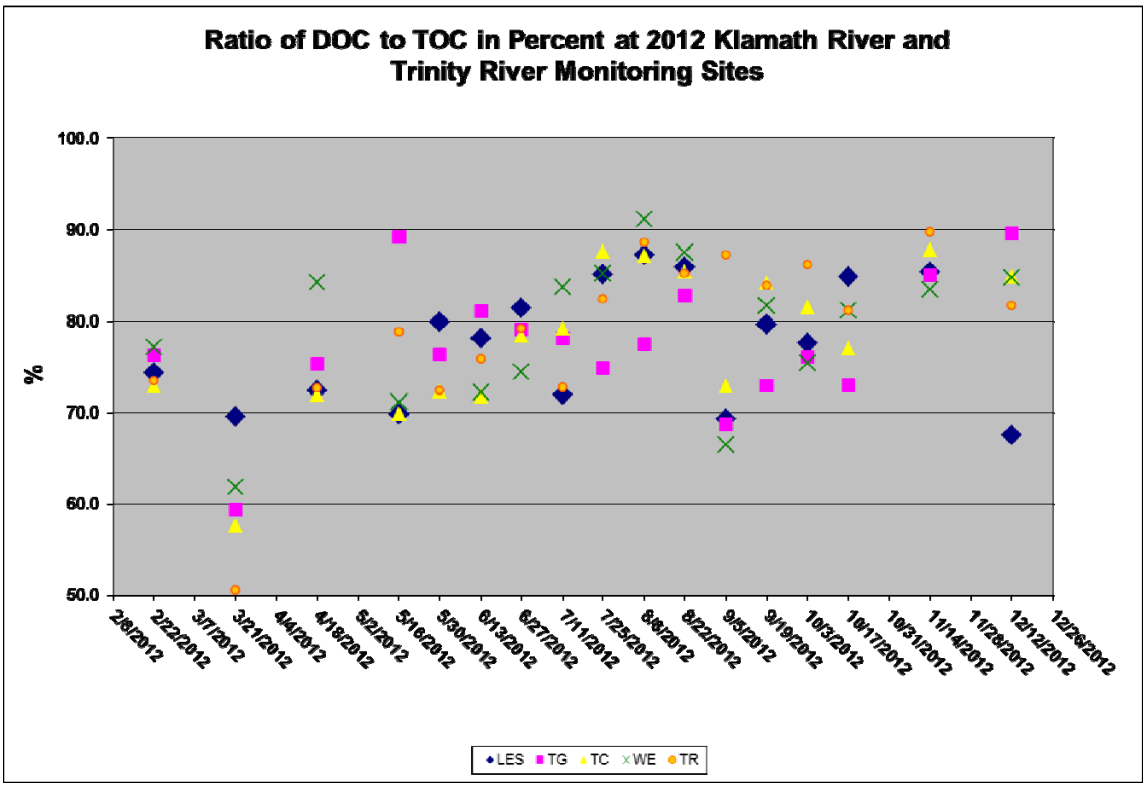

Figure 7-2. Ratio of DOC to TOC 2012

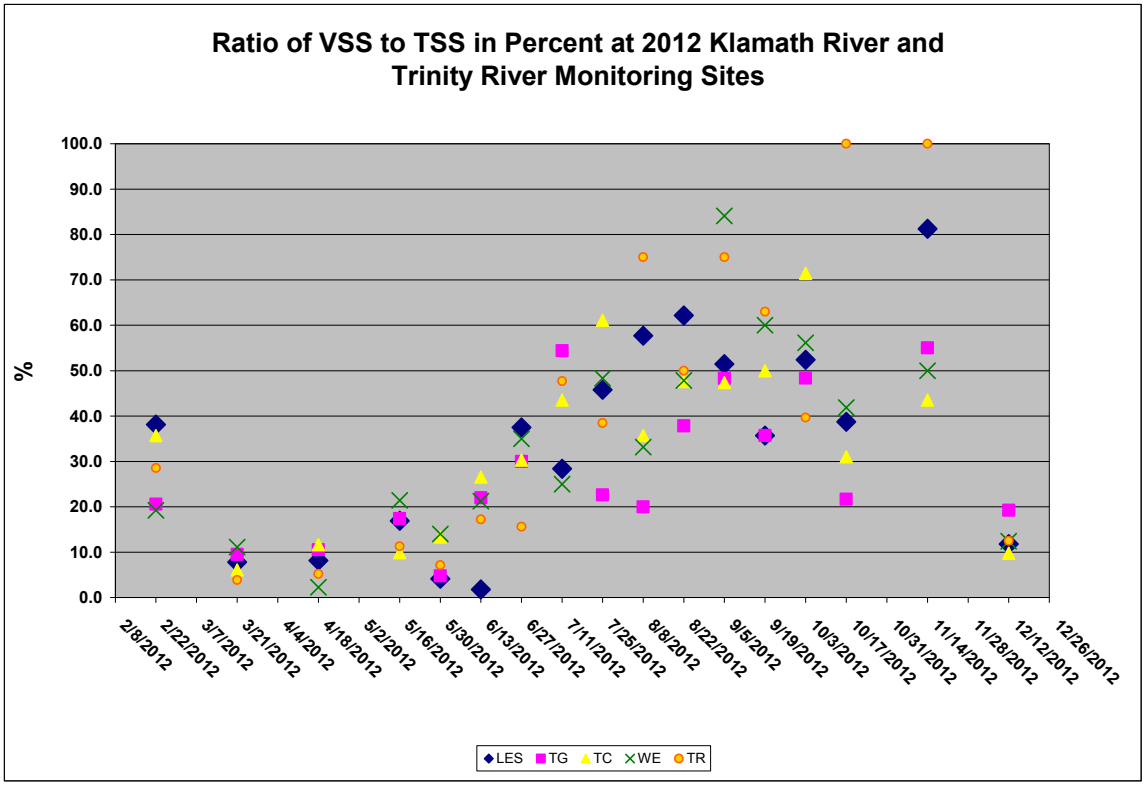

Figure 7-3. Ratio of VSS to TSS 2012

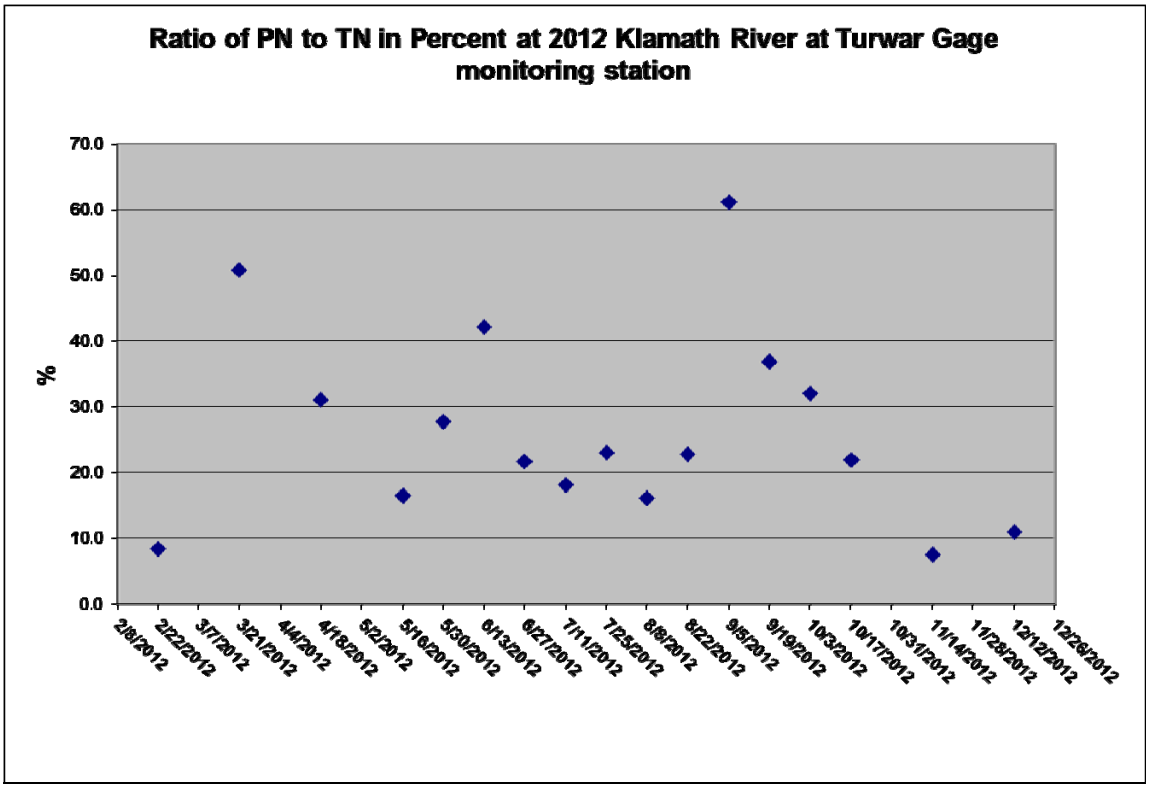

Figure 7-4. Ratio of PN to TN 2012

Periphyton Growth

Periphyton, also known as benthic or attached algae, removes nutrients dissolved in water to facilitate biochemical processes involved in cellular growth. Periphyton can improve water quality by removing nutrients from the water and can also contribute to water quality degradation by re-releasing the nutrients into the river system during decomposition (Water Quality Control Plan: Hoopa Valley Reservation, 2008). Luxuriant periphyton growth also causes large swings in pH and dissolved oxygen over the course of the day as biochemical processes increase and decrease in accordance with the rise and fall of the sun.

Temporal Patterns

The Klamath River's nutrient concentrations also vary over time. In the Klamath Basin, the principal source of nutrient loading in rivers and streams during months with large quantities of rainfall is from runoff originating from agricultural land. In this type of system, an increase in precipitation initiates an increase in runoff and associated streamflows, which subsequently leads to an increase in nutrient concentrations (Mueller et al., 2006; Sprague et al., 2008). The Klamath Basin receives most of its rain from November to April; however, in 2012 a few small rain events occurred in May and June (Figure 6-22). As can be seen in Figures 6-1 through 6-14, concentrations of many parameters increased during the rain events on March 15th, March 30th and December 4th, 2012. The December 4th event, which was the first rain event of the wet season, seems to have acted as a flushing event as parameters increased that did not respond during rain events at other times during the year.

During months with little rainfall, however, the principal source of nutrient loading in the Klamath River is from Upper Klamath Lake. In Upper Klamath Lake the source of nutrients during the spring and summer are largely due to internal loading from lake sediments (Lindenberg et al. 2008). Therefore, a drop in water levels does not correspond with a drop in nutrient levels. As can be seen in Figures 6-1 through 6-14, this corresponds to increasing levels of nutrients, except nitrate plus nitrite, in the Klamath River as the summer progresses and river levels drop.

Nutrient Criteria

In this report, Hoopa Valley Tribal EPA nutrient criteria standards are applied to the information collected in 2012. The Hoopa Valley Tribe has not set standards for all nutrients analyzed by YTEP, therefore, nutrient standards to be discussed will be limited to total nitrogen and total phosphorous.

Total Nitrogen

The Hoopa Valley Tribal EPA has set the water quality standard for total nitrogen at 0.200 mg/L (Table 7-5, red line in Figure 6-5). As can be seen in Table 6-1 and Figure 6-5, total nitrogen concentrations exceeded 0.200 mg/L during the rain event in early December. In mid-March all sites dropped below the standard. All sites except WE and TG remained below until mid-August. WE and TG remained above the threshold in mid-April, dropping below 0.200 mg/L in Late May for TG and early June for WE. In early July concentrations increased gradually until all sites except TR exceeded the limit in mid-August. Concentrations stayed there

until mid-December when TC and WE dropped below the limit while LES and TG hovered above. TR stayed below the standard for the entire 2012 sampling season.

Total Phosphorous

The Hoopa Valley Tribal EPA has set the proposed standard for total phosphorous at 0.035 mg/L (Table 7-5, red line in Figure 6-1). As can be seen in Table 6-1 and Figure 6-1 this threshold was surpassed during the late summer of the 2012 sampling year. All sites resulted in concentration below the standard for mid-February. All sites exceeded standard during the sampling events in mid-March and mid-April, which occurred after rain events of March 15th and March 30th (Figure 6-22). All sites then fell below the threshold in early May. We exceeded the standard in late May, dropping in early June and fluctuating close to the standard through late July. All the other sites stayed below the standard until mid-August, with just TC exceeding the standard in mid-August. From September to mid–November all the Klamath River sites exceeded the limit. In mid-December all Klamath River sites except LES dropped below the standard limit. Throughout the entire 2012 sampling season TR did not exceed the standard of 0.035 mg/L.

Table 7-5. Nutrient Standards for the Klamath River (based on data from Hoopa Valley Indian Reservation)

Parameter	Proposed Standard (mg/L)
Total Nitrogen	0.200
Total Phosphorous	0.035

The results from total nitrogen and total phosphorous indicate that nutrient levels in the Lower Klamath River often exceed water quality standards recognized as acceptable levels to meet beneficial uses.

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Appendix A

Grab Sample Protocol

'Grab sampling' refers to water samples obtained by dipping a collection container into the upper layer of a body of water and collecting a water sample (USGS File Report -00213). For quality assurance/quality control (QA/QC) purposes replicate, and blank bottle sets will be prepared and collected for one site each sampling period. These additional bottle sets will be handled, prepared and filled following the same protocol used for regular bottle sets and samples. General water quality parameters will also be measured with a freshly calibrated portable multi-probe water quality instrument during grab samples and recorded onto data sheets.

Upon arrival at each site, the sampling churn will be rinsed three times with distilled water. The goal of rinsing is 'equipment decontamination – the removal from equipment, residues from construction and machining and the removal of substances adhering to equipment from previous exposure to environmental and other media' (USGS Open File Report 00213). After rinsing with D.I. water, the churn will be rinsed three times with stream water. The churn is then fully submerged into the stream and filled to the lid with sample water. Completely filling the churn allows for all samples to be filled from one churn; thereby minimizing differences in water properties and quality between samples.

Proper use of the churn guarantees the water is well mixed before the sample is collected. The churn should be stirred at a uniform rate by raising or lowering the splitter at approximately 9 inches per second (Bel-Art Products, 1993). This mixing must continue while the bottles are being filled. If filling is stopped for some reason, the stirring rate must be resumed before the next sample is drawn from the churn. As the volume of water in the churn decreases, the round trip frequency increases as the velocity of the churn splitter remains the same. Care must be taken to avoid breaking the surface of the water as the splitter rises toward the top of the water in the churn.

Sample bottles and chemical preservatives used were provided by associated laboratories and were considered sterile prior to field usage. Sample bottles without chemical preservatives were rinsed with stream water from the churn 2-3 times before filling with sample water. In the case of bottles that contained chemical preservatives, bottles were not rinsed before sample collection and care was taken to avoid over-spillage that would result in chemical preservative loss. Collected samples will be placed in coolers on ice or dry ice for transport to contracted laboratories for analysis.

QA/QC – Duplicate, Blank and QA Reference Standard Bottle Sets

To ensure laboratory and sampling accuracy, one site every sampling period was randomly selected to receive two additional QA/QC bottle sets. These bottle sets contains duplicate and blank water samples. Duplicate samples are obtained using the same process as regular samples. This information is used to assure the laboratory maintains precision within results. True blank samples were collected by pouring distilled water straight into the sample bottles. These are disguised so the lab does not know which samples are blank samples. All bottle sets are then placed on ice and are transported to the associated laboratories by mailing a cooler via Fed Ex. All grab samples were processed within 24 hours or within known laboratory holding periods.

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Appendix B

SOP for Particulate Carbon Filtration

1. Get out vacuum pump and flask (should be connected by tubing). Plug in pump.
2. Make sure stopper is placed in opening at top of flask.
3. Lay out sample bottles by site.
4. Get out Whirl-Pak bags, sharpie, sticky labels, and scissors.
5. Get out basin to collect waste water in, can also use sink as basin.
6. Get out waste HCl bottle and funnel to collect waste HCl in.
7. Put on latex gloves and splash apron.
8. Get out squirt bottles with dilute Liquinox, 10% HCl solution, and deionized water and graduated cylinder. Place next to basin/sink.
9. On a separate surface, lay down large sheet of aluminum foil to place filter holder, forceps, etc on.
10. Get out container holding 25 mm filters, place on aluminum foil square.
11. Tear off another, smaller piece of aluminum foil.
12. Using scissors cut out a 3 in. by 3 in. square of aluminum foil from sheet in Step 11.
13. With the dull side up, and without touching the center of the square, fold aluminum foil in half.
14. Fold over the sides that are perpendicular to the side that now has the crease. Fold twice on both sides. You should now have a small pouch that is open at one end.
15. Place pouch on large aluminum foil square.
16. Remove filter holder/funnel from box.
17. Rotate funnel counter-clockwise to disengage funnel from filter holder, being careful not to drop the plastic disc that sits at the top of the filter holder. Place near basin/sink.
18. Remove graduated cylinder from bubble wrap. Place near basin/sink.
19. Remove forceps from bag. Place near basin/sink.

20. Clean filter funnel, filter holder, graduated cylinder, and forceps by squirting with dilute Liquinox, then distilled water, followed by 10% HCl soluting, then dionized water.

21. Place filter funnel, filter holder, graduated cylinder and forceps on large aluminum foil square after they have been cleaned.

22. Using forceps, place one filter on filter holder, concave side up. If the filter is dropped while placing it on the holder, discard and select another filter

23. Being careful to keep filter centered on filter holder, put funnel and filter back together, twist clockwise to lock back into place.

24. Insert base of funnel into hole in stopper until base of filter holder presses against stopper.

25. Select sample bottle from one site and gently swirl to suspend particles.

26. Pour half of the sample into graduated cylinder, swirl again, pour half of remaining sample into graduated cylinder, swirl again, pour remaining sample into graduated cylinder. Tap the bottom of the sample bottle to get remaining drops.

27. Record the volume of sample that poured into the graduated cylinder on the data sheet.

28. Gently swirl the graduated cylinder to keep particles suspended, pour half of sample into filter funnel, swirl, pour half of remaining sample into filter funnel, swirl again, pour rest of sample into filter funnel.

29. While gently holding the filter funnel/holder tightly against the stopper, turn on vacuum pump.

30. Once all of the liquid has been pulled through the filter, allow the pump to keep running in order to slightly dry out filter.

31. Turn off vacuum pump.

32. If filter is light brown/tan color, proceed to Step 33. If not, return to Step 22 and follow procedure to filter another sample bottle.

33. Remove filter funnel/holder from stopper. Remove slowly to slowly release pressure.

34. Rotate funnel counter-clockwise to disengage funnel from filter holder.

35. Place filter funnel on large aluminum foil square.

36. Using forceps with pointed ends, loosen filter by gently putting one side of forceps under edge of the filter and running the forceps around circumference of filter.

37. Use forceps to fold filter in half, with the suspended material on the inside. Be careful not to remove material with the forceps. This works best with two people. One person carefully folds the filter in half with the pointed forceps. Once the filter is folded in half, the other person gently presses down the filter at the crease with the flat pair of forceps. The second person then pinches the filter together to keep the part with the suspended material on the inside. The first person then lets go.

38. Place filter in aluminum foil pouch.

39. We need two filters per site so repeat Steps 22-37 to get another filter.

40. Label filter pouch with Site ID, Date, and volume filtered per pad using labels.

41. Place aluminum foil pouch in Whirl-Pak bag and seal bag.

42. Place Whirl-Pak bag with filter in freezer.

43. Clean filter funnel and graduated cylinder by squirting with dilute Liquinox, making sure Liquinox is draining into waste basin.

44. Thoroughly rinse with distilled water, allowing water to drain into waste basin.

45. Wash filter funnel with 10% HCl solution, collecting waste into waste HCl bottle.

46. Thoroughly rinse filter funnel and holder with deionized water, collecting waste into waste HCl bottle.

47. Repeat Steps 22-46 for every site that was sampled for Particulate Carbon.

48. Once all sites have been sampled, place all of the Whirl-Pak bags into a ziplock bag.

49. If this is occurring on Wednesday or later in the week, store samples in freezer so they can be mailed at a later date.

50. If the samples will be sent off that day, fill small cooler with double-bagged ice and place the samples on top of the ice. Do not place ice on top of the samples.

51. Place a copy of the datasheet and COC in cooler, tape shut, and ship overnight to:

    Carl Zimmermann or Jerry Frank

    Chesapeake Biological Laboratory

    1 Williams Street

Solomons, MD 20688

NOTES:
Bring the amber glass bottles back to the lab to be cleaned for the next sampling event.