

KARUK TRIBE

DEPARTMENT OF NATURAL RESOURCES
P.O. Box 282 * Orleans, California 95556



2008 WATER QUALITY ASSESSMENT REPORT



**KLAMATH RIVER, SALMON RIVER, SCOTT
RIVER, SHASTA RIVER, AND BLUFF CREEK**



The seal of the Karuk Tribe is a circular emblem. The outer ring contains the text "THE KARUK TRIBE OF CALIFORNIA" at the top and "NATURAL RESOURCES" at the bottom. The inner circle depicts a landscape with a river, trees, and a person on a boat. The seal is rendered in a light gray, semi-transparent style.

Karuk Tribe

Water Quality Assessment Report
2008

Prepared by
Karuk Tribe
Water Quality
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KARUK TRIBE

KLAMATH RIVER, SALMON RIVER, SCOTT RIVER, SHASTA RIVER & BLUFF
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WATER QUALITY ASSESMENT REPORT
JANUARY - OCTOBER 2008

1 BACKGROUND

The Karuk Tribe is the second largest Tribe in California, with over 3,500 Tribal members currently enrolled. The Karuk Tribe is located along the middle Klamath River in northern California. Karuk Ancestral Territory covers over 90 miles of the mainstem Klamath River and numerous tributaries. The Klamath River system is central to the culture of the Karuk People, as it is a vital component of our religion, traditional ceremonies, and subsistence activities. Degraded water quality and quantity has resulted in massive fish kills, increased populations of toxic algae, and pandemic fish diseases, in addition to the extreme limitations and burdens applied to our cultural activities.

2 PURPOSE

It is the mission of the Karuk Tribe to protect, promote, and preserve the cultural, resources, natural resources, and ecological processes upon which the Karuk People depend. This mission requires the protection and improvement of the quality and quantity of water flowing through Karuk Ancestral Territory and Tribal trust lands. The Karuk Tribe's Department of Natural Resources has been monitoring daily water quality conditions in the Klamath River since January of 2000 and tributaries to the Klamath River since 1998. The Karuk Tribe has been collaboratively involved in maintaining water quality stations along the Klamath River and its tributaries with the United States Fish and Wildlife Service (USFWS), the United States Geological Survey (USGS), and the Yurok Tribe.

This data is important to state and federal processes currently underway and provides information for Tribal Council and resource managers to make informed decisions. The Klamath Hydroelectric Project (KHP) is undergoing relicensing by the Federal Energy Regulatory Commission (FERC). Along with this process both Oregon and California will have to issue 401 certifications for the KHP. The North Coast Regional Water Quality Control Board (NCRWQCB) is developing and/or implementing Total Maximum Daily Loads (TMDL's) for the Scott, Shasta, Salmon, and Klamath Rivers. Tribes, counties, and the state of California have developed draft guidance for public health for a toxic blue green algae *Microcystis aeruginosa* and associated toxin microcystin. The water quality data the Karuk Tribe collects is essential to providing quality data regarding processes that involve and affect the Karuk Tribe.

The purpose of this study is to monitor the quality of water flowing into and out of Karuk Ancestral Territory and Tribal trust lands. The information produced allows the Karuk Tribe to give valuable input on land management decisions and demonstrates the Tribe's commitment to sound resource management. The data produced is indispensable in monitoring water quality conditions within the Klamath River System. We are building a long-term monitoring data set that lets us track these conditions and monitor for improvement. During 2008, Karuk Water Quality employees performed all data collection, QA/QC, and database management. Funding

for this project has come mainly through the Karuk Tribe's EPA 106 Water Pollution Control Program with some support from the US Bureau of Reclamation (USBOR).

3 MONITORING METHODS & QA/QC Summary

Monitoring Methods

The Karuk Tribe monitored seven water quality stations in the summer of 2008 and two sites in the winter of 2008. Summer monitoring sites included the Klamath River near Orleans, the Klamath River near Seiad Valley, the Klamath River below Iron Gate dam, and the Scott, Salmon and Shasta Rivers. Parameters collected included water temperature, dissolved oxygen (DO), pH, specific conductance, blue green algae (BGA), and nutrients. These parameters were measured using YSI 6600 V2 multiparameter probes, which collected the aforementioned parameters every half-hour. The Orleans and Seiad sites were linked to satellites to allow real time monitoring via the Internet. This was accomplished by collaboration with USGS and the Yurok tribe. Nutrient data was obtained weekly in the mainstem Klamath and monthly in the tributaries, using grab samples that were then analyzed by an independent lab. A multiparameter probe was not deployed at the Klamath River at Walker Bridge site, spot measurements of temperature, DO, pH, and specific conductivity were collected with each nutrient sampling event.

The 2008 winter turbidity data was collected using HydroLab DataSonde 4a multiparameter instruments; Turbidity measurements were taken every half hour using an optical turbidity probe. Sites for winter monitoring included Bluff Creek and Salmon River.

Water quality monitoring sites utilizing multiparameter probes were visited at biweekly intervals. At this time audits were performed with a Hydrolab Quanta, a hand-held water quality instrument. The audits allowed field personnel to compare Quanta and YSI or HydroLab readings taken before and after calibration. Calibration of the YSIs and HydroLabs was performed in the field to minimize the amount of time the instruments were out of the water and thus not collecting data. Water quality probes were calibrated and serviced according to Karuk Quality Assurance/Quality Control protocol adopted from USFWS and Yurok protocols. These calibrations followed the specific manufacturer's instructions as outlined in the section 2.6.1 *Calibration Procedures*¹ of the YSI manual and the *Maintenance, Calibration and Storage*² section of the HydroLab manual. During these regular visits, data was downloaded from the probes, brought back to the office, and reviewed.

QA/QC

The Department of Natural Resources Water Quality Program developed an EPA-approved Quality Assurance Project Plan (QAPP) to ensure that data generated from environmental measurement studies are technically sound and legally defensible. The QAPP summarizes procedures to be followed in administering federally funded programs that involve measurement of environmental parameters. The QAPP applies to special water quality studies involving

¹ YSI Incorporated. "Calibration Procedures." 6-Series Environmental Monitoring Systems Operations Manual.

² Hydrolab, Corporation. "Maintenance, Calibration and Storage." DataSonde 4 and MiniSonde Water Quality Multiprobes User's Manual. Revision G. 1999.

surface and ground water bodies, as well as to surveillance and compliance monitoring of discharges.

Briefly, the QAPP requires that (a) physical and professional capabilities be adequate to perform the analysis for all parameters in the sampling plan; (b) sample collection, handling, and preservation be conducted according to EPA manuals; (c) time-sensitive samples be transported and analyzed within specific holding times; (d) sample integrity be provided for a legal chain of custody of samples collected for support of enforcement actions; (e) analytical methods be in accordance with standardized methods; and (f) analytical quality control procedures be established for intra-laboratory checking of reference samples. Laboratory records including reference sample results are to be available for EPA.

A detailed description of our QA/QC is available in our QAPP; however a brief summary for our YSI and HydroLab monitoring data follows. For monitoring with YSIs and HydroLabs, QA/QC was performed in both the field and the office. Every two weeks in the field, probes were examined, cleaned, and calibrated. In the office, data was reviewed to help locate failed probes or other malfunctions in a timely manner. Daily values (based on at least 46 of 48 measurements since data was collected in ½ hour intervals) were obtained utilizing an Excel spreadsheet. If there were less than 46 measurements for a 24-hour period that day's data was not used in the daily maximum, mean, and minimum calculations. In 2008, optical dissolved oxygen (DO) probes were utilized on all YSI instruments thereby eliminating the 24-hour "rest" period associated with the Clark's membrane probe used in previous years. All data collected has gone through QA/QC, outliers and instances of improper calibration were removed from further analysis.

4 WATER QUALITY PARAMETERS

Water quality data collected included water temperature, dissolved oxygen, pH, specific conductivity, BGA, total nitrogen, total phosphorus and turbidity. These parameters are outlined and described below. Karuk tribal water quality standards are included where applicable.

4.1 Water Temperature

Water temperature varies both seasonally and diurnally (within a twenty-four hour period). Elevated temperatures may lead to increased metabolic rates in organisms, algal growth, and increased fish susceptibility to disease. Many factors can affect stream temperature, including discharge, air temperature, the amount of shaded cover (which significantly influences smaller streams), contribution of snow melt and springs (or cold water tributaries), aspect, amount of runoff from human influenced areas, smoke cover from summer wildfires, and the length the stream must travel.

Temperature has an impact on many beneficial uses in the Klamath River, including cold-water fish, subsistence fishing, cultural use, and recreational use. A common method to assess water temperature for streams that support salmonid populations is to compare sustained water temperatures to an acute and chronic temperature standard. The acute standard represents the lethal temperature for salmonids . The chronic temperature designation represents the maximum weekly average temperature (MWAT), which is the upper limit for optimum growth for

salmonids. The Karuk Tribe's water quality objectives have set the maximum temperature threshold at 21°C and MWAT of 15.5°C³.

4.2 Dissolved Oxygen

Dissolved oxygen (DO) varies both seasonally and diurnally, particularly in the summer when photosynthesis adds oxygen to the system during the day and respiration consumes it at night. In cold water, oxygen is more soluble; therefore the amount of available oxygen for salmonids is greater. Oxygen levels lower when water temperatures are elevated and more photosynthesis is occurring. A supersaturated (very high DO) environment may exist during daytime hours, but at night DO levels may drop to lethal levels due to microbial respiration and lack of photosynthesis.

The Karuk Tribe's water quality objectives have established minimum DO levels for waters designated as Cold Freshwater Habitat (COLD) in the Karuk Tribe Water Quality Control plan, to be 6.0 mg/L. Areas providing Spawning, Reproduction, and/or Early Development habitat (SPWN) need to maintain a minimum DO of 9.0 mg/L for tribal trust fish species. The Basin plans specific water quality objectives state that the Klamath River below Iron Gate shall maintain a minimum DO of 8.0 mg/L, the Shasta and Scott River shall maintain a minimum DO of 7.0 mg/L and the Salmon River 9.0 mg/L⁴. These DO objectives are currently in a review processes under the California Environmental Quality Act (CEQA).

4.3 pH/Alkalinity

The pH level or alkalinity of water refers to the concentration of hydrogen and hydroxide ions in the water. Water becomes more acidic with higher concentrations of hydrogen ions and lower concentrations of hydroxide ions, likewise water will be more basic if there are more hydroxide ions present than hydrogen ions. Water temperature has a significant impact on the concentrations of these ions in water. As water temperatures rise, algae and plant photosynthesis increases, leading to a daily fluctuation of pH. Photosynthesis extracts dissolved CO₂ from the water column, which was previously in the form of carbonic acid, H₂CO₃. High levels of photosynthesis cause the pH to rise during the day and lower at night when respiration is occurring. High pH levels cause ammonium ions to go from an ionized state to a de-ionized form that is vastly more toxic to fish. The Klamath River has abundant ammonium ions due, in a large part, to agricultural runoff and nitrogen fixation by algae within the reservoirs. The pH or alkalinity also determines the solubility and biological availability of nutrients and other chemicals in water. Changes in pH can greatly influence how much of a nutrient or chemical is available for use by aquatic organisms. The Karuk Tribe has established a minimum pH objective of 6.5 and a maximum of 8.5. Changes in normal ambient pH levels shall not exceed 0.5 units within the range specified above in fresh waters with designated COLD or WARM beneficial uses⁵.

³ Tripp, Sandi, and Susan Corum. Karuk Tribe of California. Department of Natural Resources. Water Quality Control Plan. Orleans, CA: 2002.

⁴ State of California. North Coast Regional Water Quality Control Board. Water Quality Control Plan For The North Coast Region January 2007. Santa Rosa, California: GPO, 2007.

⁵ Tripp, Sandi, and Susan Corum. Karuk Tribe of California. Department of Natural Resources. Water Quality Control Plan. Orleans, CA: 2002.

4.4 Specific Conductance

Specific conductance is a measure of the electrical conductivity of water at 25°C, and is a function of the concentration of dissolved solids in solution. A solution with a high concentration of dissolved solids will yield a greater value for the specific conductance than a solution with lower concentrations of dissolved solids. Specific conductivity measures how well water can conduct an electrical current across a particular length. Conductivity increases with increasing amounts of unbound ions. These ions, which come from the breakdown of compounds, conduct electricity because they are negatively or positively charged when dissolved in water. Therefore, specific conductivity is an indirect measure of the presence of dissolved solids such as chloride, nitrate, sulfate, phosphate, sodium, magnesium, calcium, and iron, and can be used as an indicator of water pollution.

The Karuk Tribe's specific conductance objective is consistent with the NCRWQCB, which is 350 $\mu\text{s}/\text{cm}$ for a 90% upper limit and 275 $\mu\text{s}/\text{cm}$ for a 50% upper limit. The 90% upper and lower limits represent the 90th percentile values for a calendar year. Ninety percent or more of the values must be less than or equal to an upper limit and greater than or equal to a lower limit. The 50% upper and lower limits represent the 50th percentile values of the monthly means for a calendar year. Fifty percent or more of the monthly means must be less than or equal to an upper limit and greater than or equal to a lower limit.

4.5 Nutrients

Nutrient grab sampling was conducted at 7 sites. Mainstem sites were located just upstream of the Orleans Bridge, Sluice Box river access, at Walker Bridge and just below Iron Gate. These sites were sampled on a weekly basis. Tributary sites were located near the mouths of the Salmon River, Scott River and Shasta River. These sites were sampled biweekly. The sampling protocol was adapted from USFWS and the Yurok tribes grab sample protocol. Nutrient samples were then sent to Aquatic Research in Seattle, Washington to be analyzed.

4.6 Turbidity

Turbidity data was collected from January to April on Bluff Creek and from January to March on Salmon River using HydroLab DataSonde 4a optical turbidity probes. These streams were selected based on road decommissioning efforts occurring in prior years by the Karuk Watershed Restoration Program. The monitoring was timed to capture sediment flushes in the watersheds from both rain and rain-on-snow events. The HydroLab DataSondes were calibrated to the specifications outlined in the *Maintenance/Calibration/Logging Procedures*⁶ section in the manufactures manual. Salmon River results are not included in this report due to multiple probe failures.

4.7 Blue-Green Algae (BGA)

Blue-Green Algae data was collected at the three mainstem sites. YSI Phycocyanin probes were used to determine a cell per milliliter estimate. The use of these probes coupled with real time

⁶ Hydrolab, Corporation. "Maintenance, Calibration and Storage. "DataSonde 4 and MiniSonde Water Quality Multiprobes User's Manual. Revision G. 1999.

results available on the internet allows timely assessment of public health threats from toxigenic algal species.

4.8 Flow

Stream flow (ft³/sec) data are from USGS gauging stations located in the Klamath Basin and its tributaries. All water quality monitoring stations are directly associated with USGS gauging stations except the Scott River site and the Walker Bridge nutrient sampling site. The nearest USGS flow gage on the Scott is about 20 miles upriver of the monitoring site, downstream of the agricultural influenced valley but just upstream of where the canyon reach starts. Flow rates in the Klamath Basin are affected by a variety of variables including rainfall, snow pack, dam releases, agricultural use, domestic use, evapotranspiration rates, and groundwater levels.

Stream flow has an impact on all of the water quality parameters mentioned above as well as for listed beneficial uses. For example, subsistence fishing for the Karuk Tribe at Ishi Pishi Falls is a flow-dependent fishery. Flow is also critical to provide ample habitat for Tribal Trust fish species. Adequate flows allow fish access to rearing, feeding, and cover habitat. Flows also need to be high enough to allow connectivity to cold water refugias and tributaries, so that fish may move freely into and out of these habitats to find relief from high summer water temperatures and other detrimental water quality parameters. Flow and how it relates to fish disease and toxic algae blooms is also being investigated in other studies.

5 WATER QUALITY STATIONS

The Karuk Ancestral Territory, located along the middle course of the Klamath River and the lower Salmon River in Northern California, includes an estimated 1.38 million acres within the Klamath River Basin. This portion of the Klamath Basin has over 1,900 miles of perennial streams, thousands of acres of wetlands and riparian areas, and approximately 107 lakes. Approximately 90 miles of the Klamath River transects the Territory. Several major tributaries flow into the Klamath within the Ancestral Territory. The USDA-Forest Service has defined 19 watersheds or sub-basins that exist wholly or partially in the Territory. The following tables summarize waters within the ancestral territory, tribal uses and goals of these waters, and impairments to these uses and goals (Tables 1-2).

Atlas of Tribal Waters Within Ancestral Territory	
Total number of Klamath River miles	90
Total number of perennial stream miles	1,900
Total number of lake acres	442
Total number of wetland acres	UNKNOWN

Table 1 - Atlas of Tribal Waters within Ancestral Territory

Making Assessment Decisions	
Designated Beneficial Uses and Tribal Goals	Parameter(s) to be Measured to Determine Support of Use of Goal
Rare, Threatened, or Endangered Species (RARE)	Temperature, DO, pH, Conductivity,
Subsistence Fishing (FISH)	Temperature, DO, pH, Conductivity
Cold Freshwater Habitat (COLD)	Temperature, Turbidity
Cultural Contact Water (CUL-1)	Temperature, Phosphorus, Nitrogen
Cultural Non-Contact Water (CUL-2)	Temperature, Phosphorus, Nitrogen
Fish Consumption (FC)	Temperature, Phosphorus, Nitrogen
Water Contact Recreation (REC-1)	Temperature, Phosphorus, Nitrogen
Non-Contact Water Recreation (REC-2)	Temperature, Phosphorus, Nitrogen
Spawning, Reproduction, and/or Early Development (SPWN)	Temperature, DO, pH, Conductivity, Turbidity

Table 2 - Designated uses and tribal goals and what parameters are measured to monitor impairments to these uses and goals.

Use/Goal Support in Tribal Streams				
Designated Use or Tribal Goal	No. of Stream Miles Monitored/Assessed	No. of Stream Miles Fully Supporting Use or Goal	No. of Stream Miles Supporting Use or Goal but Threatened	No. of Stream Miles Not Supporting Use or Goal
RARE	178	0	156	22
FISH	178	0	0	178
COLD	178	0	16	162
CUL-1	178	0	16	162
CUL-2	178	0	16	162
FC	178	0	0	178
REC-1	178	0	16	162
REC-2	178	0	16	162
SPWN	178	0	0	178

Table 3 – Extent to which rivers meet designated uses or tribal goals.

For 2008, water quality monitoring stations were located at three fixed points along the mainstem Klamath River. These stations create a longitudinal profile of water entering and exiting the Mid-Klamath region. Three monitoring sites have been established on larger tributaries to the Klamath River, which are within and upstream of Karuk Ancestral Territory. The tributary sites are on the Salmon, Scott and Shasta Rivers. These sites are located near the mouths to highlight their influence on the mainstem Klamath. These tributaries also supported

abundant runs of spring and fall chinook, coho, steelhead, lamprey, and sturgeon (Salmon River only). A turbidity monitoring site has been added on Bluff Creek, a tributary within the Mid-Klamath. Bluff Creek was historically important to all Tribal Trust fish species. The health of these tributaries is closely tied to the well being of the Klamath River, the Karuk people, and the River's ability to support beneficial uses.

5.1 Klamath River Stations

The following section describes the Klamath River monitoring sites. Tables 3 and 4 summarize impairments to the Klamath River and identify sources of these impairments. The Klamath River is currently listed under the federal Clean Water Act (CWA) section 303(d) for temperature, dissolved oxygen, and nutrients. A TMDL is being developed for the Klamath and should be adopted by 2010.

Causes of Impairment in Klamath River		
Parameter	Number Of Stream Miles Monitored or Assessed	Number Of Stream Miles Not Supporting Use or Goal
Dissolved Oxygen	140	140
pH	140	140
Water Temperature	140	140
Phosphorous	140	140
Total Nitrogen	140	140

Table 4 - Causes of impairments in Klamath River

Sources of Impairment in Klamath River		
Source of Impairment	Number Of Stream Miles Monitored or Assessed	Number Of Stream Miles Not Supporting Use or Goal
Hydrological modification	140	140
Agriculture (livestock grazing)	50	50
Legacy Roads	140	140
Timber Harvesting	140	140
Mining Activities	140	140

Table 5 - Sources of impairments in Klamath River

5.1.1 Below Iron Gate Dam

This monitoring site is located just downstream of Iron Gate dam, the fish hatchery, and Bogus Creek at the USGS gauging site. Data collected here monitors the quality of water exiting the dam and entering the Mid-Klamath region. Nutrient grab samples were taken at the Iron Gate River Access immediately downriver of the hatchery bridge (Figure 2). This site monitors a drainage area of approximately 4,630 square miles. This area of the Klamath is much drier than down river and is vegetated by oak woodlands.

The approximate location of this station is:

Latitude: 41°55'41" N

Longitude 122°26'35" W NAD27

Elevation: 2,162.44 feet above sea level

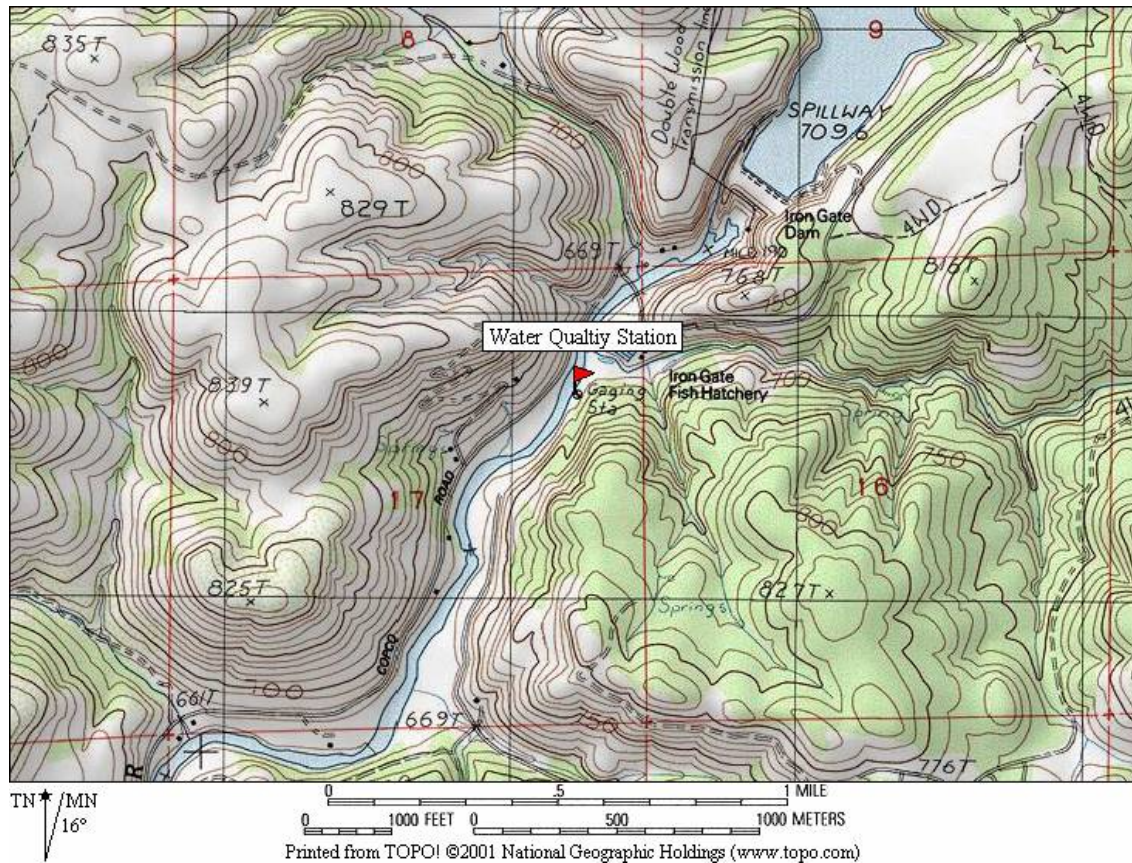


Figure 1 - Klamath River below Iron Gate Dam water quality station.



Figure 2 - Klamath River below Iron Gate Dam across river looking up from water quality station.

5.1.2 Near Seiad Valley

This monitoring site is located at the USGS gauging station approximately 62 miles downriver from the Iron Gate Monitoring site and 2.2 miles south of Seiad Valley. Nutrient Grab Samples were taken at the Sluice Box river access approximately 1 mile upstream from the gauging station. This site is at the more upstream end of Karuk Ancestral Territory and monitors a drainage area of approximately 6,940 square miles. Conifers dominate this area and the topography is much steeper than the area surrounding the Iron Gate site. These landscape changes are captured in Figures 1-4.

The exact location of this station is:

Latitude: 41°51'14" N

Longitude 123°13'52" W NAD27

Elevation: 1,320.00 feet above sea level

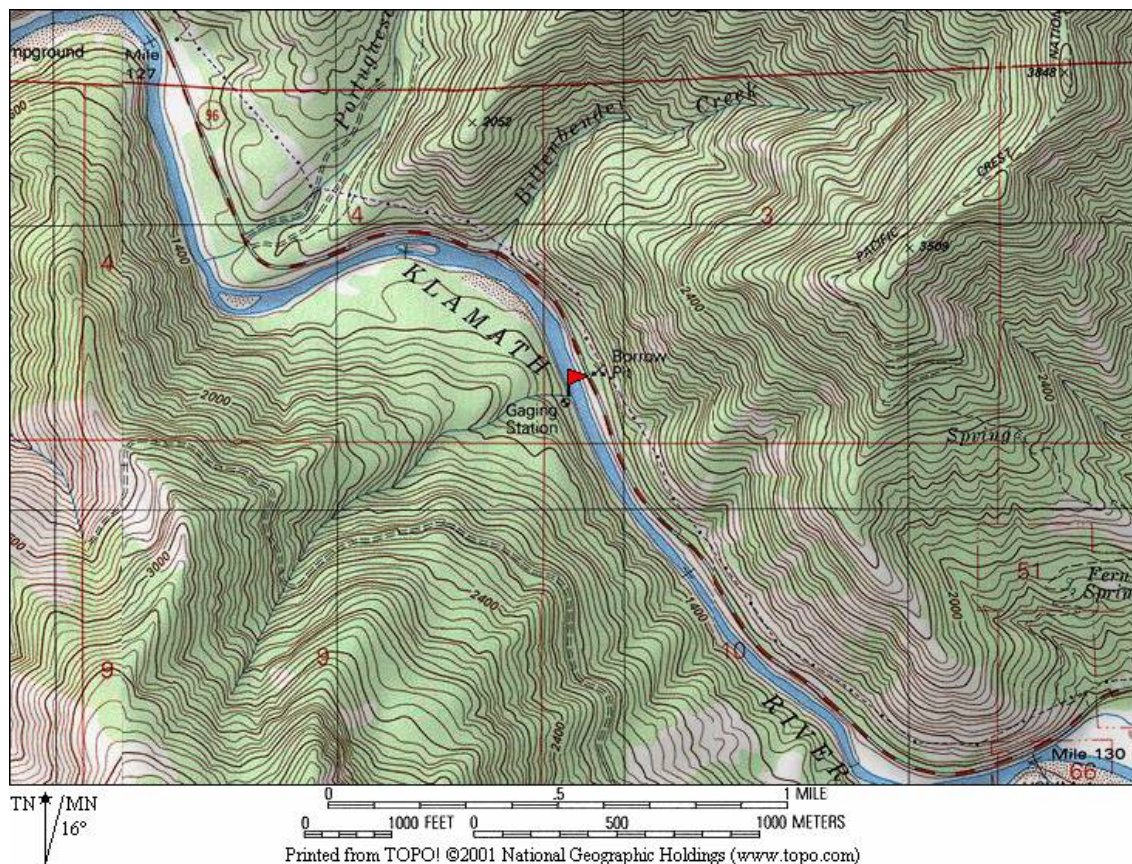


Figure 3 - Klamath River near Seiad Valley water quality station.



Figure 4 - Klamath River near Seiad Valley looking up river from Sluice Box River Access.

5.1.3 Near Orleans

The Klamath River station near Orleans is the furthest downstream monitoring station on the mainstem. This station provides data for water quality parameters after the river has traveled through the Mid-Klamath region and the bulk of Karuk Ancestral Territory. Nutrient data was gathered on the opposite side of the river and approximately ¼ mile upriver from where the datasonde was placed (Figure 6). This site monitors a drainage area of approximately 8,475 square miles. In this area the Klamath begins to fan out more and create larger flood plains and gravel bars (Figure 5-6). By this point, 12 major tributaries designated Key Watersheds by the Northwest Forest Plan have entered the Klamath, in addition to numerous smaller tributaries.

The exact location of this station is:
Latitude: 41°18'13" N
Longitude: 123°32'00" W NAD 27
Elevation: 355.98 feet above sea level

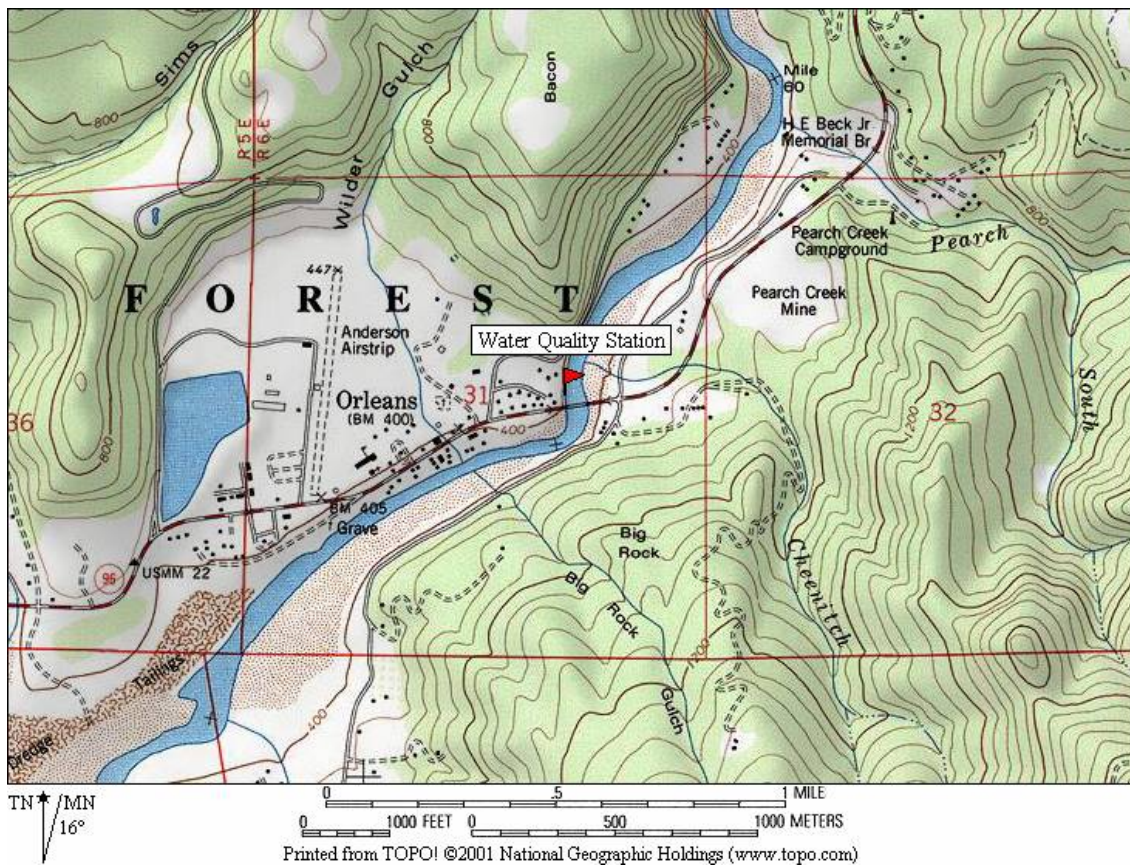


Figure 5 - Klamath River near Orleans water quality station.



Figure 6 - Klamath River near Orleans across the river of water quality station looking up river.

5.2 Tributaries

The Klamath River is a unique river in that it starts in flat land. It meanders through what were once massive wetlands and makes its way into the mountainous mid-Klamath region. Here the overall gradient and volume of the river increases and the water gets colder due to the many tributaries, which cascade into the Klamath. These tributaries are critical in maintaining water quality during the summer months. The Scott, Shasta and Salmon rivers were historically the largest tributaries in the mid-Klamath region. These rivers provided excellent spawning and rearing habitat for salmonids, steelhead, and lamprey. Mining, Logging and Agricultural uses of these watersheds have degraded the quantity and quality of habitat and water in these areas (Table 5-6).

Causes of Impairment in Major Tributaries		
Parameter	Number Of Stream Miles Monitored of Assessed	Number Of Stream Miles Not Supporting Use or Goal
Dissolved Oxygen	38	38
Water Temperature	38	38
pH	38	38
Total Nitrogen	38	22
Phosphorous	38	22

* Shasta River measured from Yreka Creek to mouth-7 miles, Scott River from Canyon Creek to mouth- 15 miles, and Salmon River from Nordheimer Creek to mouth-16 miles.

Table 6 - Causes of Impairment in tributaries to Klamath River.

Sources of Impairment in Tributaries		
Source of Impairment	Number Of Stream Miles Monitored or Assessed	Number Of Stream Miles Not Supporting Use or Goal
Hydrological modification	38	22
Agriculture	38	22
Legacy Roads	38	38
Timber Harvesting	38	38
Mining Activities	38	31

Table 7 - Sources of impairment in tributaries to Klamath River

5.2.1 Salmon River

The water quality station on the Salmon River is located approximately 1 mile above the confluence with the Klamath River (Figure 7) at the USGS gage station. Winter turbidity data and nutrient grab samples were also collected at this site. The Salmon River watershed drains an area of 480,178 acres. The Salmon River is listed in California's 303(d) list for temperature. The State and EPA have adopted the temperature TMDL for the Salmon River and implementation has begun. The data being collected is an important part of long-term monitoring of the system to see how well the implementation plan is working. The Salmon River also provides crucial habitat for tribal trust species such as green sturgeon, lamprey, Spring Chinook, Fall Chinook, and Coho salmon.

The exact location is:

Latitude: 41° 22' 37" N

Longitude: 123° 28' 38" W

Elevation: 167 m

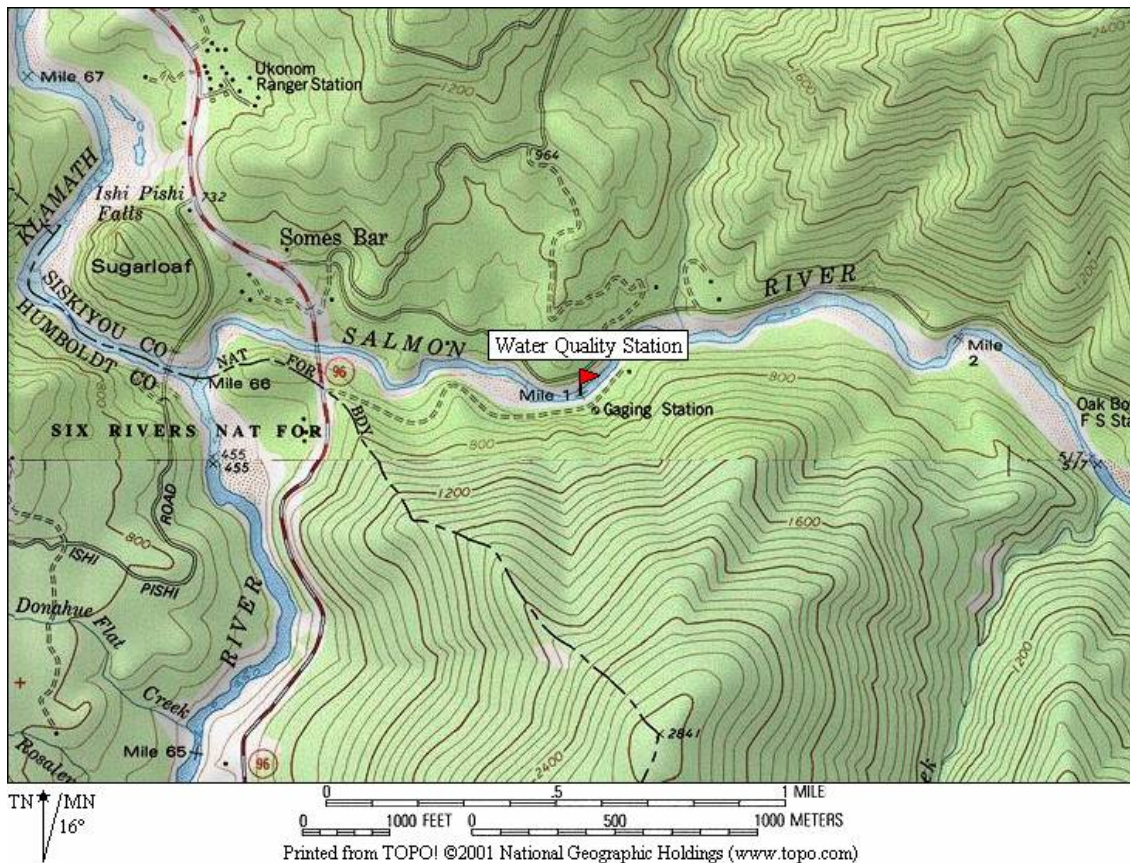


Figure 7 - Salmon River water quality station.



Figure 8 - Salmon River water quality station looking across the river and up stream.

5.2.2 Scott River

The Scott River water quality station is located about 1.25 miles from the confluence with the Klamath River (Figure 9). The drainage area for the Scott River water quality station is 520,612 acres. The Scott River is heavily diverted for agricultural use and listed on CWA section 303(d) list for sediment and temperature impairment. The State and EPA have adopted the TMDL and implementation has begun. Even though the Scott River is a major tributary to the Klamath, it contributes very little water once heavy irrigation begins in the summer. The Scott River used to be one of the predominant rearing locations for Coho, Fall Chinook, and Spring Chinook. The restoration of this tributary is critical to the future of the Karuk Tribal Trust fishery.

The approximate location of this station is:

Latitude: 41° 46' 06" N

Longitude: 123° 01' 34" W

Elevation: 489 m

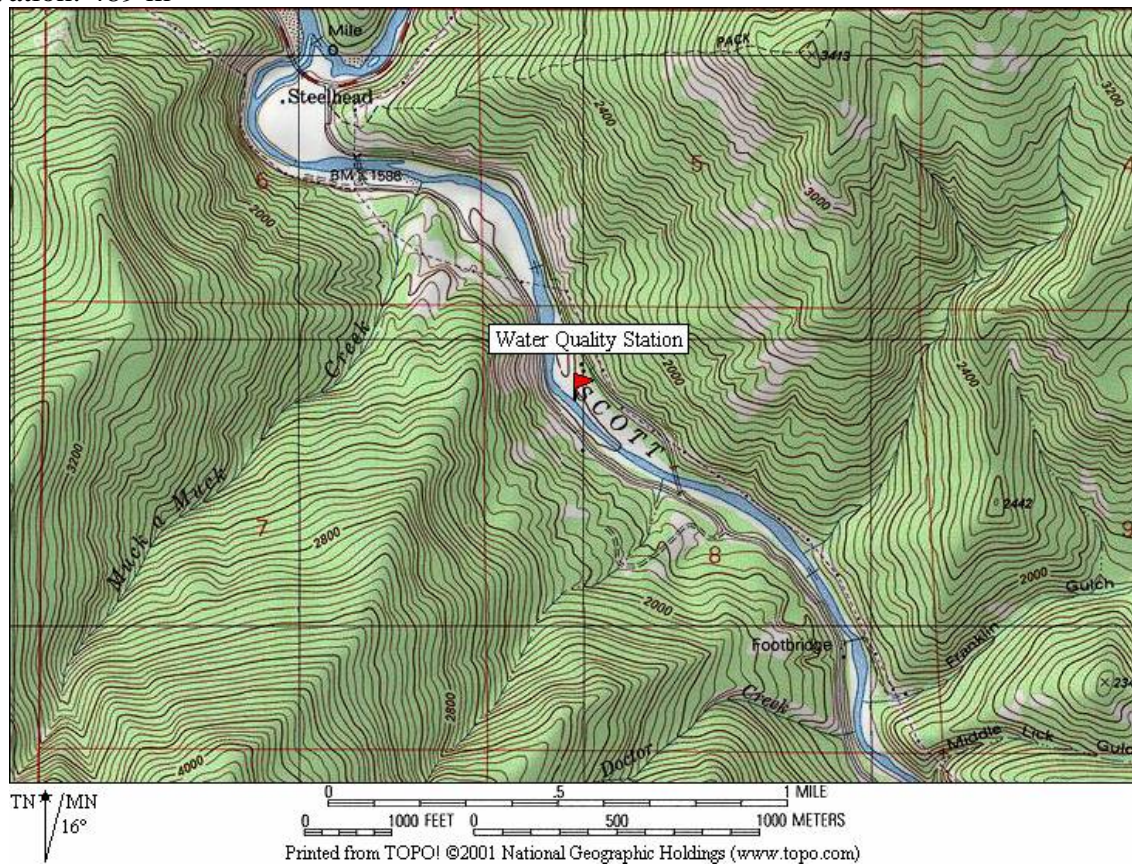


Figure 9 - Scott River water quality station.



Figure 10 - Scott River water quality station looking downstream.

5.2.3 Shasta River

The Shasta River is fed by rain and snowmelt coming down from the Klamath Mountains, in addition to numerous cold-water springs. The glacier on Mt. Shasta is one of the few expanding glaciers in the country. Therefore, the Shasta River should be an important source of cold water in the hot summer months and provide excellent rearing habitat for spring Chinook, fall Chinook, Coho, and steelhead. However, the Shasta Valley has been altered by agricultural diversions and the construction of Dwinell Dam, creating Lake Shastina, which blocks fish passage about 40 miles upstream from the mouth of the River. The Shasta River is 303(d) listed for temperature and DO. As part of TMDL implementation, the NCRWQCB says there needs to be an additional 45 cfs of cold spring flow in the River to meet temperature requirements. This site monitors a drainage area of approximately 793 square miles.

The approximate location of this station is:

Latitude: 41° 49' 23" N

Longitude: 122° 35' 40" W NAD 27

Elevation: 2,000.00 feet above sea level

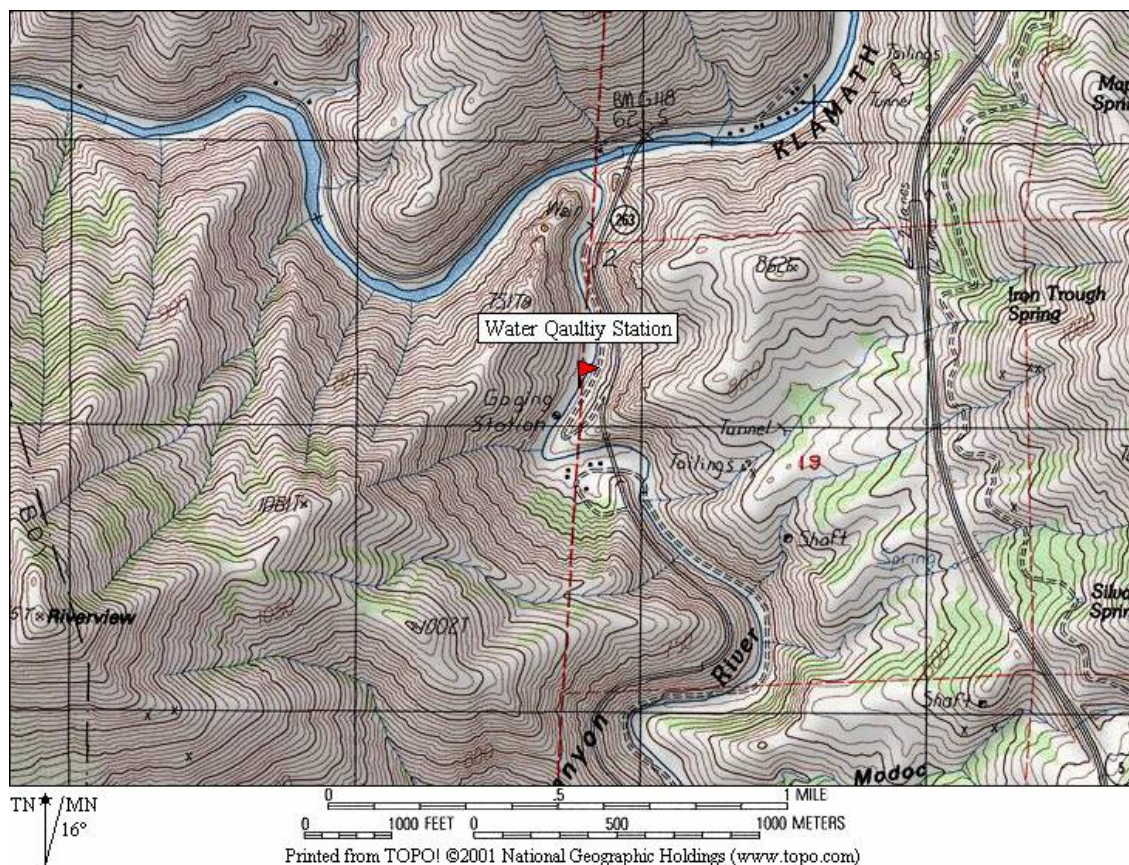


Figure 11 - Shasta River Water Quality Station.



Figure 12 - Shasta River water quality station looking downstream.

5.2.4 Bluff Creek

Bluff Creek is fed by water draining from the Siskiyou wilderness. The Bluff Creek watershed drains an area of 74.6 square miles. Bluff Creek was historically an important minor tributary to spring and fall Chinook, steelhead, coho, lamprey and sturgeon. Heavy logging and an extensive road network led to a complete rerouting of the lower portion of the creek during the 1964 flood. This effectively blocked access for most tribal trust species to Bluff Creek. The Karuk Watershed Restoration Program has been working in Bluff Creek since 2007 to try and help rehabilitate the watershed.

The approximate location of this station is:
Latitude: 41° 14' 25" N
Longitude: 123° 39' 25" W NAD 27
Elevation: 311 feet above sea level

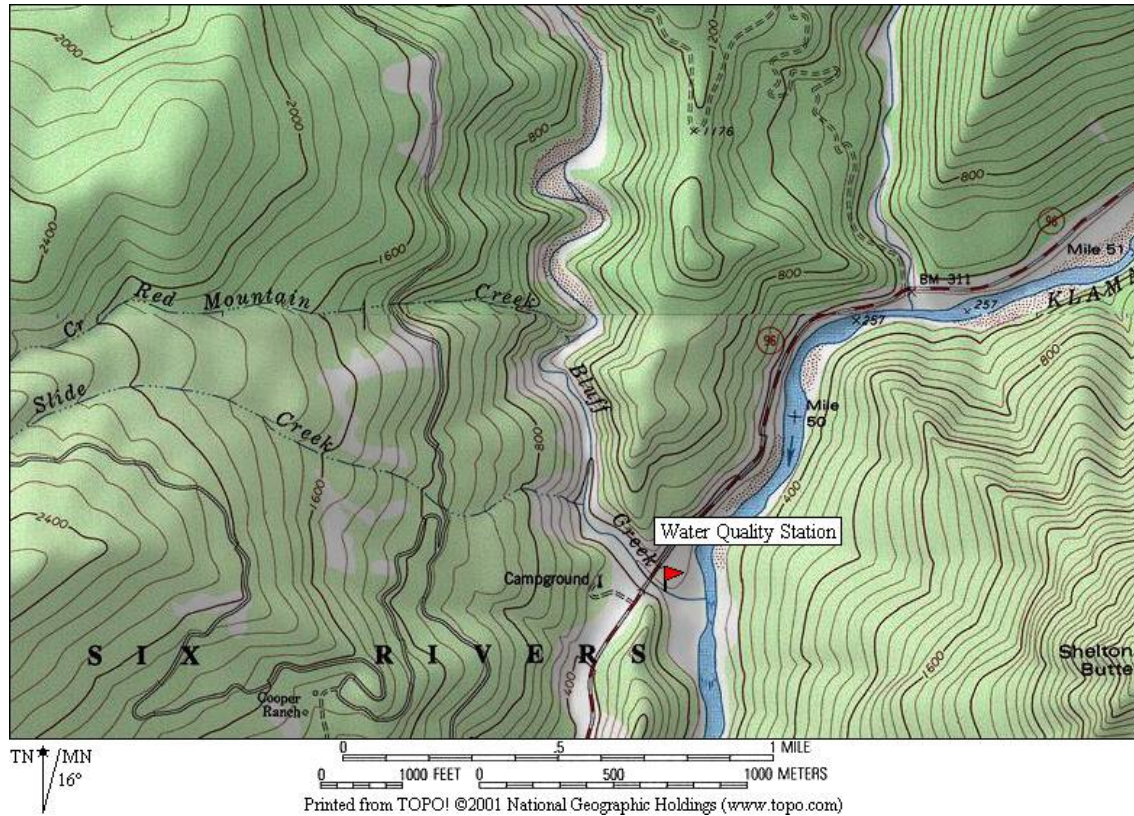


Figure 13 – Bluff Creek water quality station



Figure 14 – Bluff Creek water quality station looking upstream

6 RESULTS

The following graphs summarize the data collected during the summer of 2008. Temperature, dissolved oxygen, pH, conductivity, BGA and flow rates are given for each of the monitoring sites. Graphs depicting adopted Karuk Tribal water quality standards as compared to measured water quality conditions are also included. Nutrient data for all the Klamath River sites and tributary sites are found at the end of their respective sections.

6.1 Klamath River

6.1.1 Below Iron Gate Dam

6.1.1.1 Water Temperature

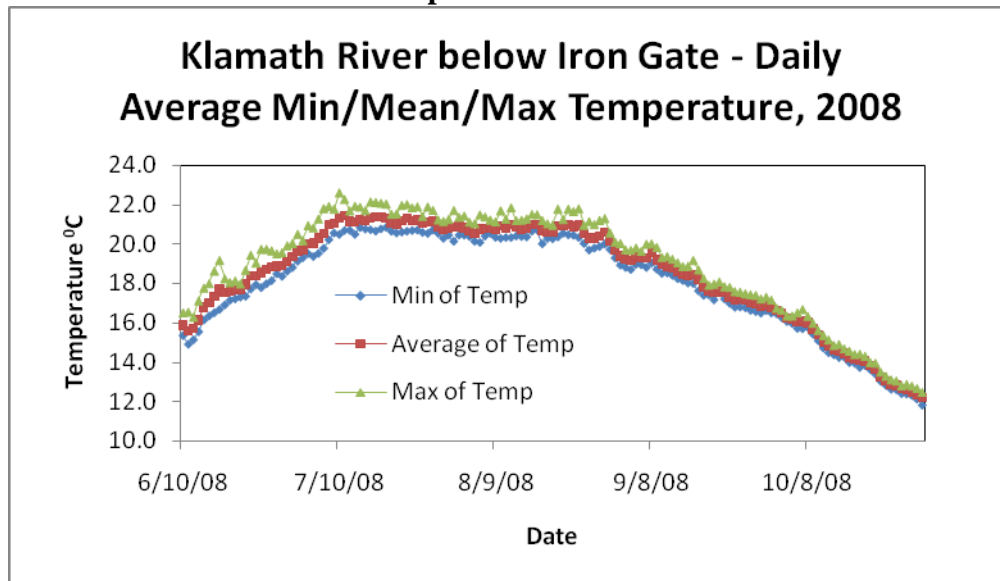


Figure 15 - Daily maximum, mean, and minimum water temperature in the Klamath River below Iron Gate from June to October, 2008

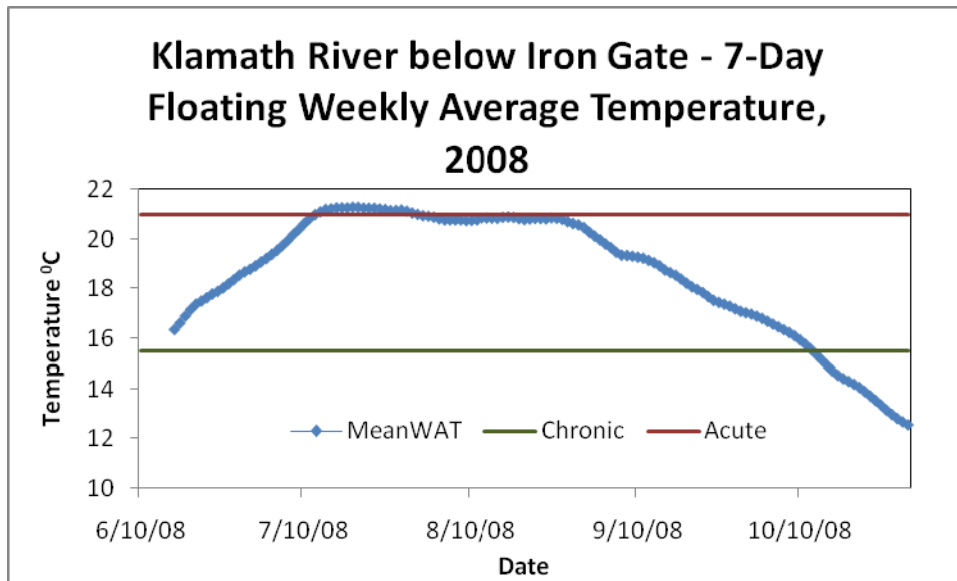


Figure 16 – 7-Day floating average temperature for the Klamath River below Iron Gate dam from June to October, 2008. The acute standard (21⁰C) represents the lethal temperature for salmonids. The chronic temperature (15.5⁰C) represents the maximum weekly average temperature (MWAT), which is the upper limit for optimum growth for salmonids.

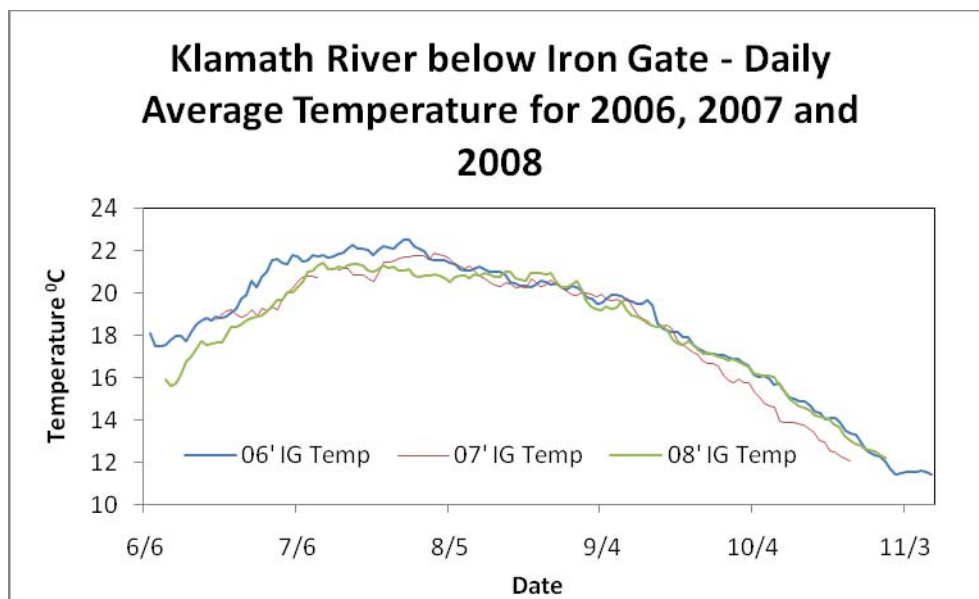


Figure 17 – Daily average temperature for the Klamath River below Iron Gate dam for the 2006, 2007 and 2008 monitoring season.

6.1.1.2 Dissolved Oxygen

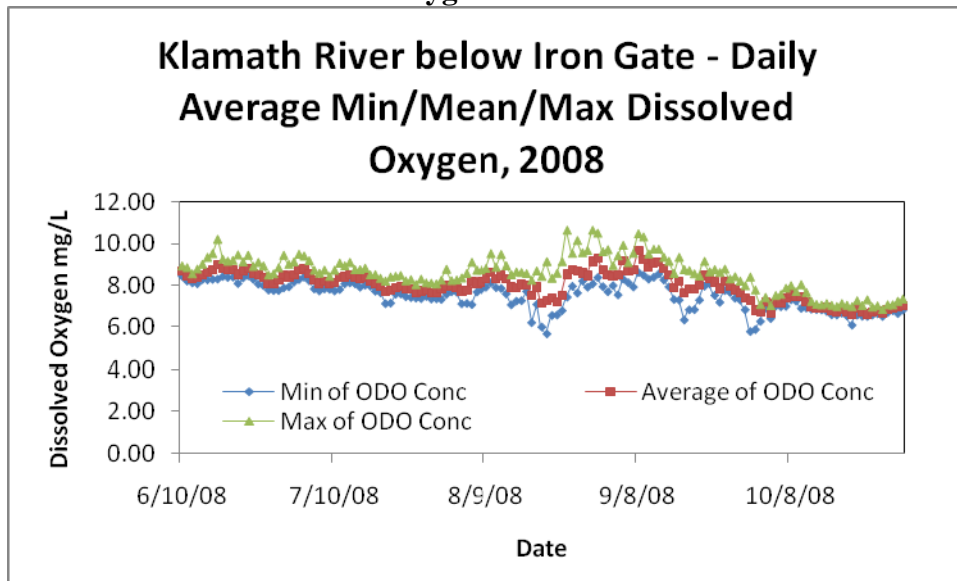


Figure 18 - Daily maximum, mean, and minimum dissolved oxygen in the Klamath River below Iron Gate Dam from June to October, 2008

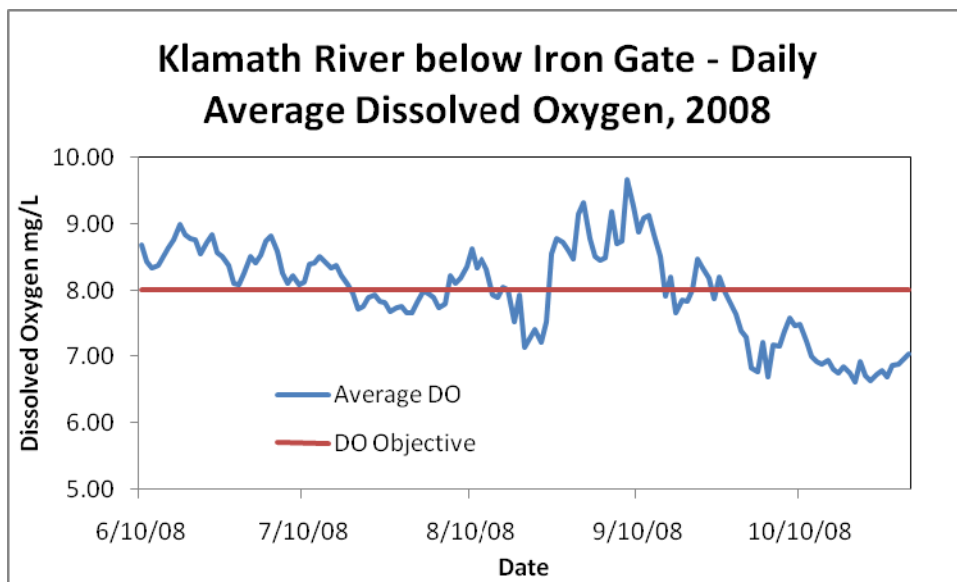


Figure 19 - Daily mean for dissolved oxygen in the Klamath River below Iron Gate Dam from June to October, 2008

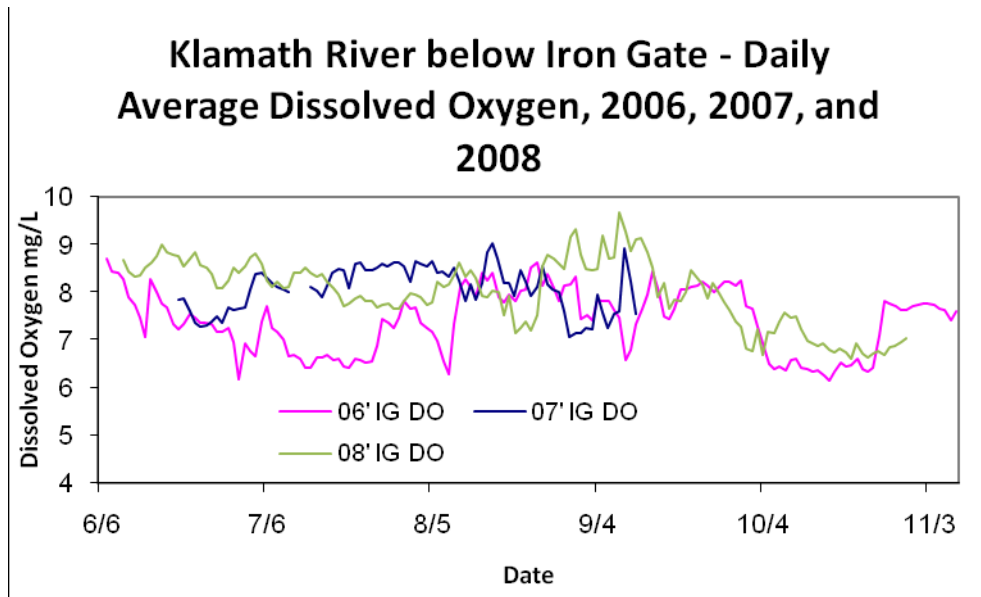


Figure 20 – Klamath River below Iron Gate daily average dissolved oxygen for the 2006, 2007 and 2008 monitoring season. DO data was collect with Clark’s membrane technology in 2006 and optical technology in 2007, 2008.

6.1.1.3 pH

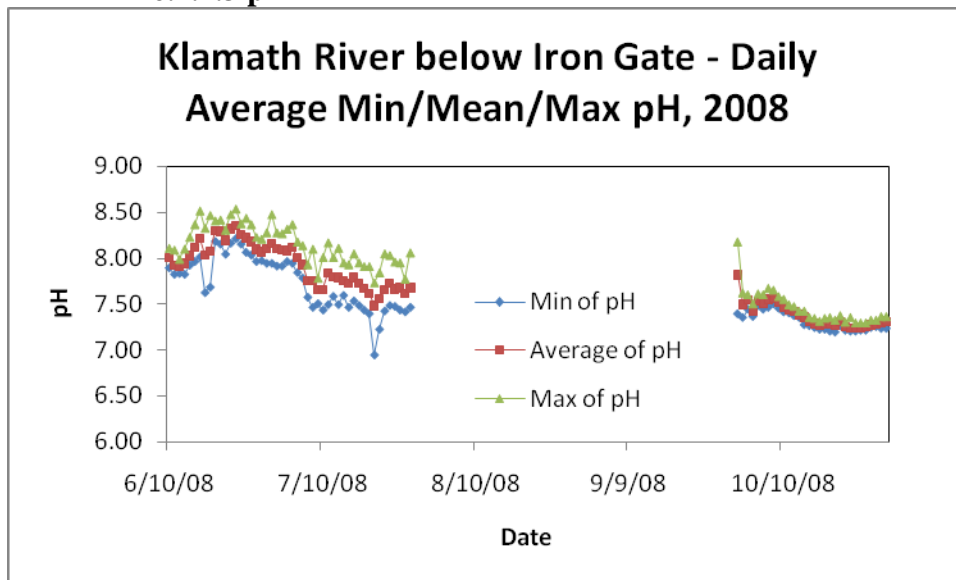


Figure 21 - Daily maximum, mean and minimum pH values on the Klamath River below Iron Gate from June to October, 2008

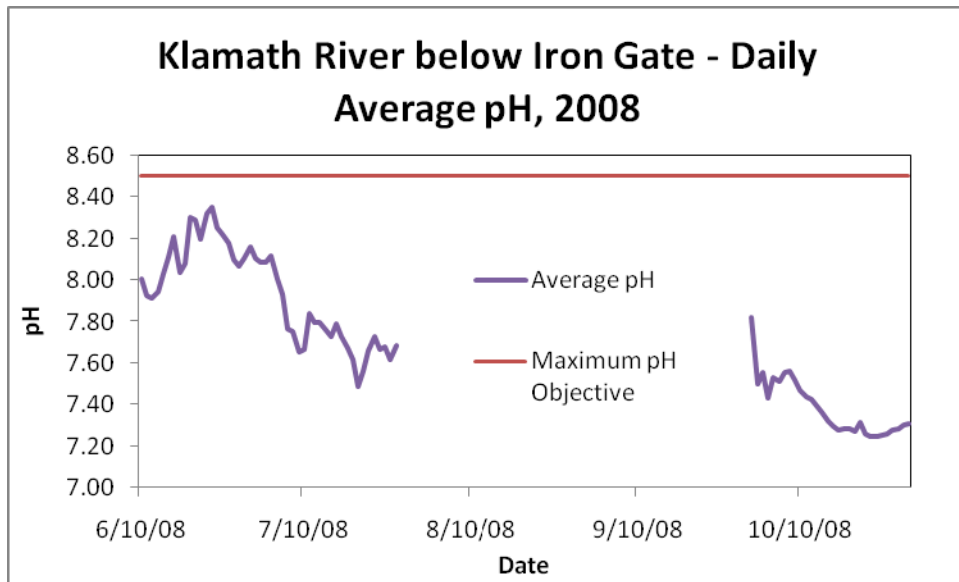


Figure 22 - Daily mean pH values on the Klamath River below Iron Gate from June to October, 2008

6.1.1.4 Specific Conductance

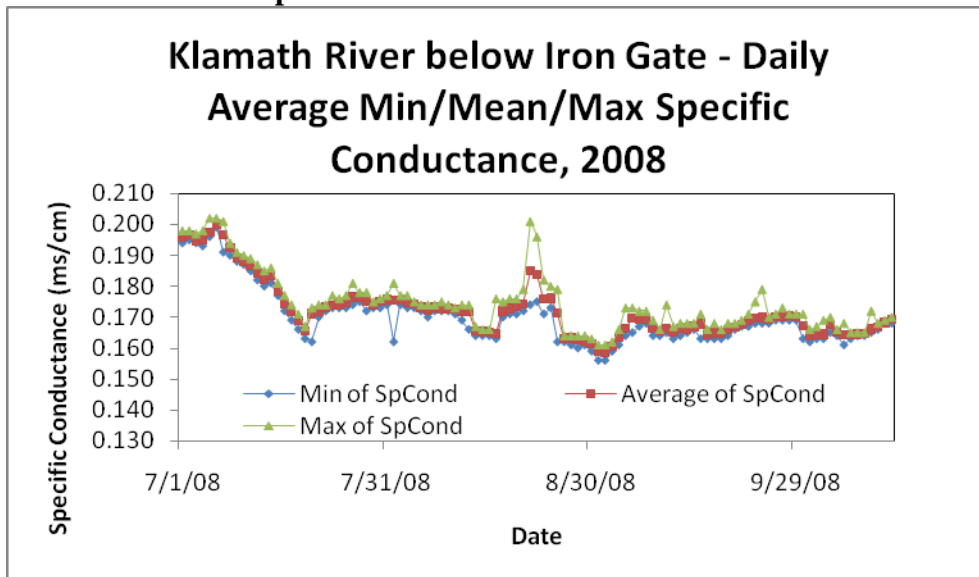


Figure 23 - Daily maximum, mean, and minimum specific conductivity in the Klamath River below Iron Gate from June to October, 2008

6.1.1.5 Blue Green Algae

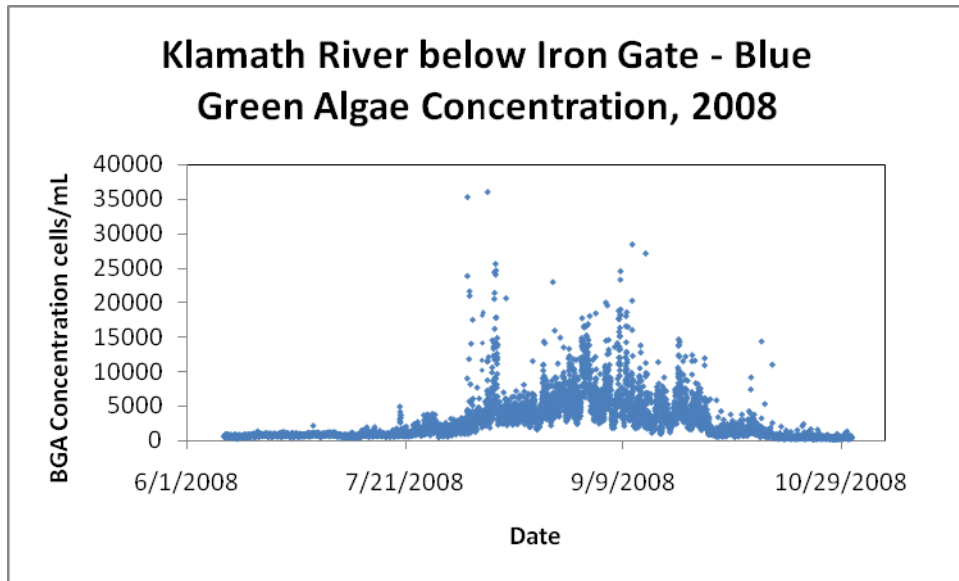


Figure 24 - Blue Green Algae concentration below Iron Gate taken every half hour from June to October, 2008

6.1.1.6 Flow

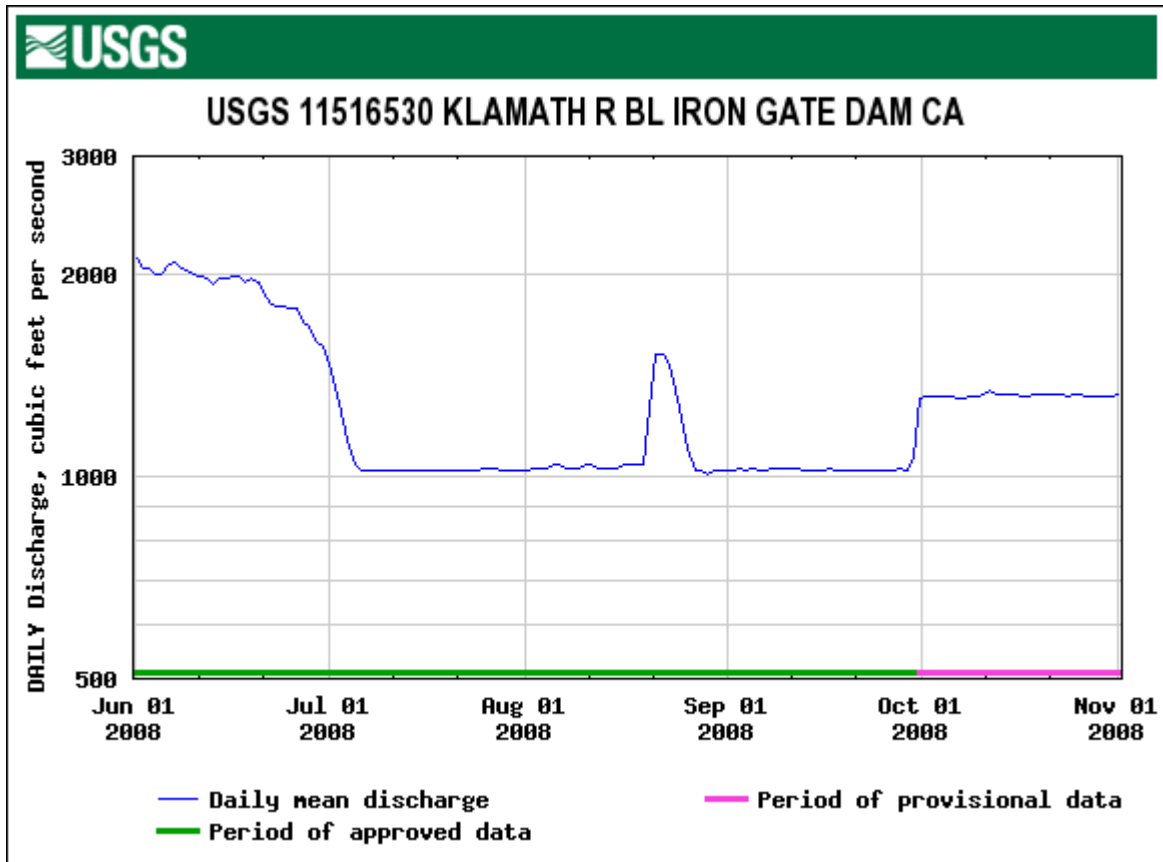


Figure 25 - Daily mean stream flow (Ft³/sec) from the Klamath River below Iron Gate Dam USGS flow gauge from June to October, 2008

6.1.2 Near Seiad Valley
6.1.2.1 Water Temperature

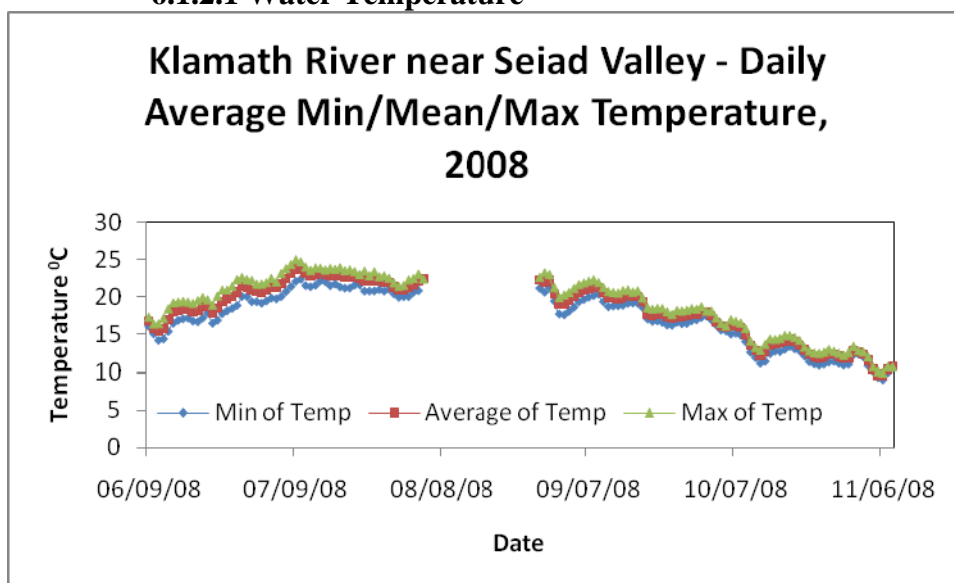


Figure 26 - Daily maximum, mean, and minimum water temperature in the Klamath River near Seiad from June to October, 2008

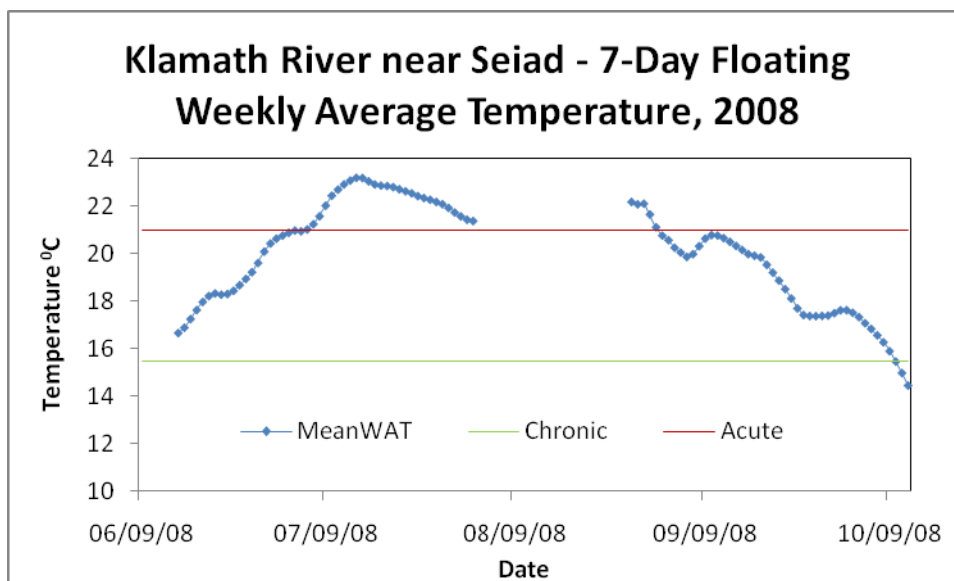


Figure 27 – 7-day floating average temperature for the Klamath River near Seiad from June to October, 2008. The acute standard (21°C) represents the lethal temperature for salmonids. The chronic temperature (15.5°C) represents the maximum weekly average temperature (MWAT), which is the upper limit for optimum growth for salmonids.

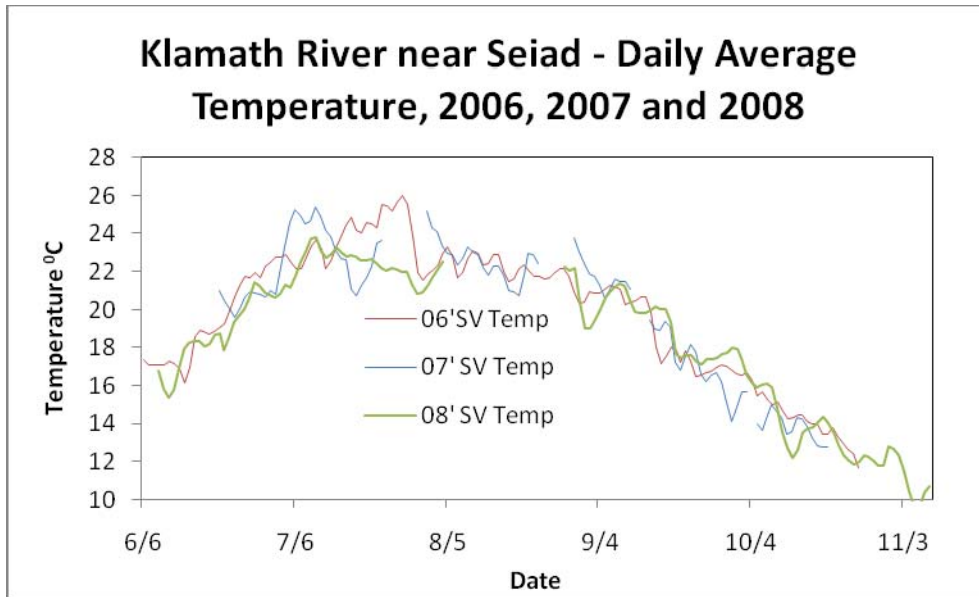


Figure 28 – Klamath River near Seiad Valley daily average temperature for the 2006, 2007 and 2008 monitoring season

6.1.2.2 Dissolved Oxygen

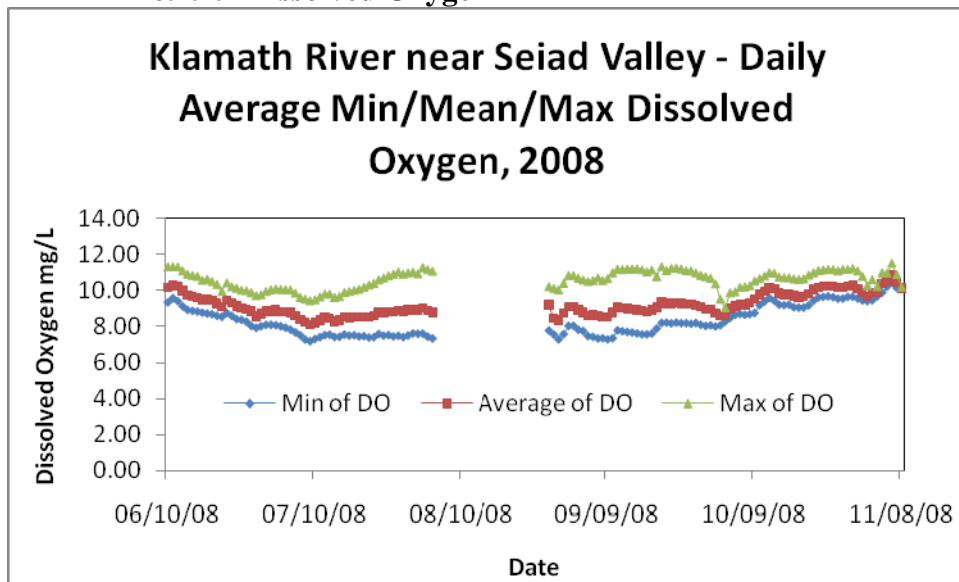


Figure 29 - Daily maximum, mean, and minimum dissolved oxygen in the Klamath River near Seiad from June to October, 2008

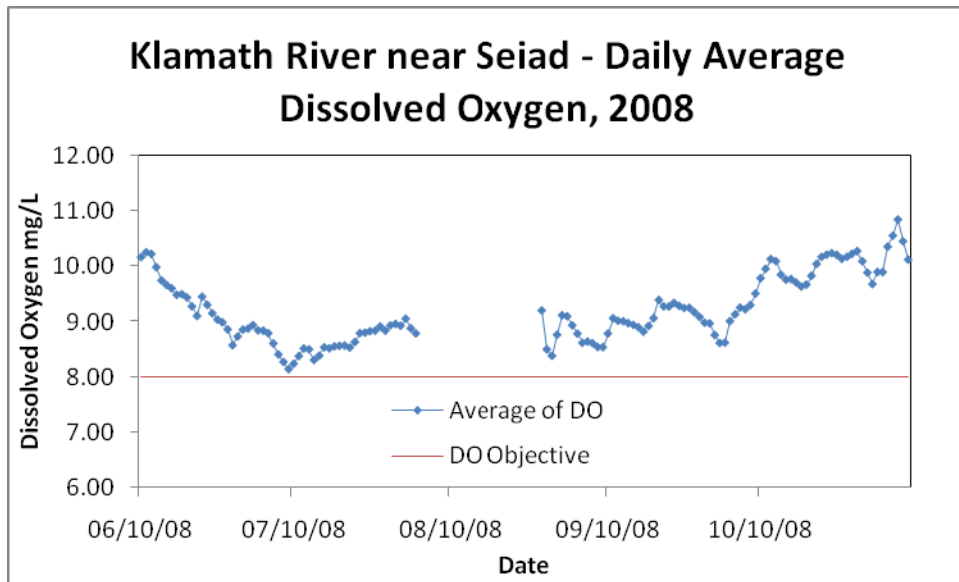


Figure 30 - Daily mean dissolved oxygen in the Klamath River near Seiad from June to October, 2008

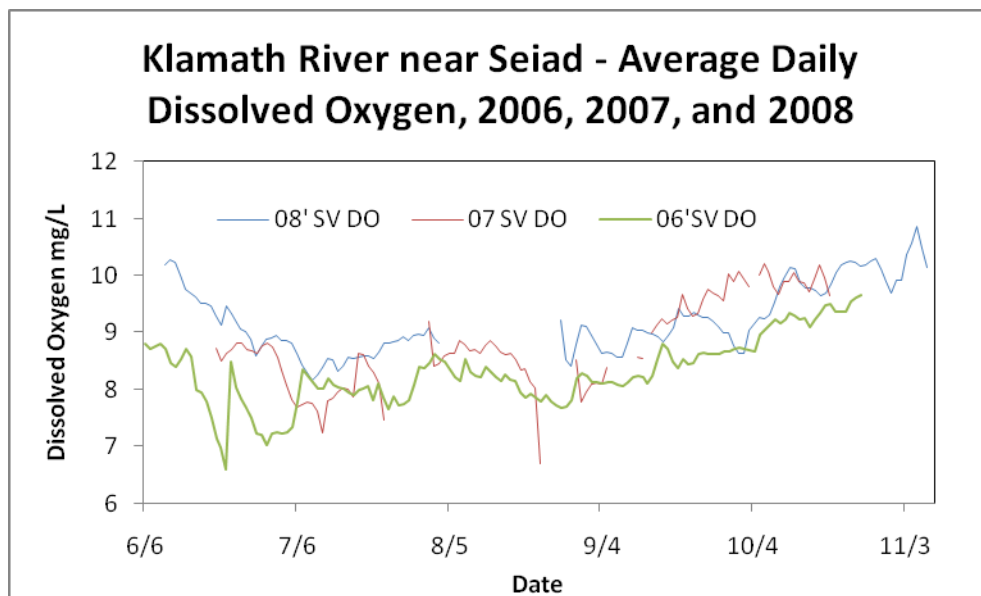


Figure 31 – Klamath River near Seiad Valley daily average dissolved oxygen for the 2006, 2007 and 2008 monitoring season. DO data was collect with Clark’s membrane technology in 2006 and optical technology in 2007, 2008.

6.1.2.3 pH

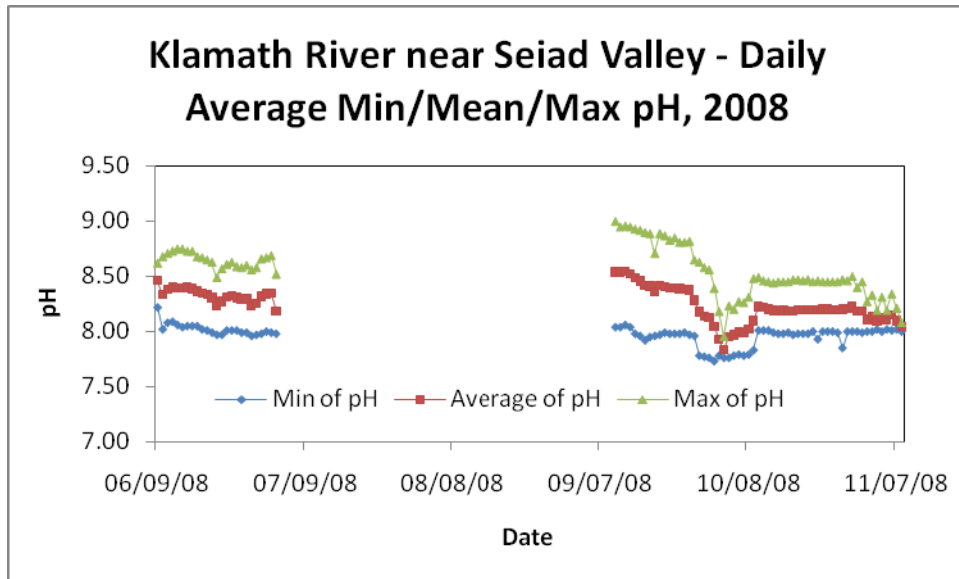


Figure 32 - Daily maximum, mean and minimum pH values on the Klamath River near Seiad from June to October, 2008

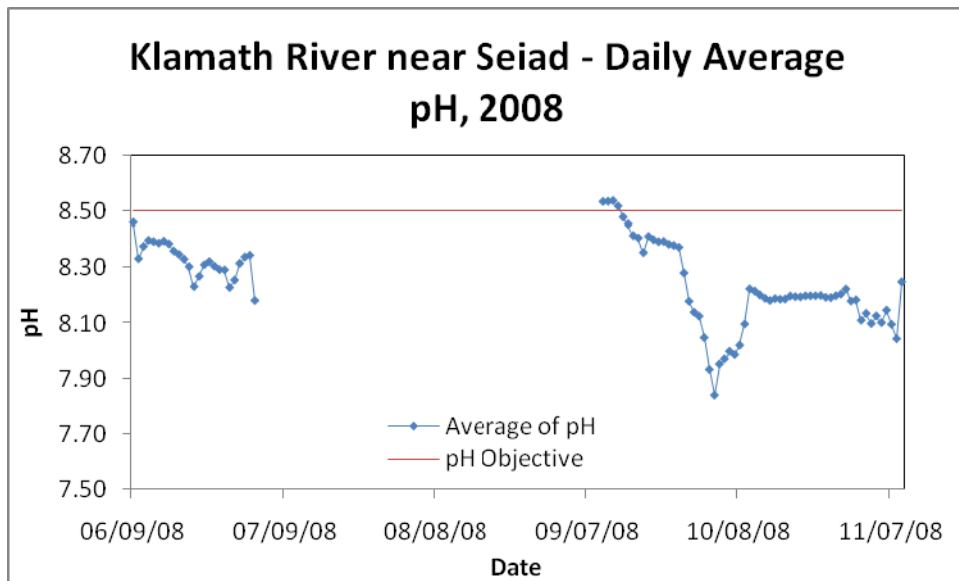


Figure 33 - Daily mean pH values on the Klamath River near Iron Gate from June to October, 2008

6.1.2.4 Specific Conductance

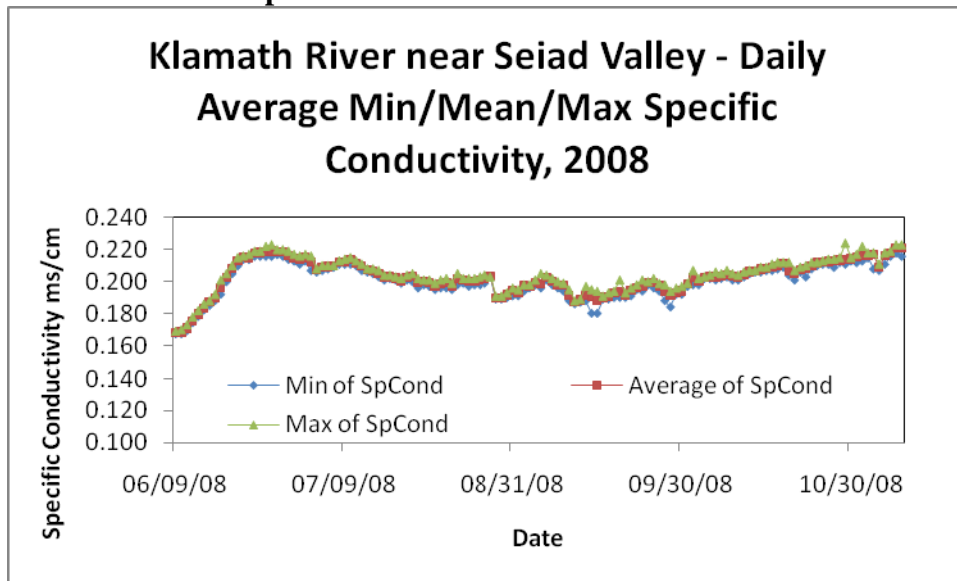


Figure 34 - Daily maximum, mean, and minimum specific conductivity in the Klamath River near Seiad from June to October, 2008

6.1.2.5 Blue Green Algae

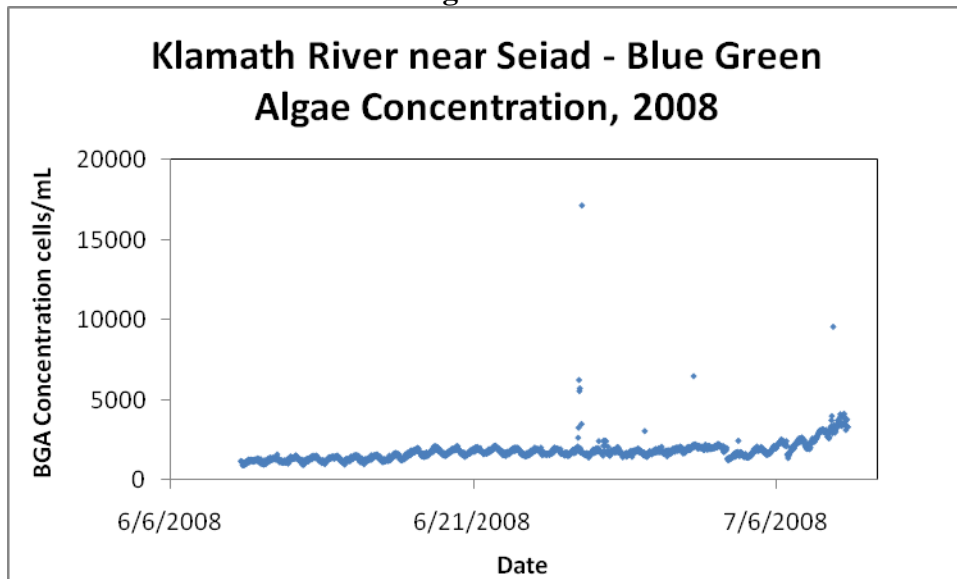


Figure 35 - Blue Green Algae concentration near Seiad taken every half hour from July to June, 2008

6.1.2.6 Flow

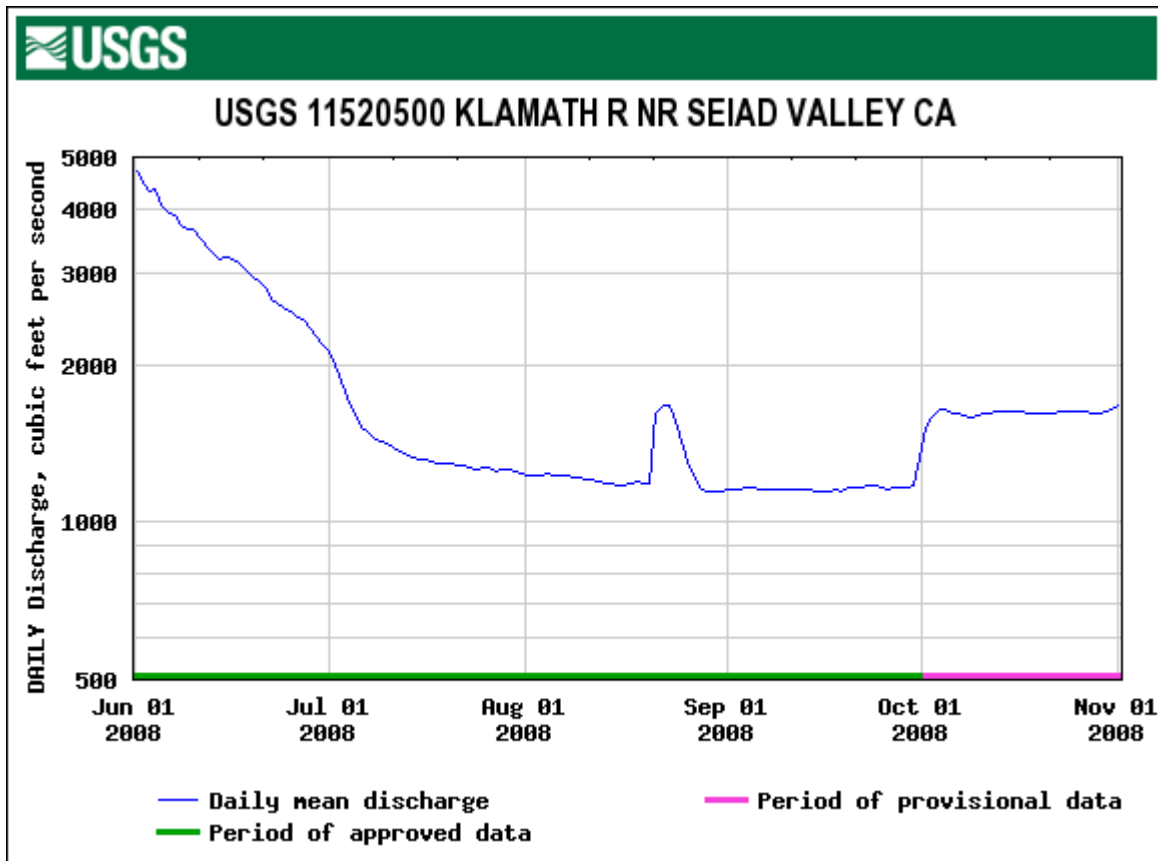


Figure 36- Daily mean stream flow (Ft³/sec) from the Klamath River at the Seiad USGS flow gauge from June to October, 2008

6.1.3 Near Orleans
 6.1.3.1 Water Temperature

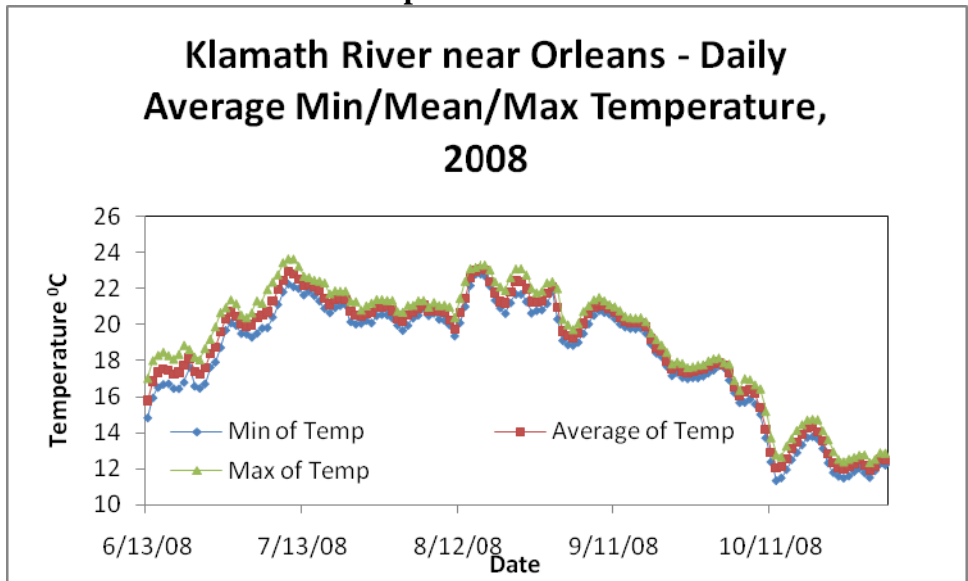


Figure 37 - Daily maximum, mean, and minimum water temperature in the Klamath River near Orleans from June to October, 2008

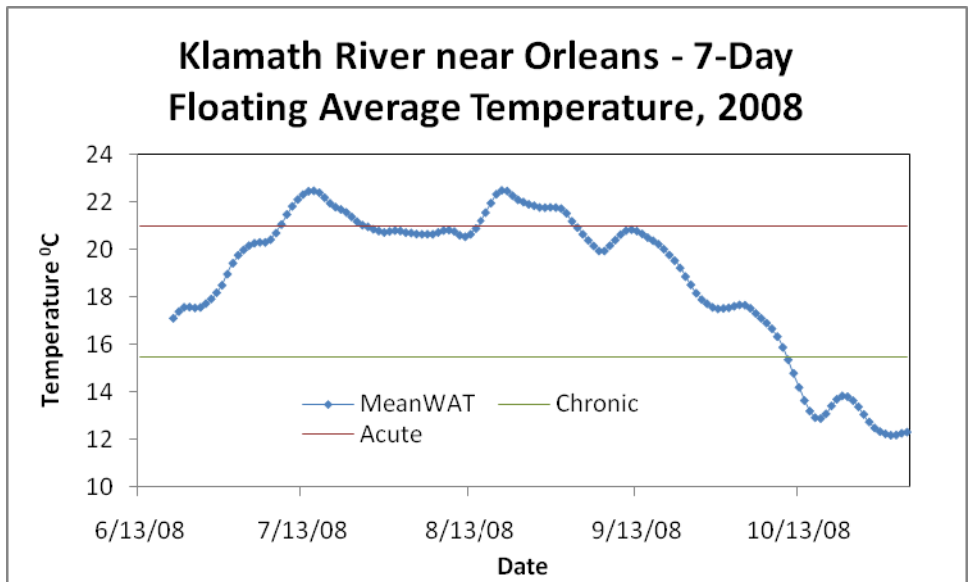


Figure 38 - 7-day floating average temperature for the Klamath River near Orleans from June to October, 2008. The acute standard (21⁰C) represents the lethal temperature for salmonids. The chronic temperature (15.5⁰C) represents the maximum weekly average temperature (MWAT), which is the upper limit for optimum growth for salmonids.

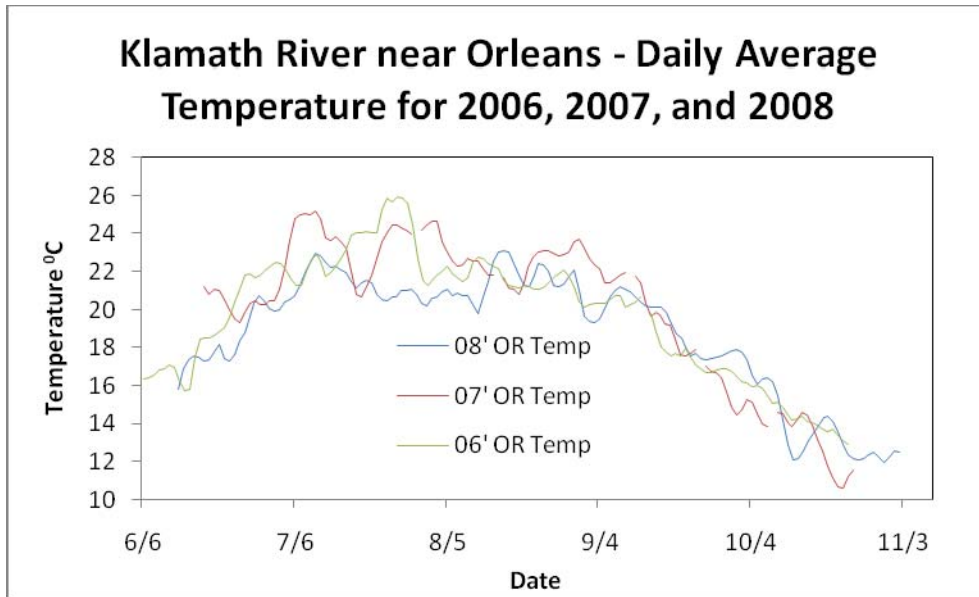


Figure 39 – Klamath River near Orleans daily average temperature for the 2006, 2007 and 2008 monitoring season

6.1.3.2 Dissolved Oxygen

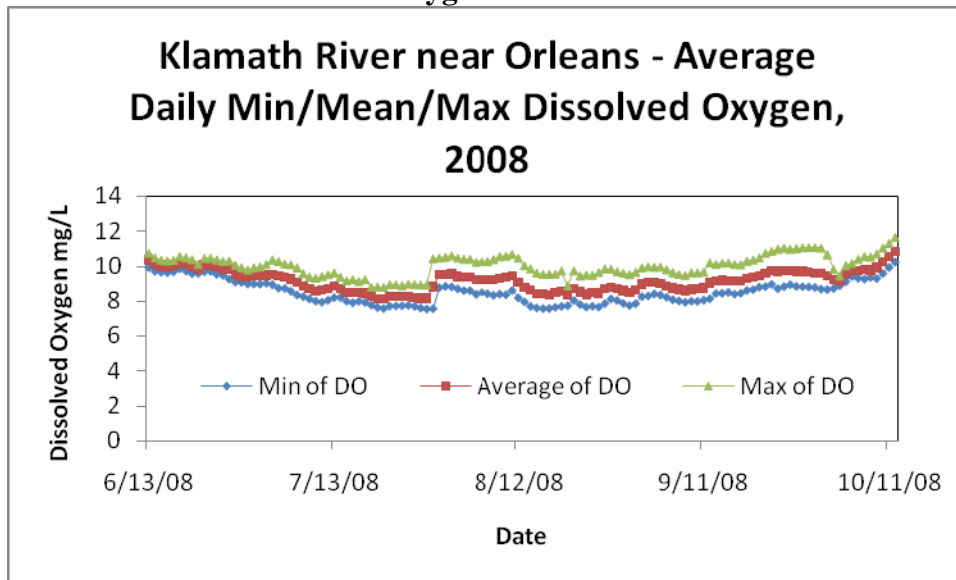


Figure 40 - Daily maximum, mean, and minimum dissolved oxygen in the Klamath River near Orleans from June to October, 2008

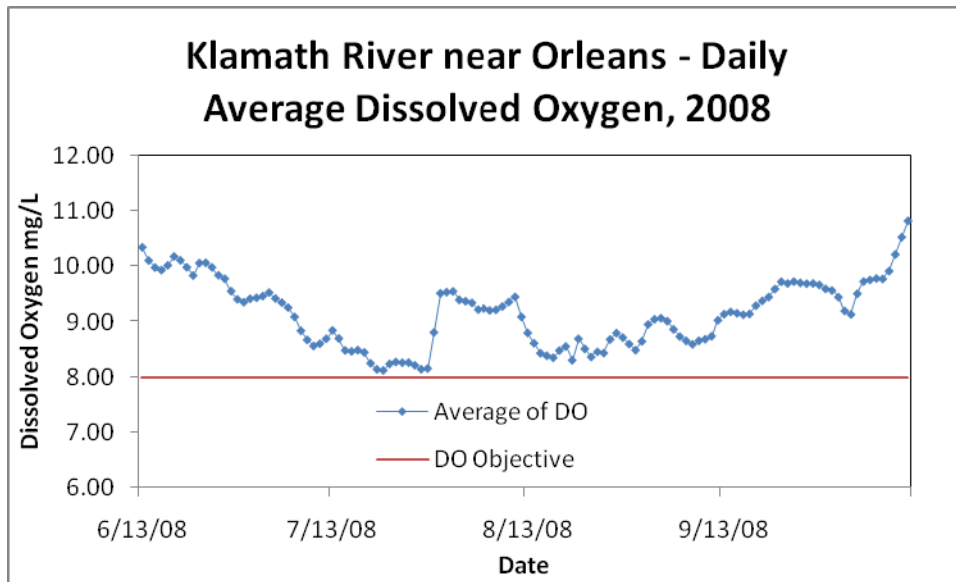


Figure 41 - Daily mean dissolved oxygen in the Klamath River near Orleans from June to October, 2008

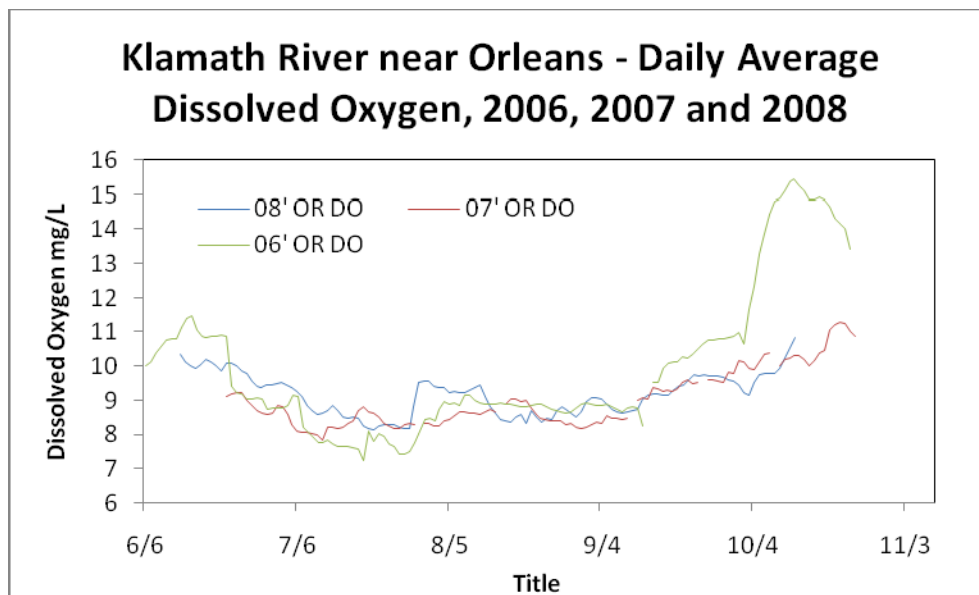


Figure 42 – Klamath River near Orleans daily average dissolved oxygen for the 2006, 2007 and 2008 monitoring season. DO data was collect with Clark’s membrane technology in 2006 and optical technology in 2007, 2008.

6.1.3.3 pH

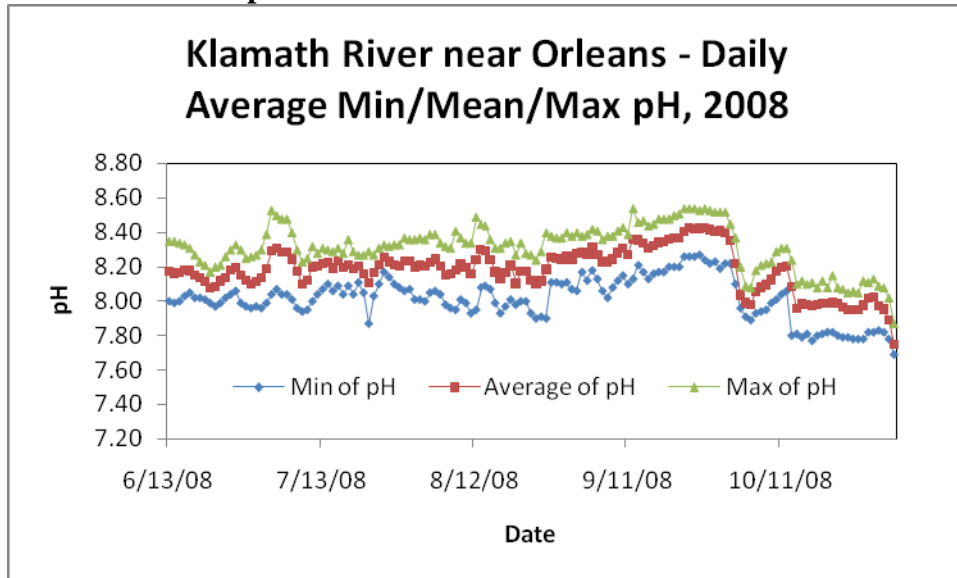


Figure 43 - Daily maximum, mean and minimum pH values on the Klamath River near Orleans from June to October, 2008

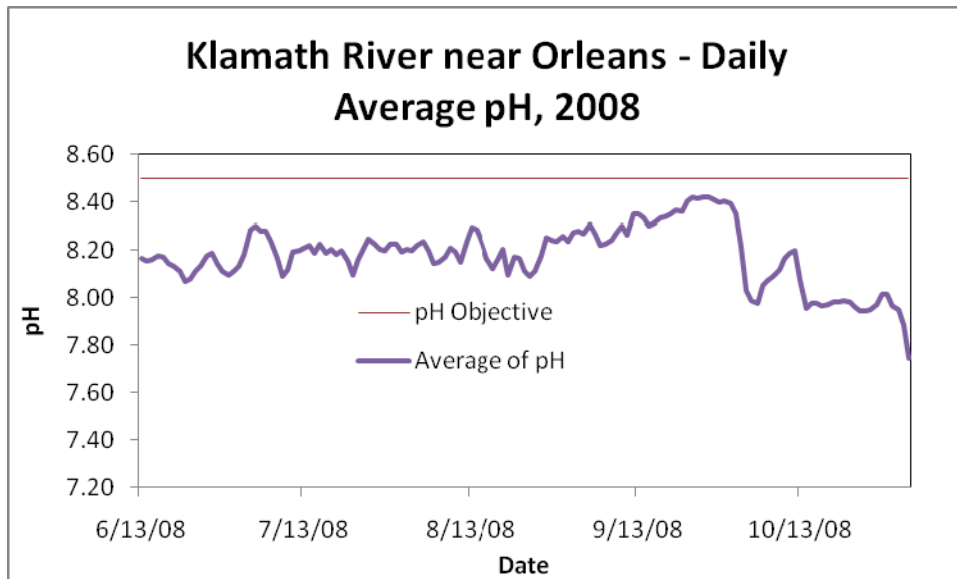


Figure 44 - Daily mean pH values on the Klamath River near Orleans from June to October, 2008

6.1.3.4 Specific Conductance

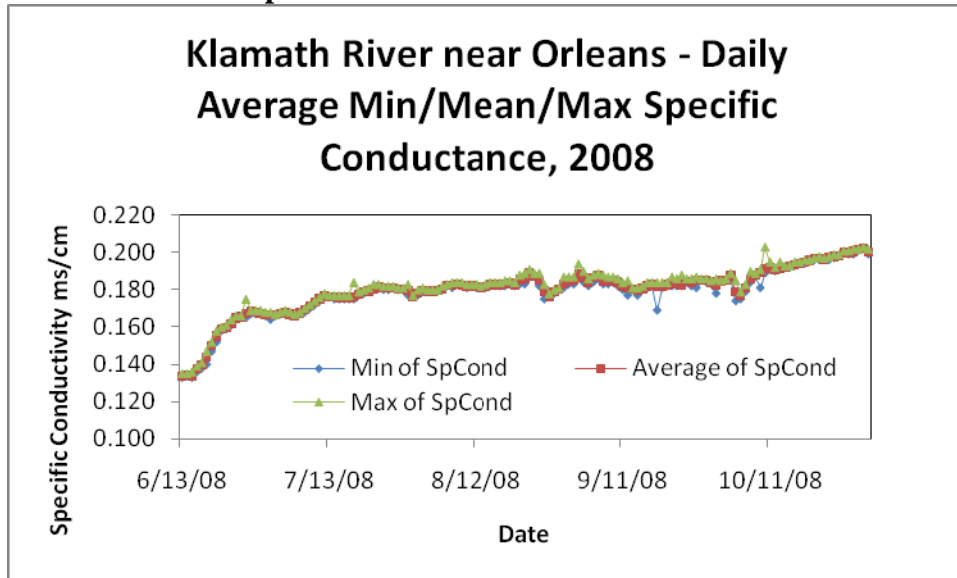


Figure 45 - Daily maximum, mean, and minimum specific conductivity in the Klamath River near Orleans from June to October, 2008

6.1.3.5 Blue Green Algae

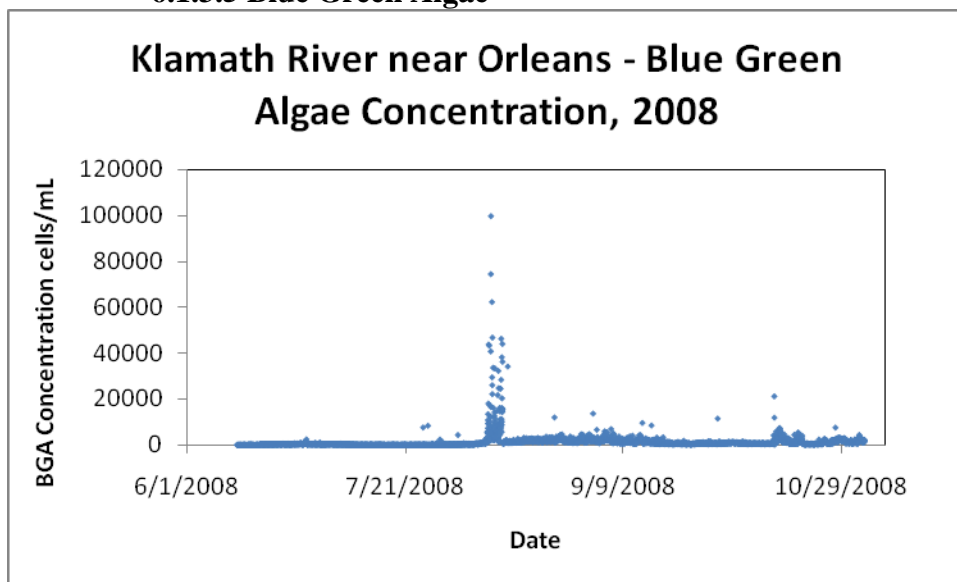


Figure 46 - Blue Green Algae concentration near Orleans taken every half hour from July to June, 2008

6.1.3.6 Flow

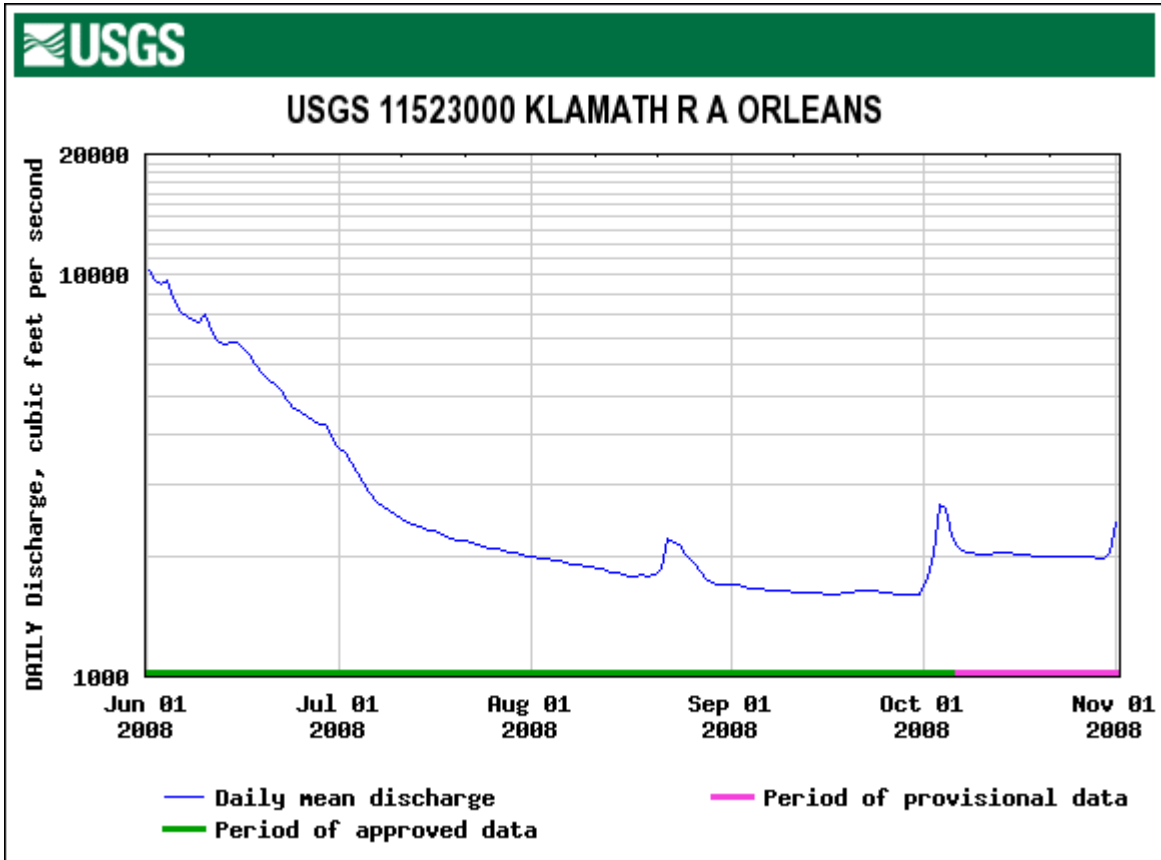


Figure 47 - Daily mean stream flow (Ft³/sec) from the Klamath River at the Orleans USGS flow gauge from June to October, 2008

6.1.4 Nutrients

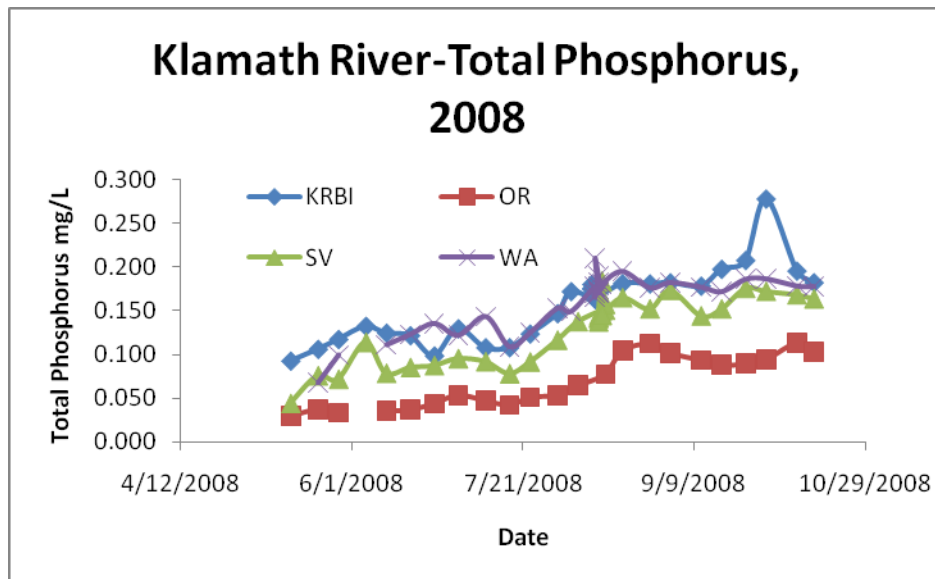


Figure 48 – Total phosphorus in mg/L for Klamath River sites from May to Oct, 2008

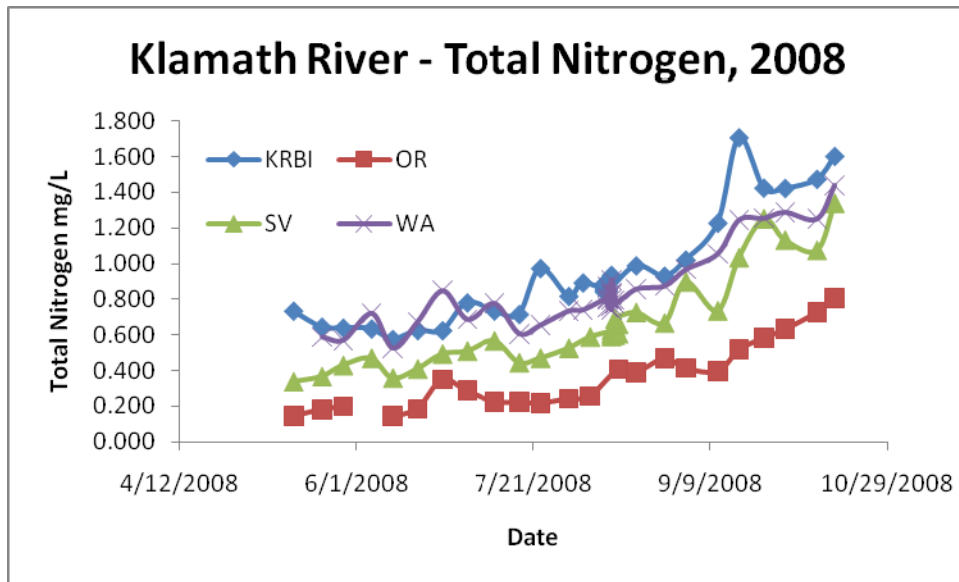


Figure 49– Total nitrogen in mg/L for Klamath River sites from May to Oct, 2008

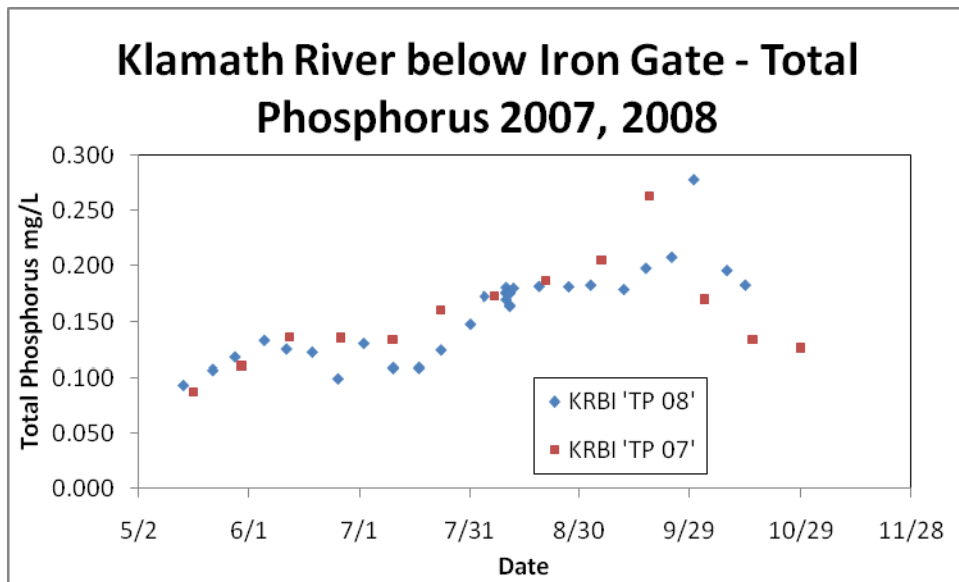


Figure 50 – Total Phosphorus in mg/L for the Klamath River below Iron Gate 2007, 2008

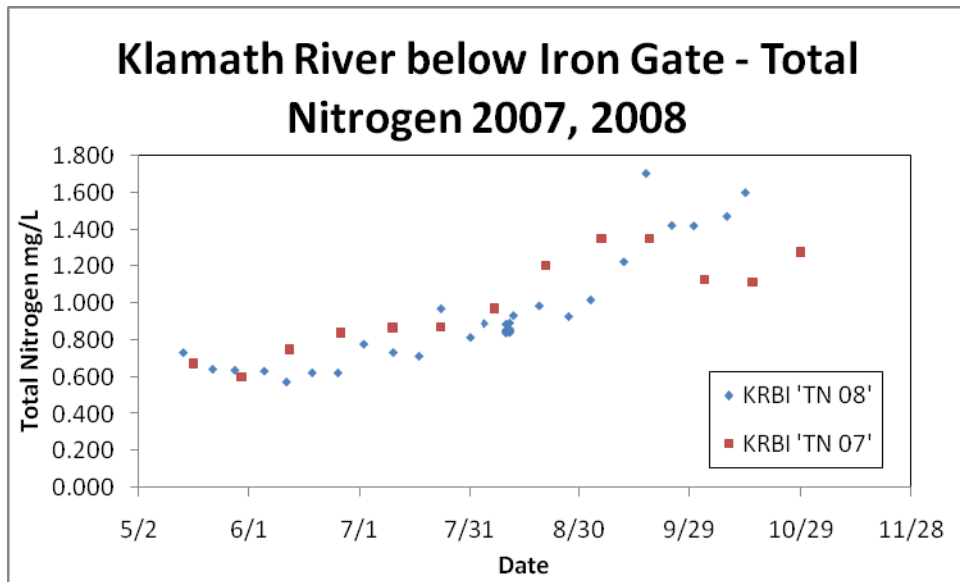


Figure 51 – Total Nitrogen in mg/L for Klamath River below Iron Gate 2007, 2008

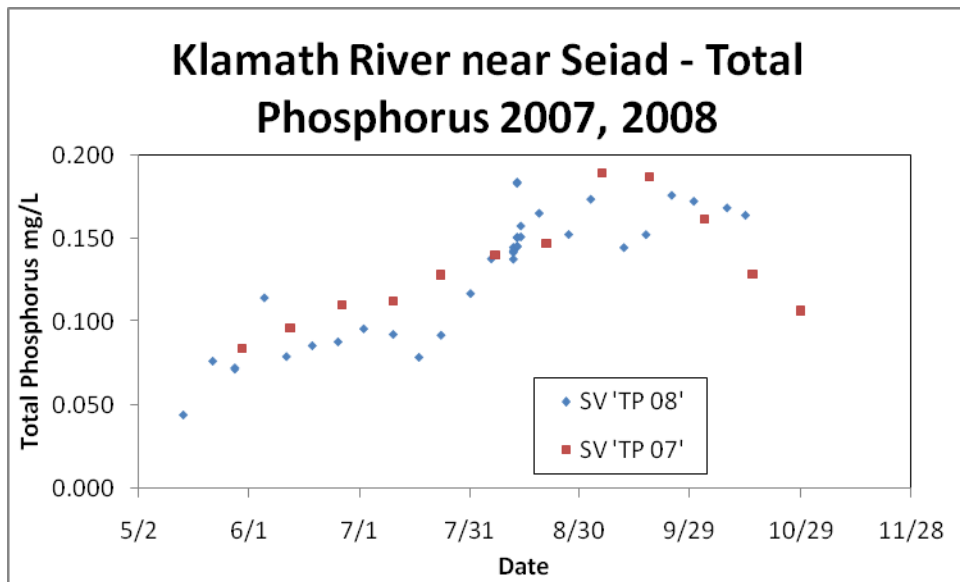


Figure 52 – Total Phosphorus in mg/L for the Klamath River near Seiad Valley 2007, 2008

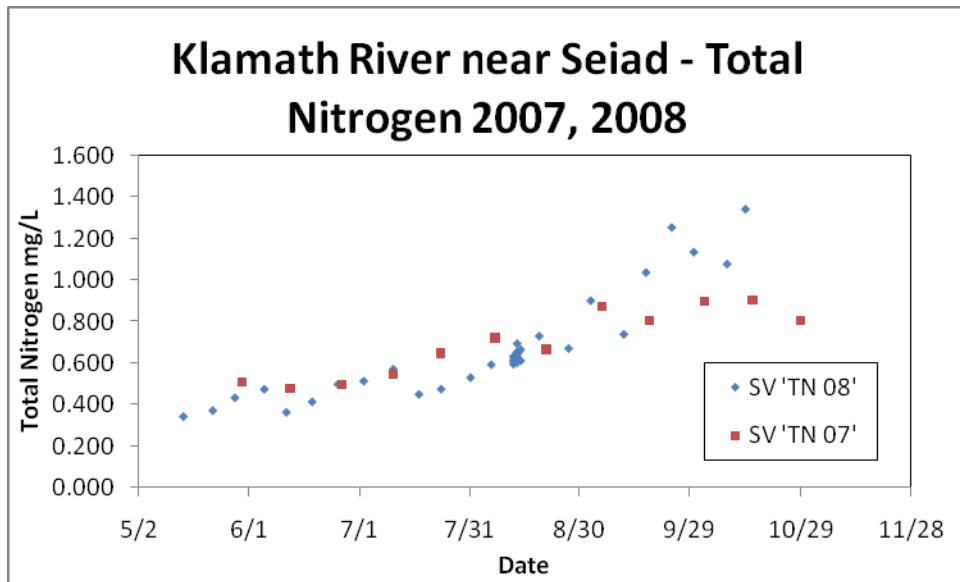


Figure 53 – Total Nitrogen in mg/L for the Klamath River near Seiad Valley 2007, 2008

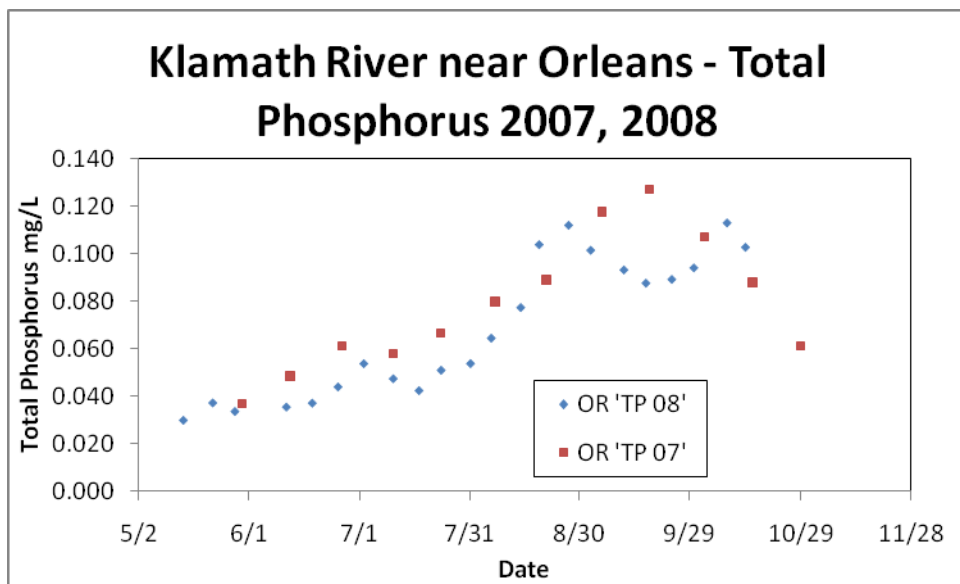


Figure 54 – Total Phosphorus in mg/L for the Klamath River near Orleans 2007, 2008

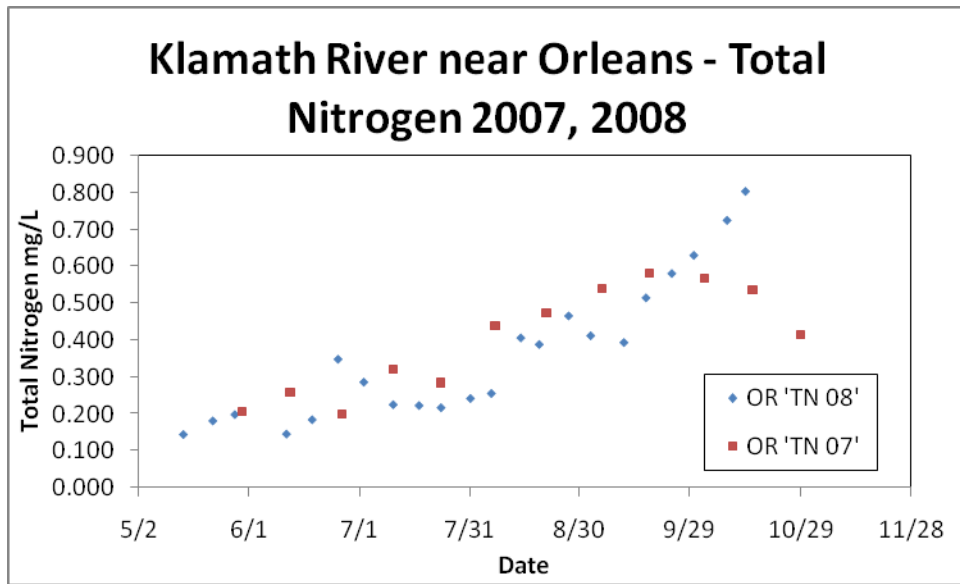


Figure 55 – Total Nitrogen in mg/L for the Klamath River near Orleans 2007, 2008

6.2 Tributaries

6.2.1 Shasta River

6.2.1.1 Water Temperature

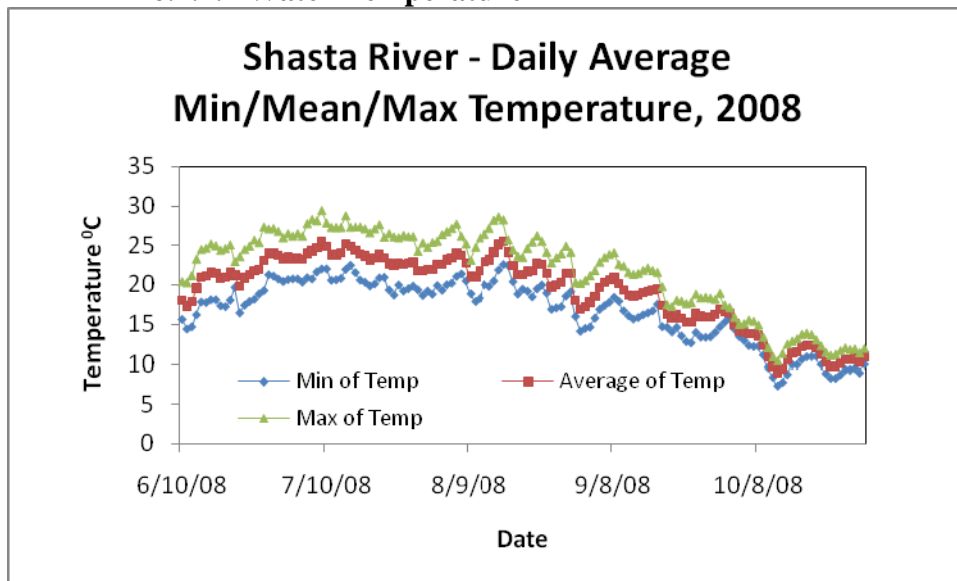


Figure 56- Daily maximum, mean, and minimum water temperature in the Shasta River from June to October, 2008

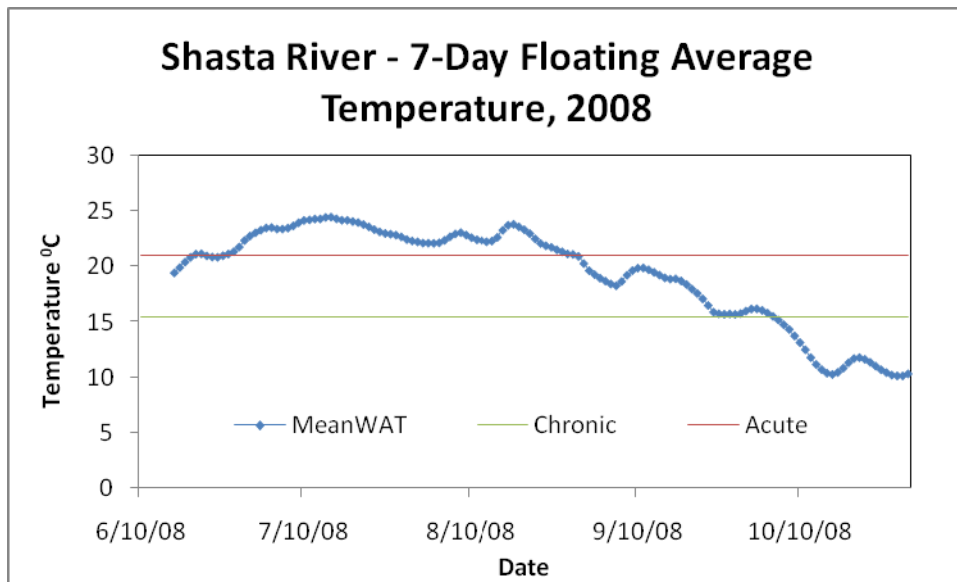


Figure 57 - 7-day floating average temperature for the Shasta River from June to October, 2008. The acute standard (21°C) represents the lethal temperature for salmonids. The chronic temperature (15.5°C) represents the maximum weekly average temperature (MWAT), which is the upper limit for optimum growth for salmonids.

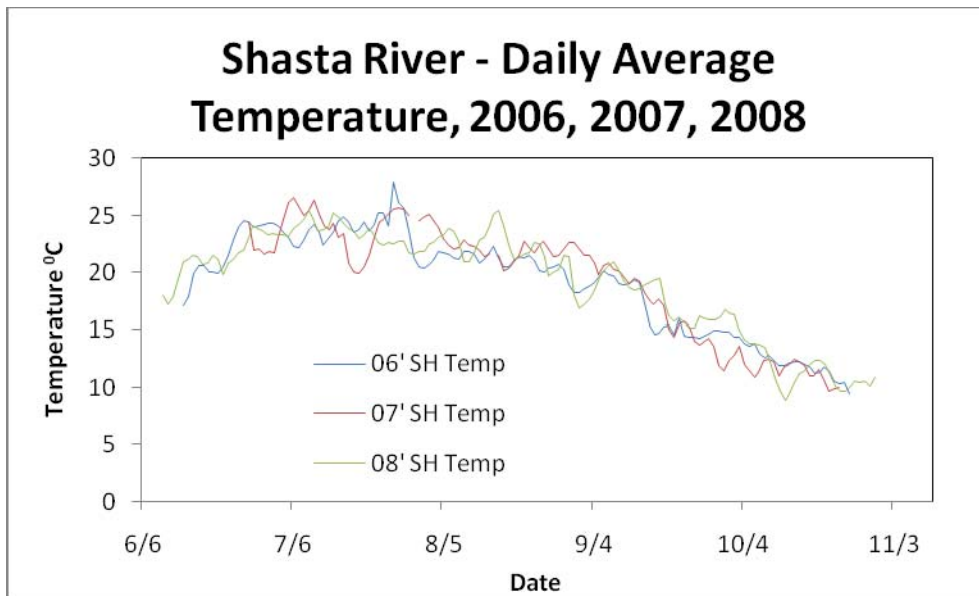


Figure 58 – Daily average temperature for the Shasta River during the 2006, 2007 and 2008 monitoring season

6.2.1.2 Dissolved Oxygen

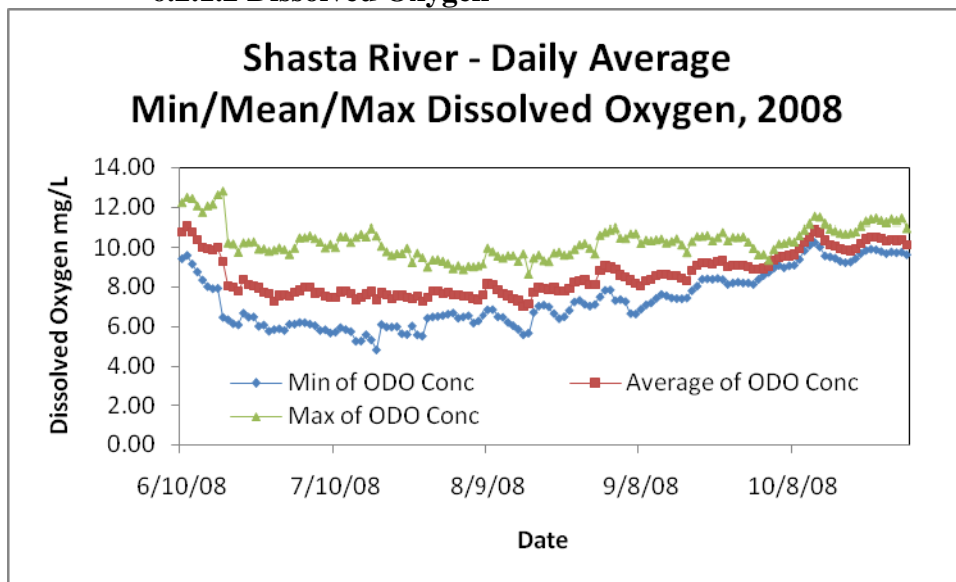


Figure 59 - Daily maximum, mean, and minimum dissolved oxygen in the Shasta River from June to October, 2008

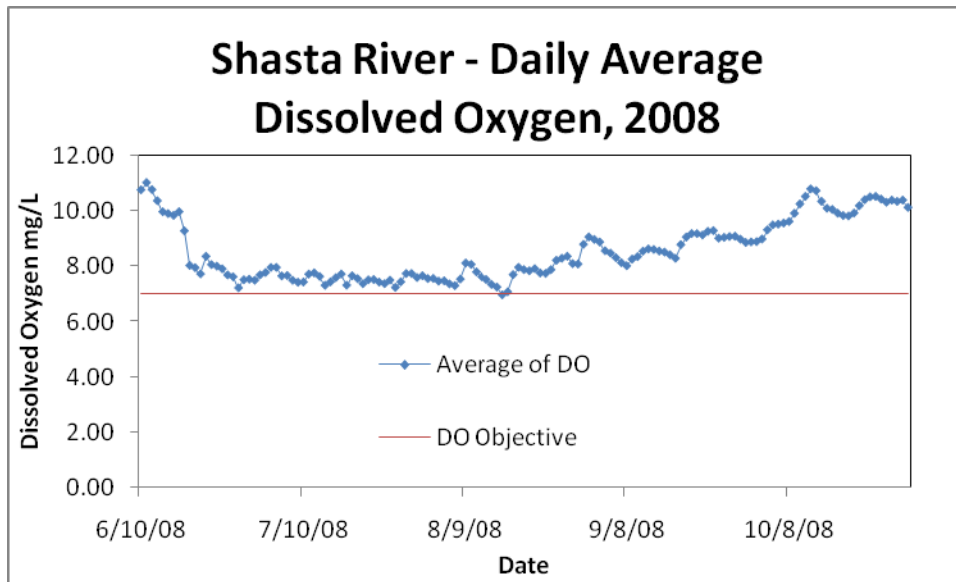


Figure 60 - Daily mean dissolved oxygen in the Shasta River from June to October, 2008

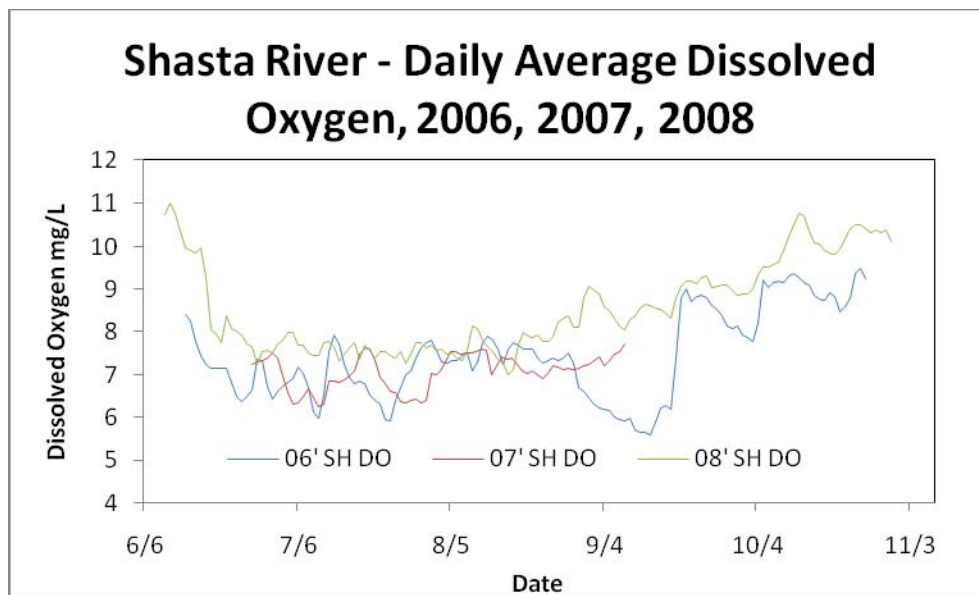


Figure 61 – Daily average dissolved oxygen for the Shasta River for the 2006, 2007 and 2008 monitoring seasons. DO data was collect with Clark’s membrane technology in 2006 and optical technology in 2007, 2008.

6.2.1.3 pH

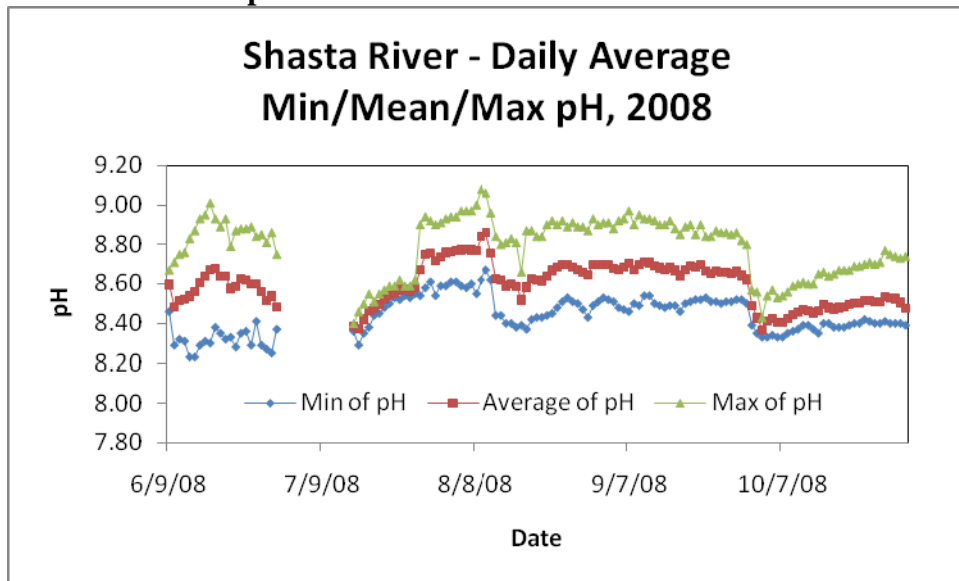


Figure 62 - Daily maximum, mean and minimum pH values on the Shasta River from June to October, 2008

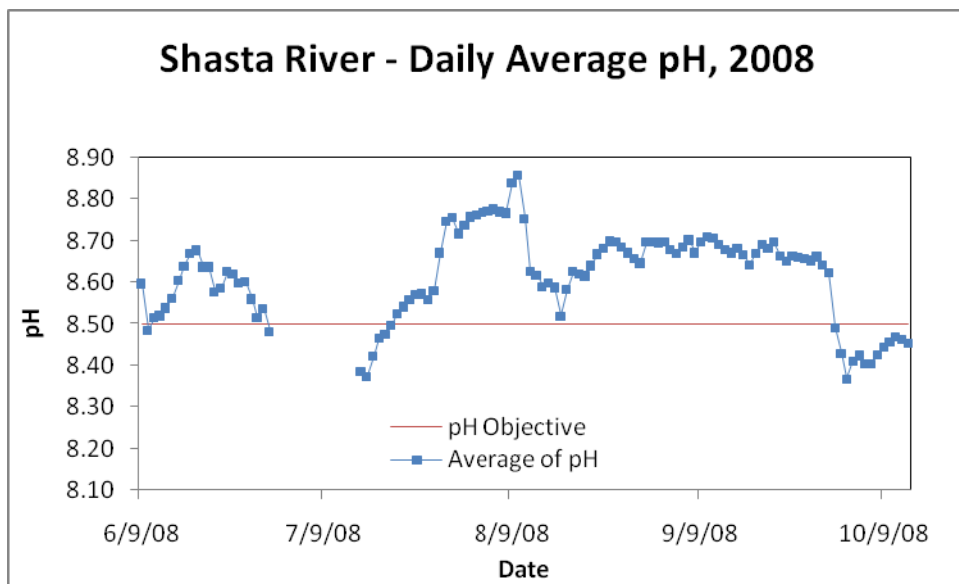


Figure 63 - Daily mean pH values on the Shasta River from June to October, 2008

6.2.1.4 Specific Conductance

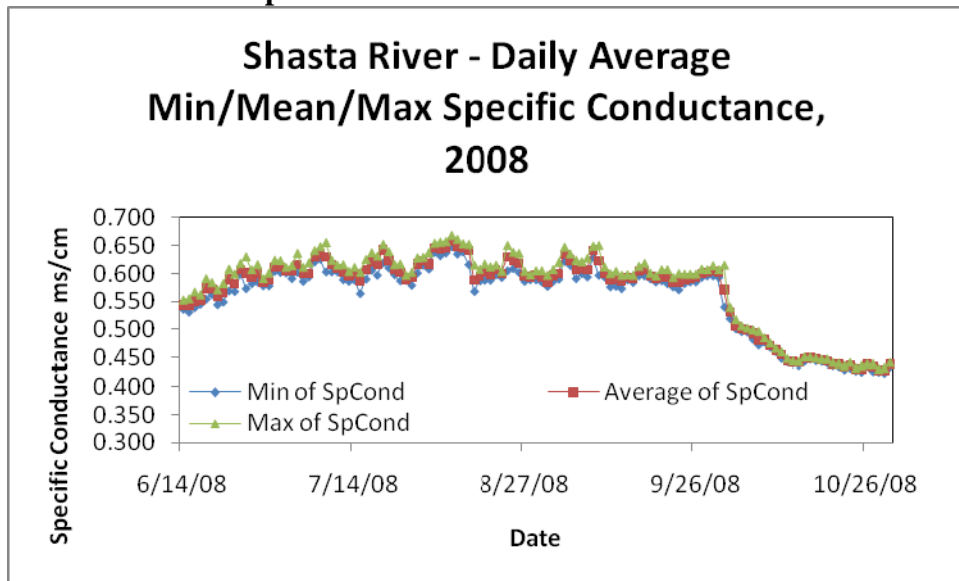


Figure 64 - Daily maximum, mean and minimum specific conductance values on the Shasta River from June to October, 2008

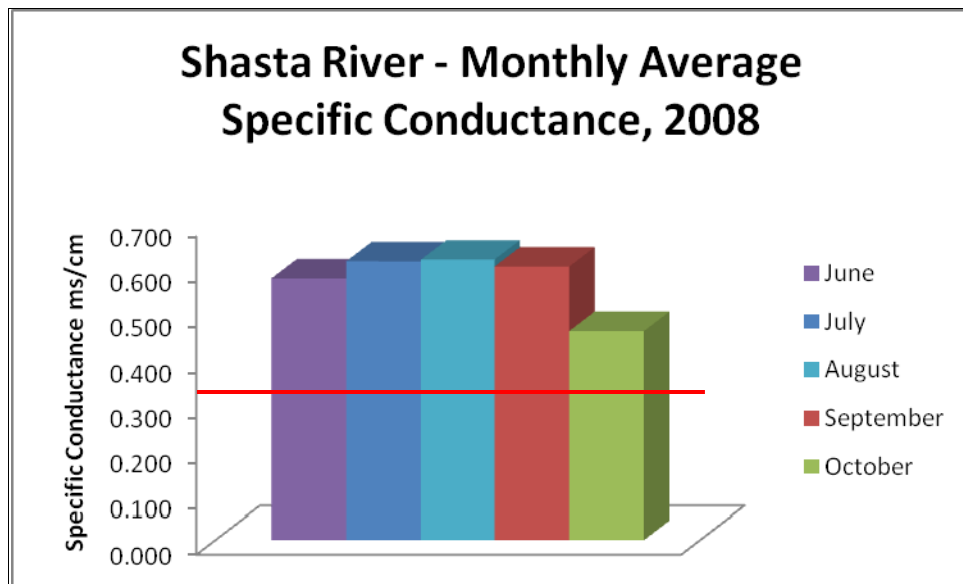


Figure 65 - Monthly average specific conductance from June to October, 2008 with maximum monthly specific conductance objective. June average based on 18 monitored days, July 28 days, August 21 days, September 30 days and October 31 days.

6.2.1.5 Flow

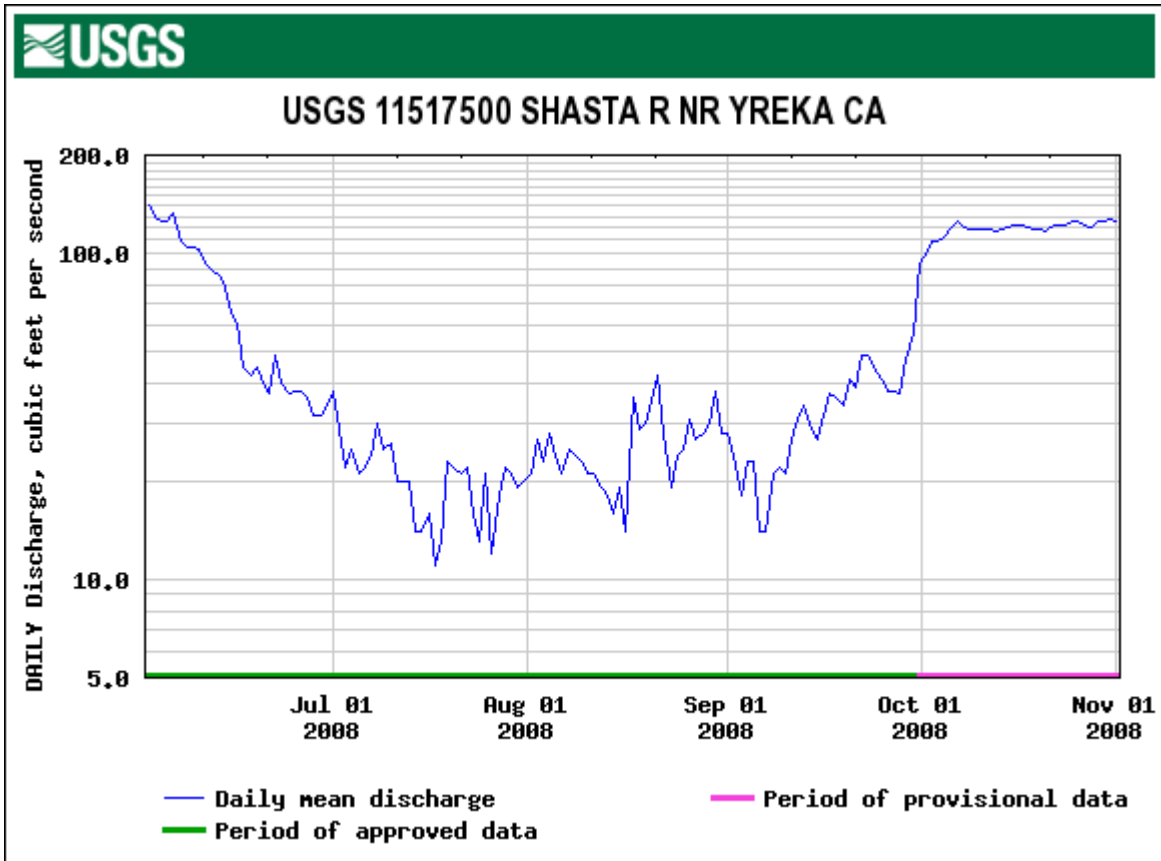


Figure 66 - Daily mean stream flow (Ft³/sec) from the Shasta River at USGS flow gauge from June to October, 2008

6.2.2 Scott River
6.2.2.1 Water Temperature

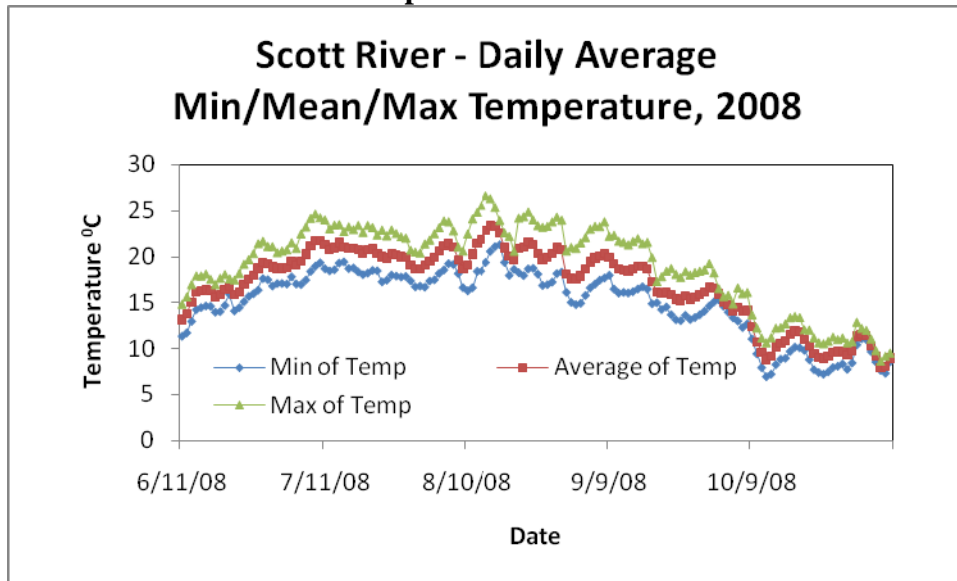


Figure 67 - Daily maximum, mean, and minimum water temperature in the Scott River from June to October, 2008

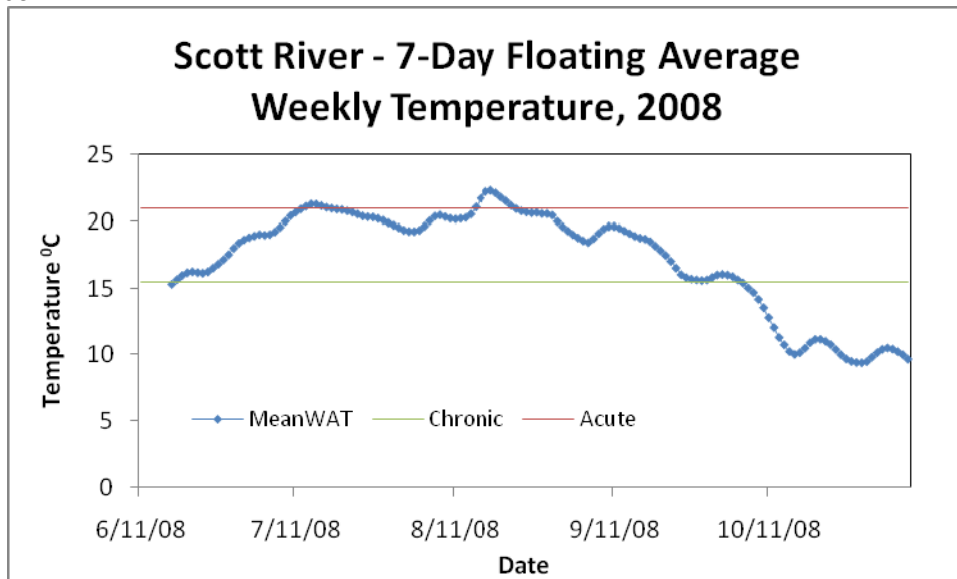


Figure 68 – 7-day floating average temperature for the Scott River from June to October, 2008. The acute standard (21⁰C) represents the lethal temperature for salmonids. The chronic temperature (15.5⁰C) represents the maximum weekly average temperature (MWAT), which is the upper limit for optimum growth for salmonids.

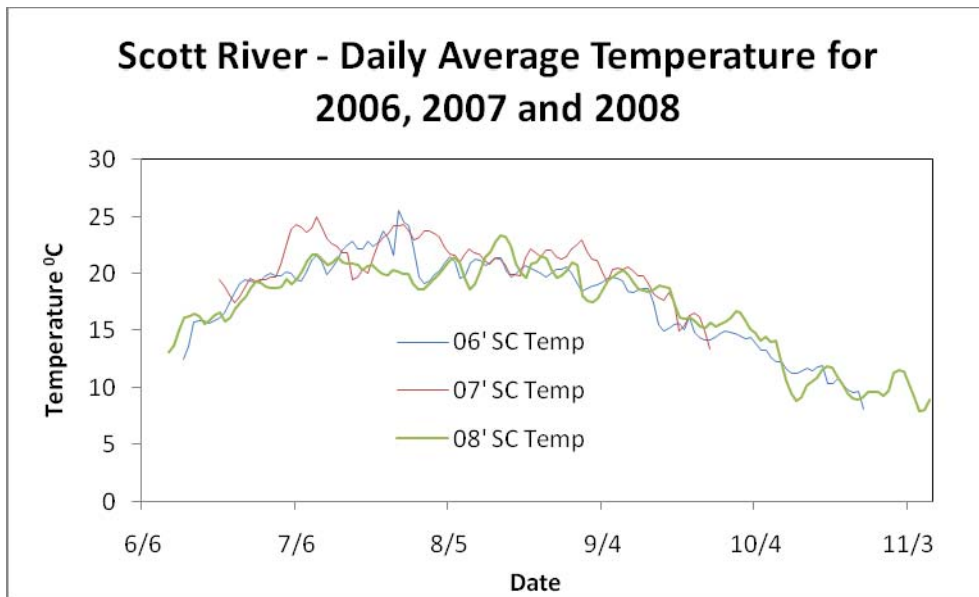


Figure 69 – Daily average temperature for the Scott River during the 2006, 2007 and 2008 monitoring seasons

6.2.2.2 Dissolved Oxygen

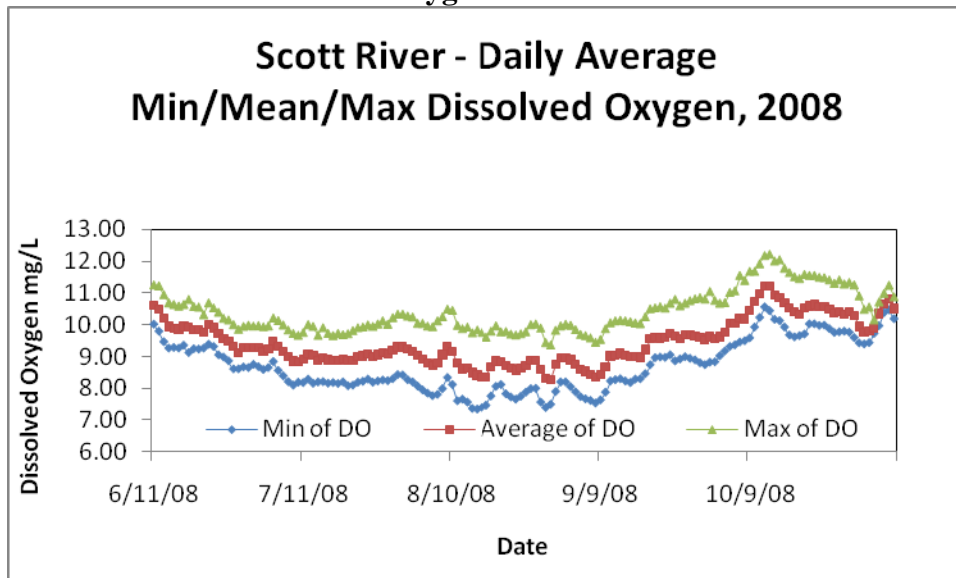


Figure 70 - Daily maximum, mean, and minimum dissolved oxygen in the Scott River from June to October, 2008

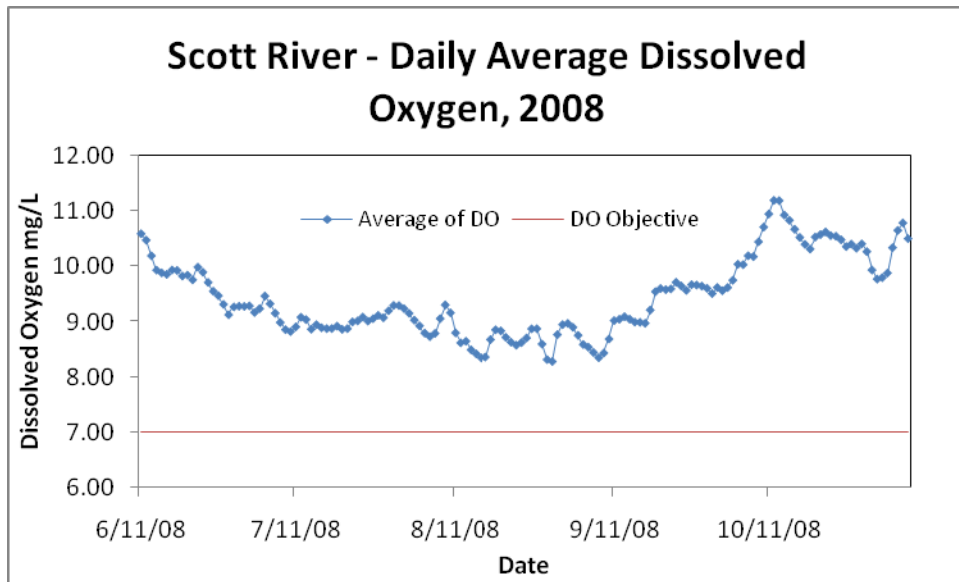


Figure 71 - Daily mean dissolved oxygen in the Scott River from June to October, 2008

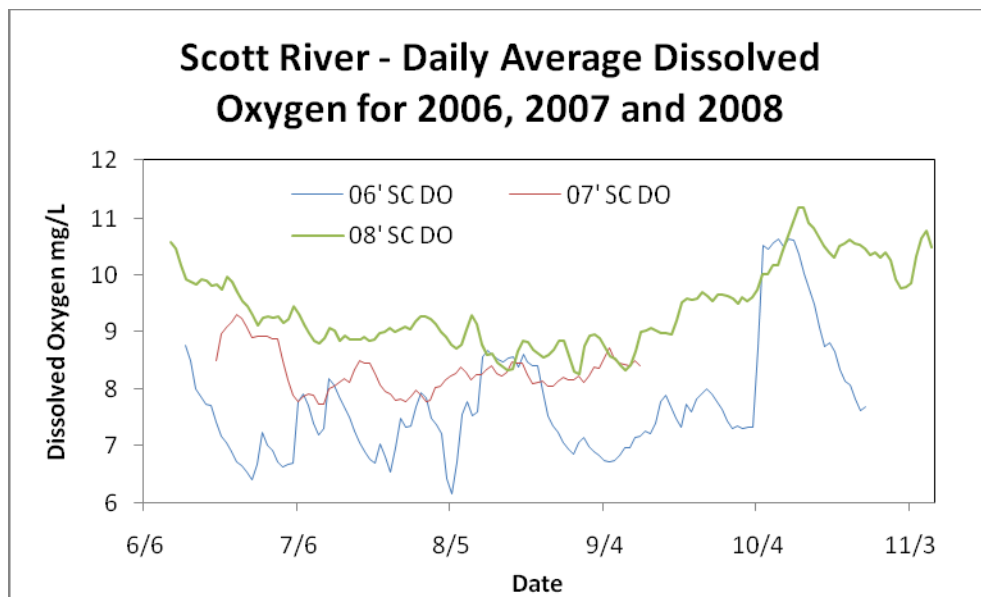


Figure 72 - Daily average dissolved oxygen for the Scott River during the 2006, 2007 and 2008 monitoring season. DO data was collect with Clark's membrane technology in 2006 and optical technology in 2007, 2008.

6.2.2.3 pH

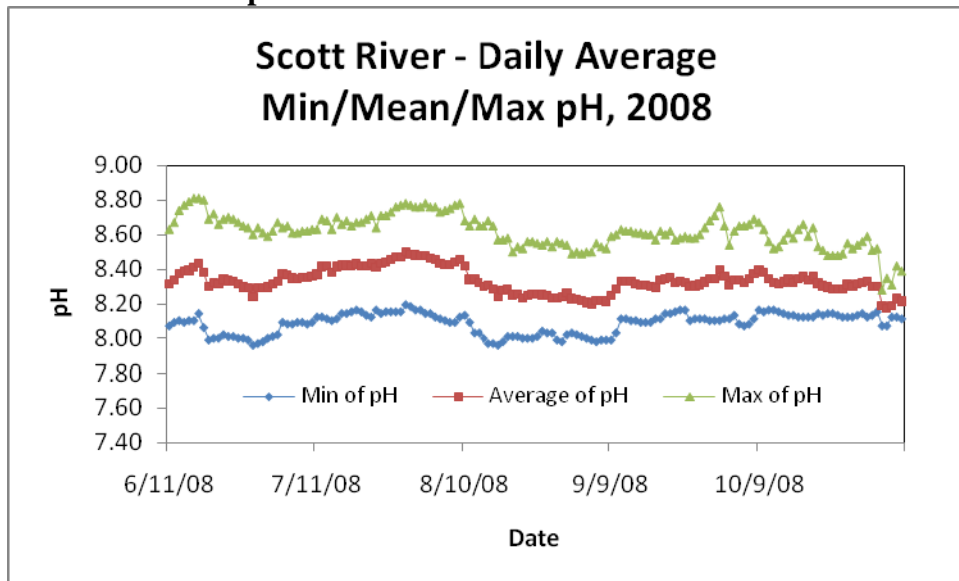


Figure 73 - Daily maximum, mean, and minimum pH values on the Scott River from June to October, 2008

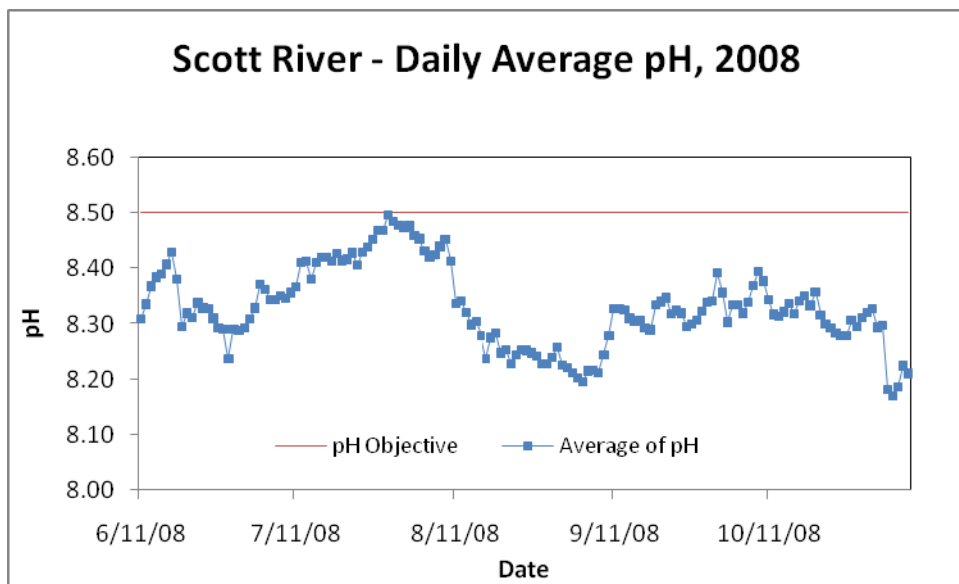


Figure 74 - Daily mean pH values on the Scott River from June to October, 2008

6.2.2.4 Specific Conductance

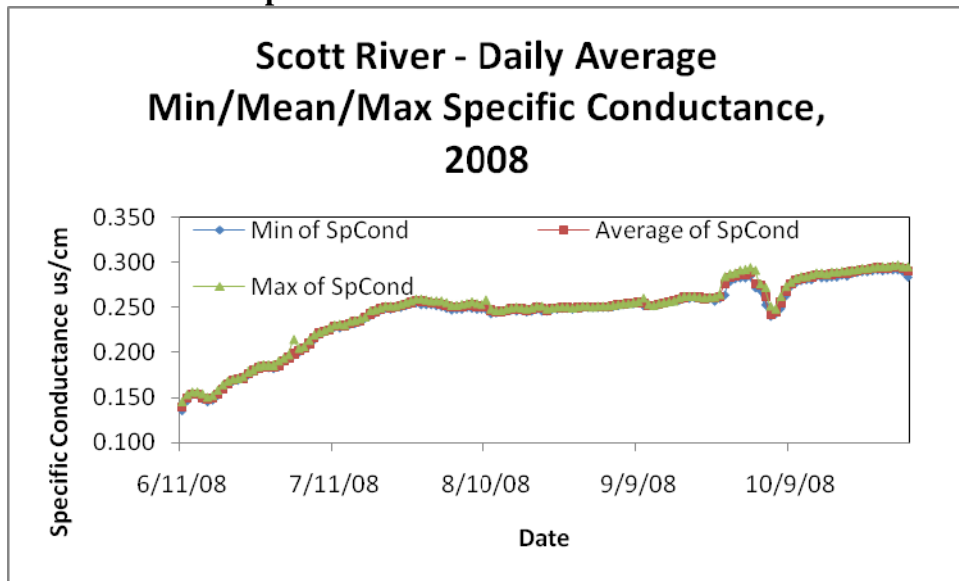


Figure 75 - Daily maximum, mean, and minimum specific conductivity in the Scott River from June to October, 2008

6.2.2.5 Flow

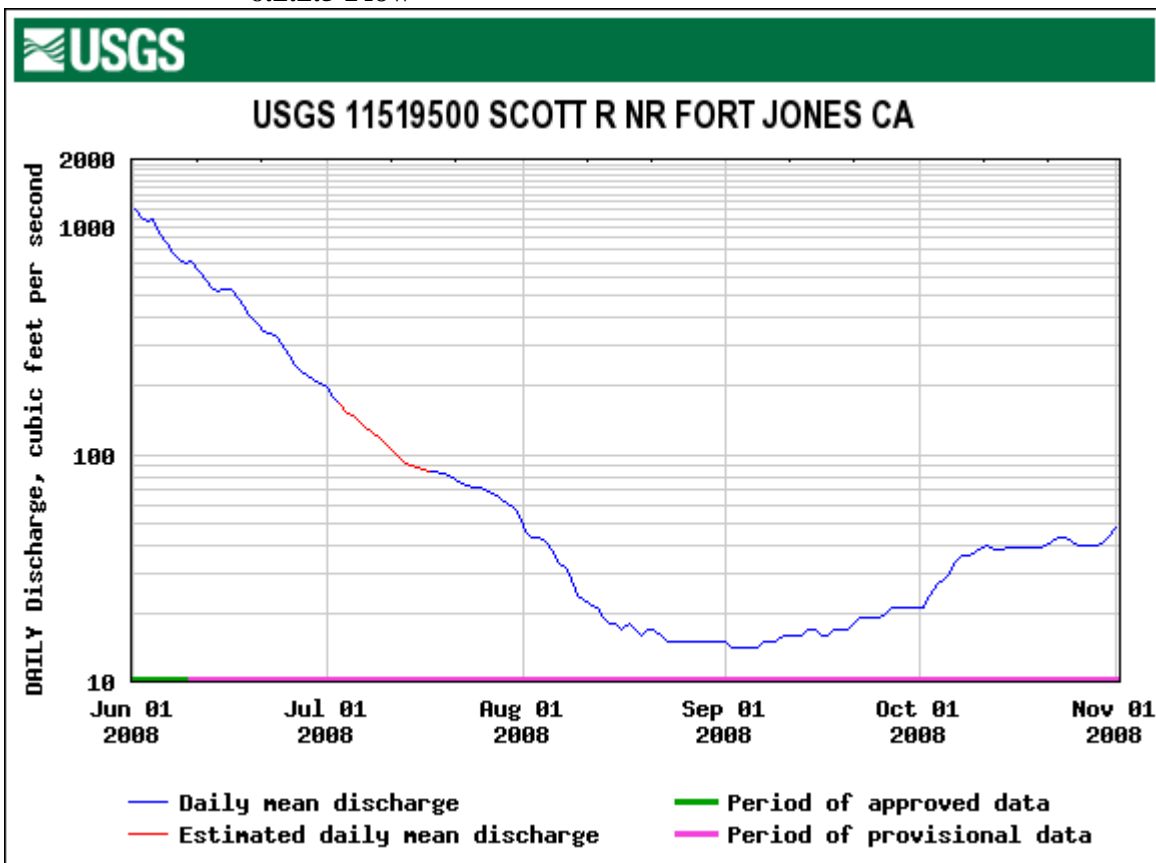


Figure 76 - Daily mean stream flow (ft^3/sec) from the Scott River at the Fort Jones USGS flow gauge from June to October, 2008

6.2.3 Salmon River
6.2.3.1 Water Temperature

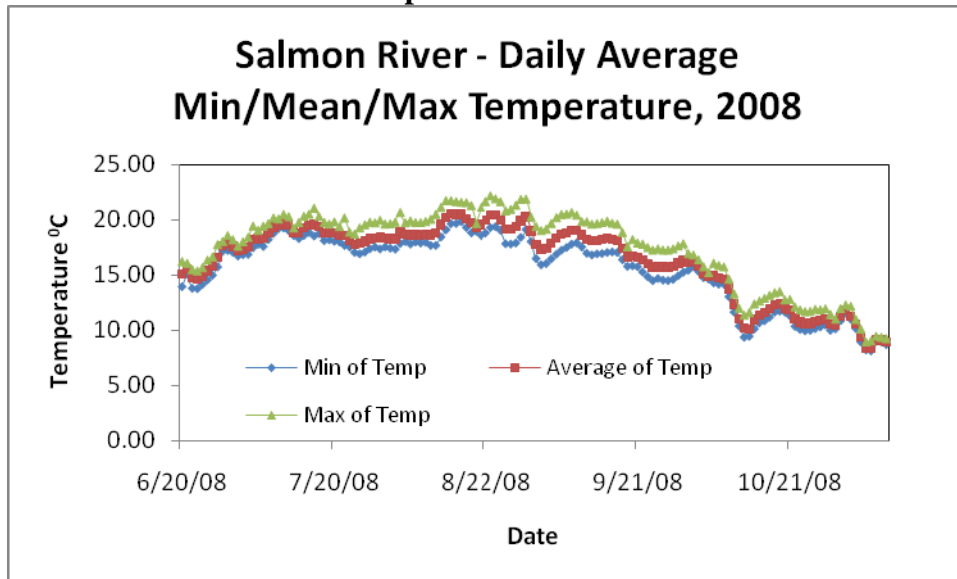


Figure 77 - Daily maximum, mean, and minimum water temperature in the Salmon River from June to October, 2008

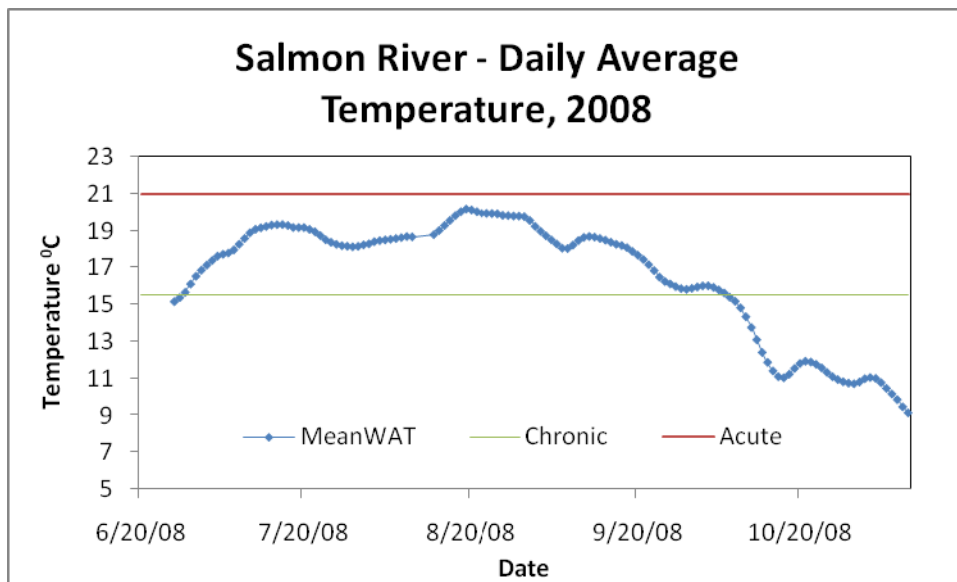


Figure 78 – 7-day floating average temperature for the Salmon River from May to October, 2008. The acute standard (21⁰C) represents the lethal temperature for salmonids. The chronic temperature (15.5⁰C) represents the maximum weekly average temperature (MWAT), which is the upper limit for optimum growth for salmonids.

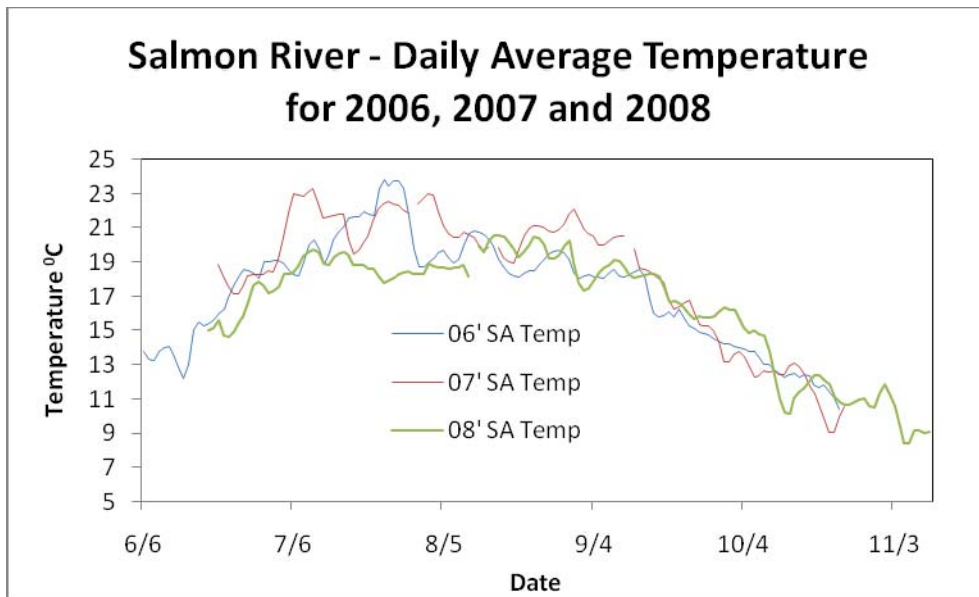


Figure 79 – Daily average temperature for the Salmon River during the 2007 and 2008 monitoring seasons

6.2.3.2 Dissolved Oxygen

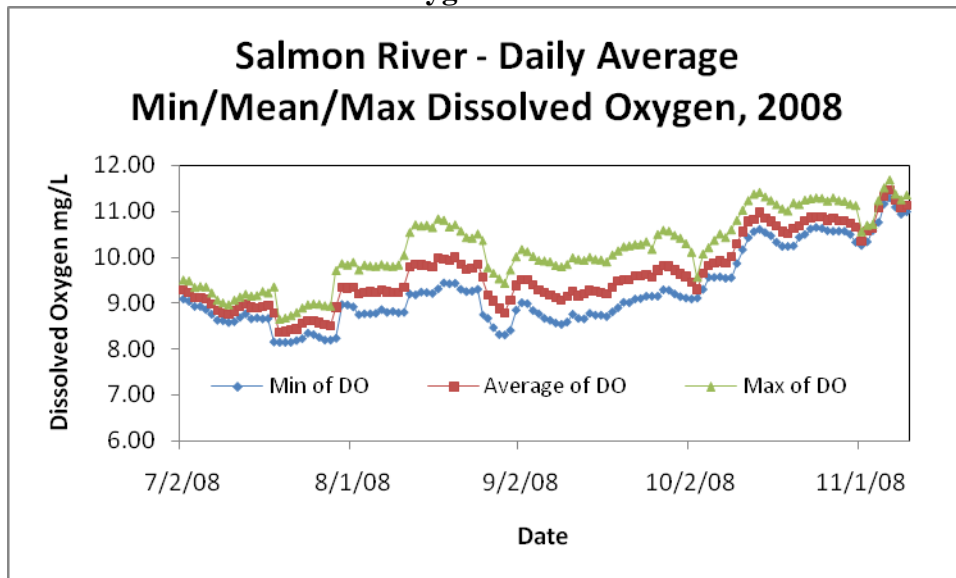


Figure 80 - Daily maximum, mean, and minimum of dissolved oxygen in the Salmon River from May to October, 2008

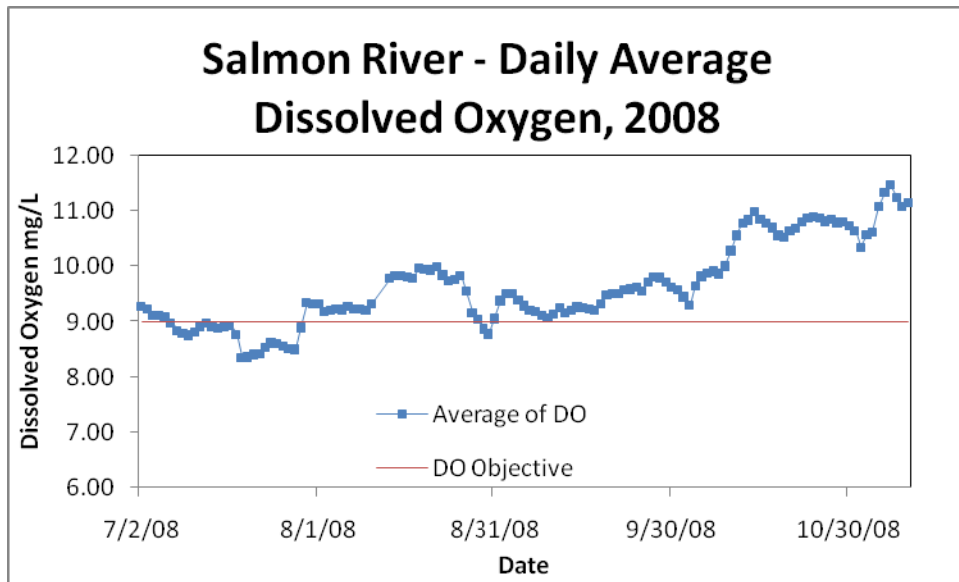


Figure 81 - Daily mean dissolved oxygen in the Salmon River from June to October, 2008

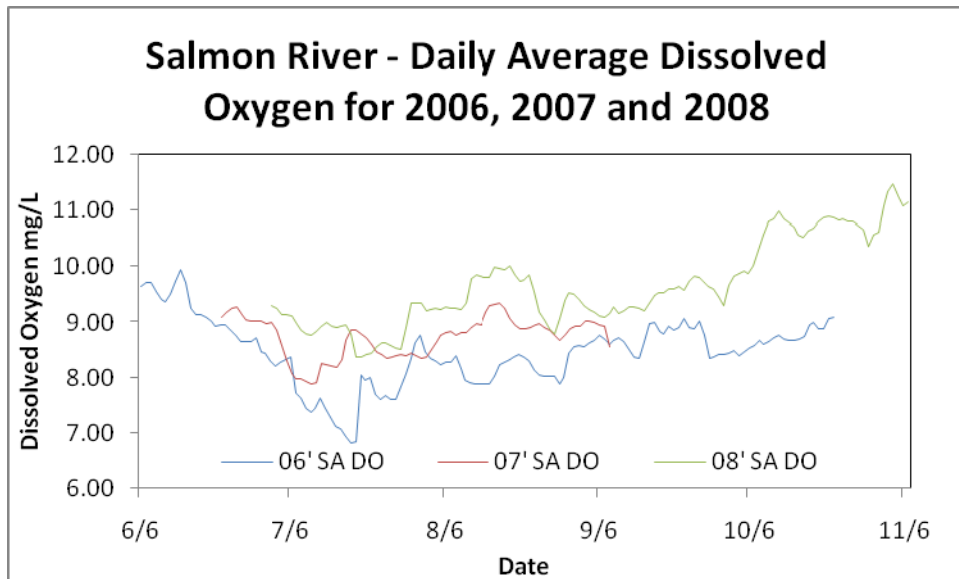


Figure 82 – Daily average dissolved oxygen for the Salmon River during the 2006, 2007 and 2008 monitoring seasons. DO data was collect with Clark’s membrane technology in 2006 and optical technology in 2007, 2008.

6.2.3.3 pH

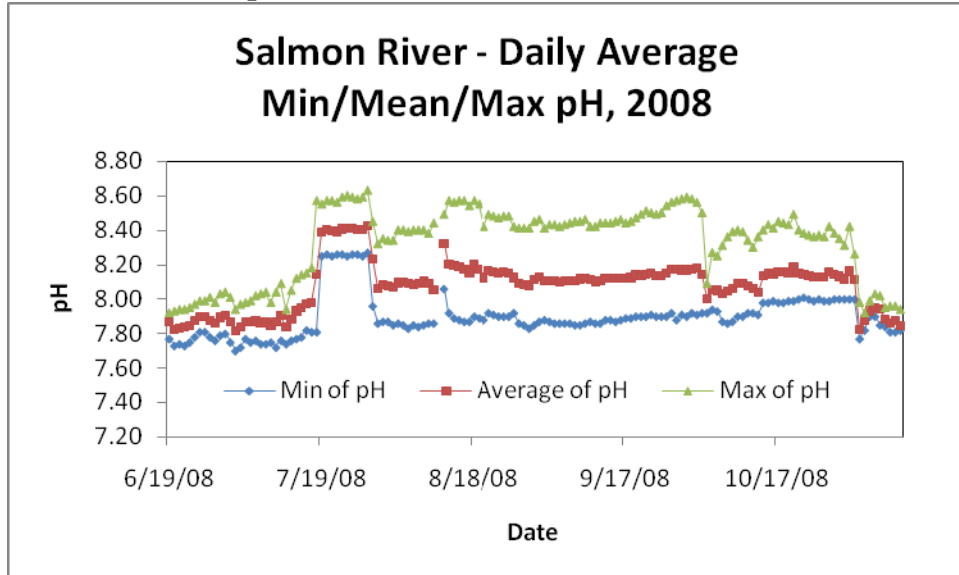


Figure 83 - Daily maximum, mean and minimum pH values on the Salmon River from June to October, 2008

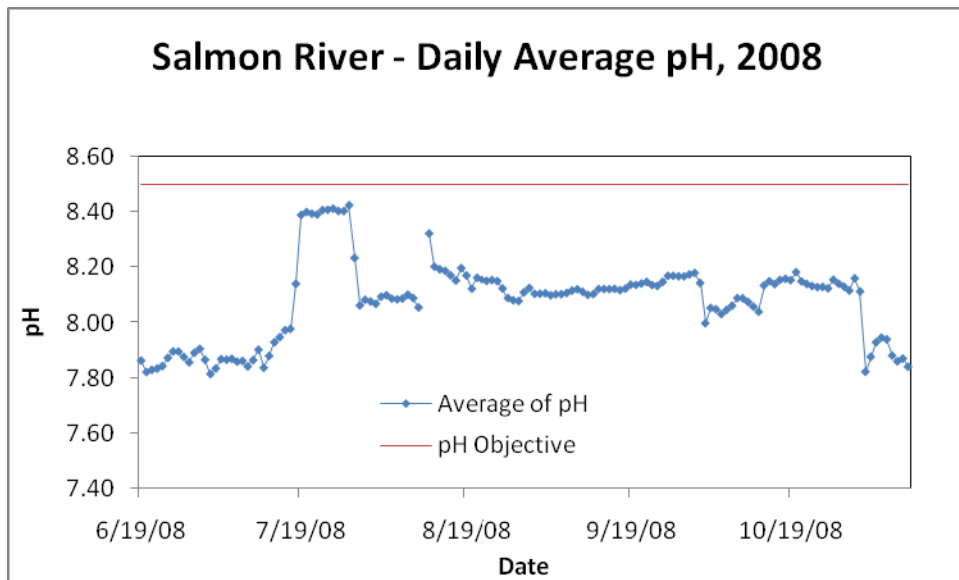


Figure 84 - Daily mean pH values on the Salmon River from June to October, 2008

6.2.3.4 Specific Conductance

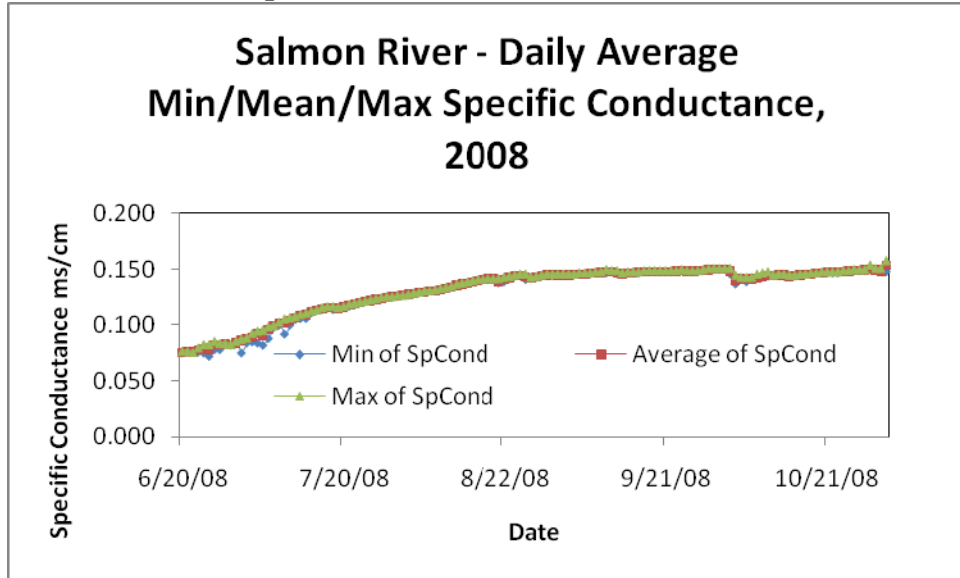


Figure 85 - Daily maximum, mean, and minimum specific conductivity values in the Salmon River from June to October, 2008

6.2.3.5 Flow

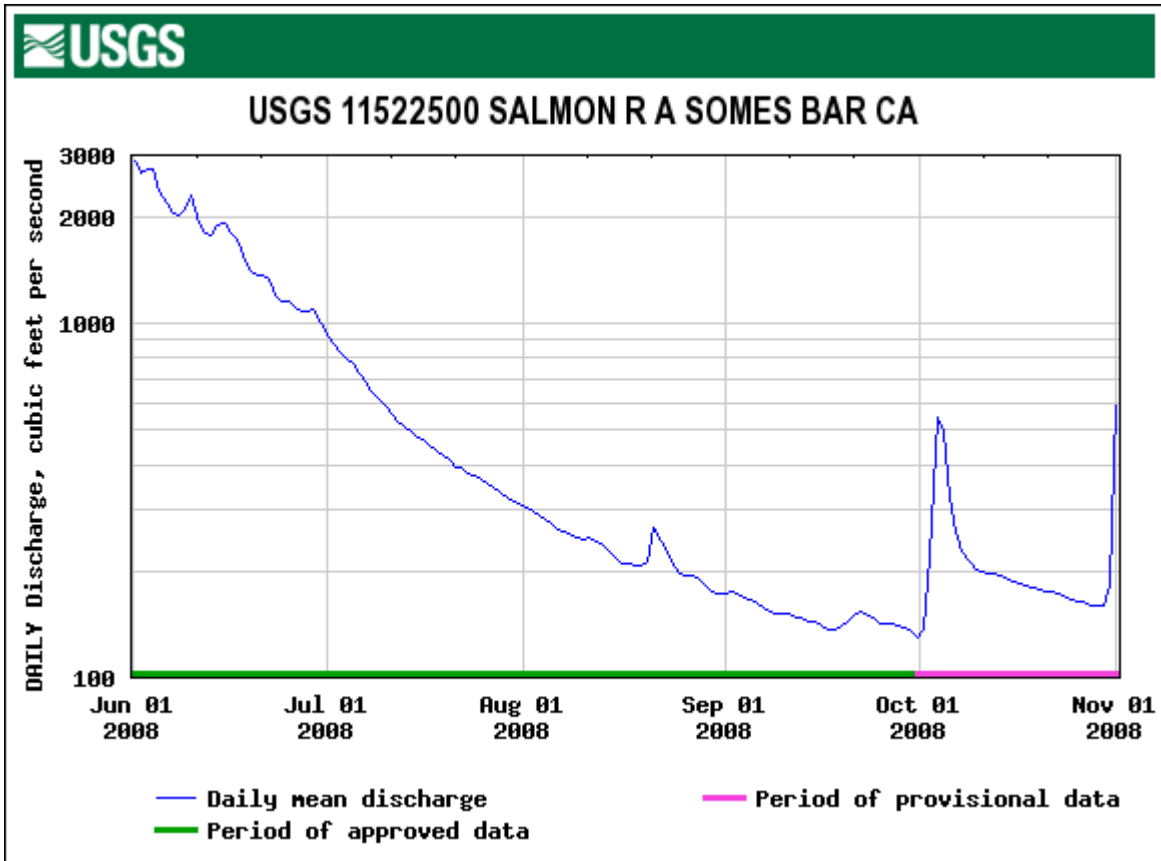


Figure 86 - Daily mean stream flow (ft^3/sec) from the Salmon River at the Somes Bar USGS flow gauge from June to October, 2008

6.2.4 Nutrients

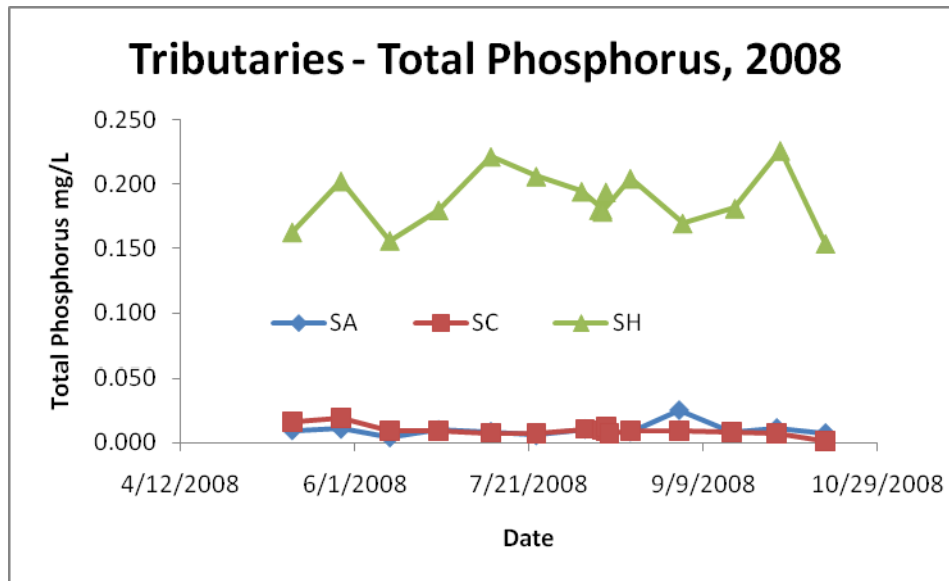


Figure 87 - Phosphorus in mg/L for Scott, Salmon, and Shasta River sites from May to Oct, 2008.

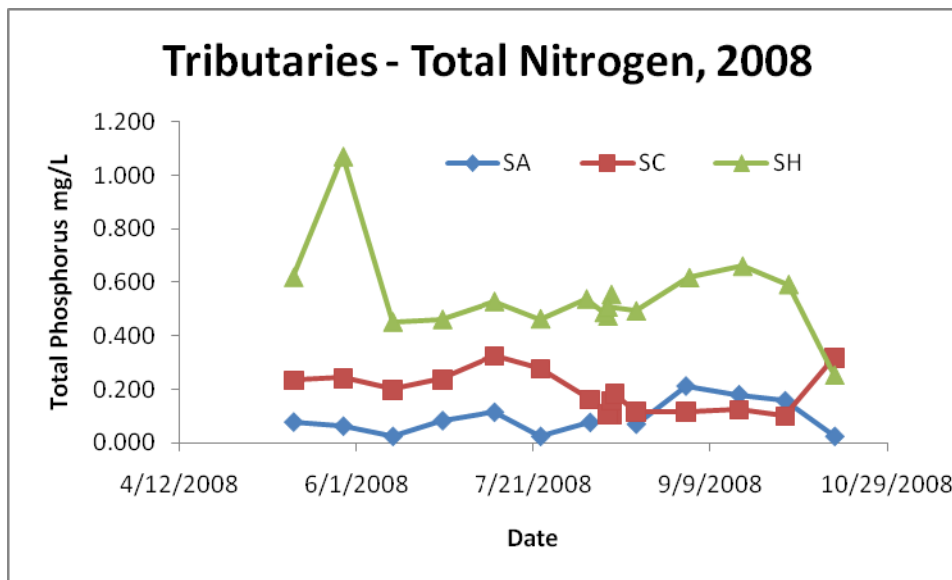


Figure 88 - Nitrogen in mg/L for Scott, Salmon, and Shasta River sites from May to Oct, 2008.

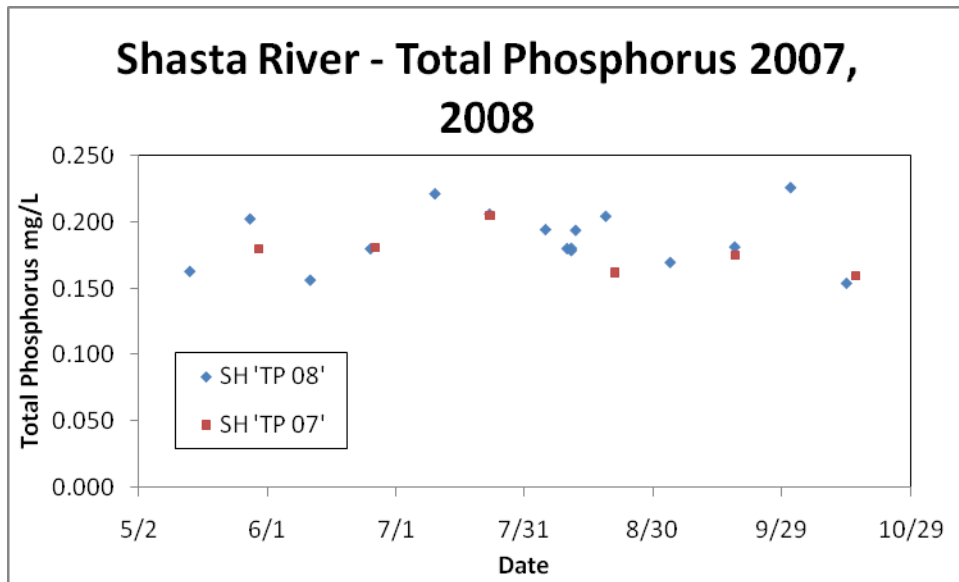


Figure 89 – Total phosphorus in mg/L for Shasta River 2007, 2008

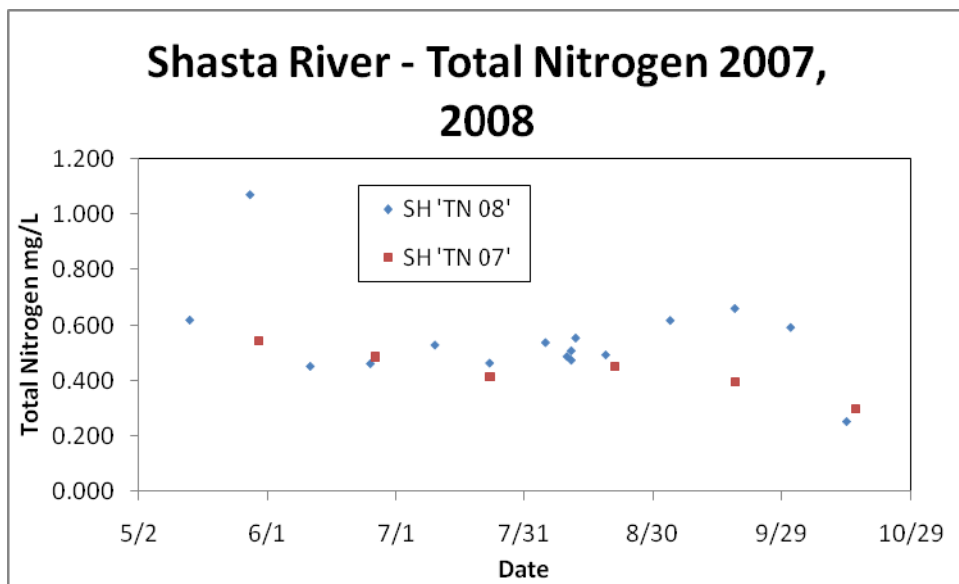


Figure 90 – Total Nitrogen in mg/L for Shasta River 2007, 2008

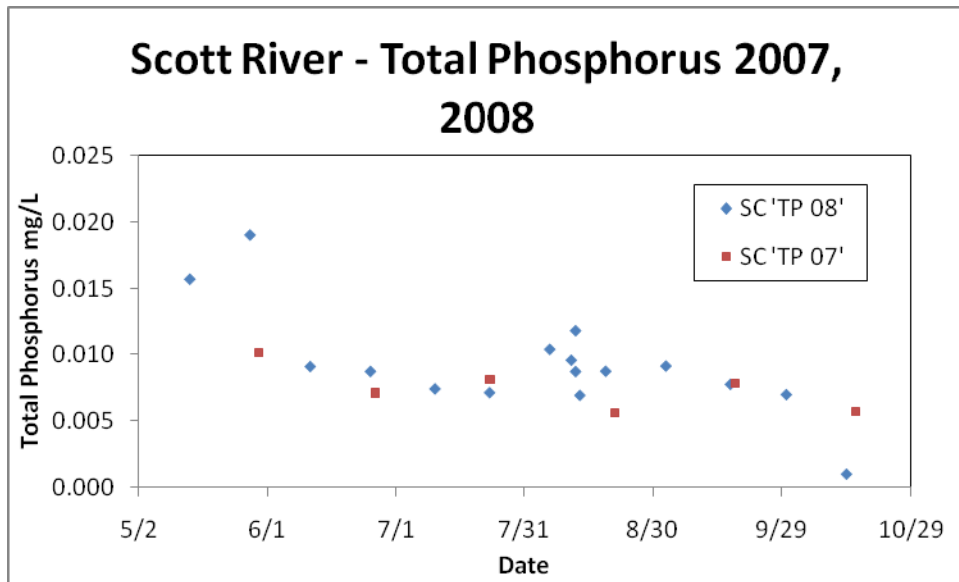


Figure 91 – Total Phosphorus for the Scott River 2007, 2008

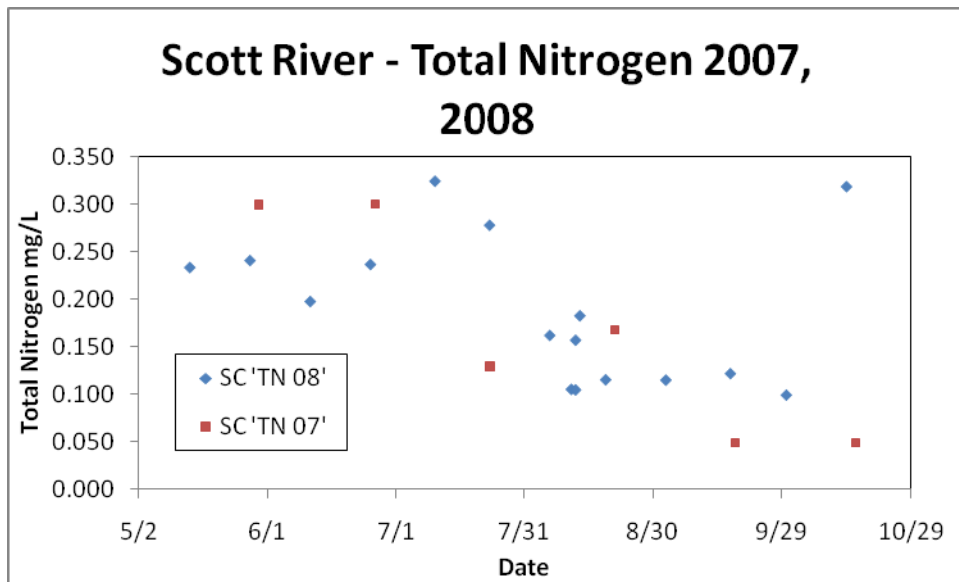


Figure 92 – Total Nitrogen for the Scott River 2007, 2008

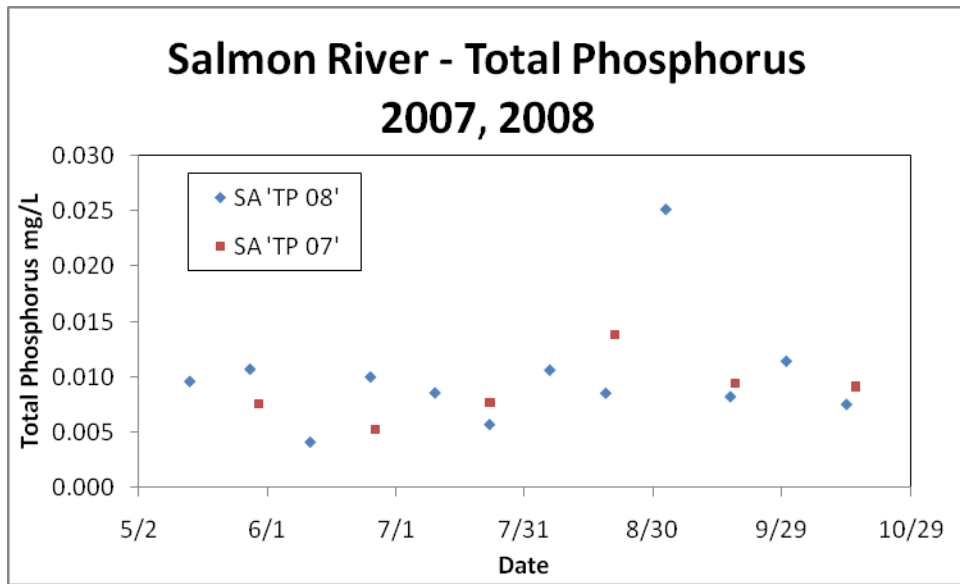


Figure 93 – Total Phosphorus for the Salmon River 2007, 2008

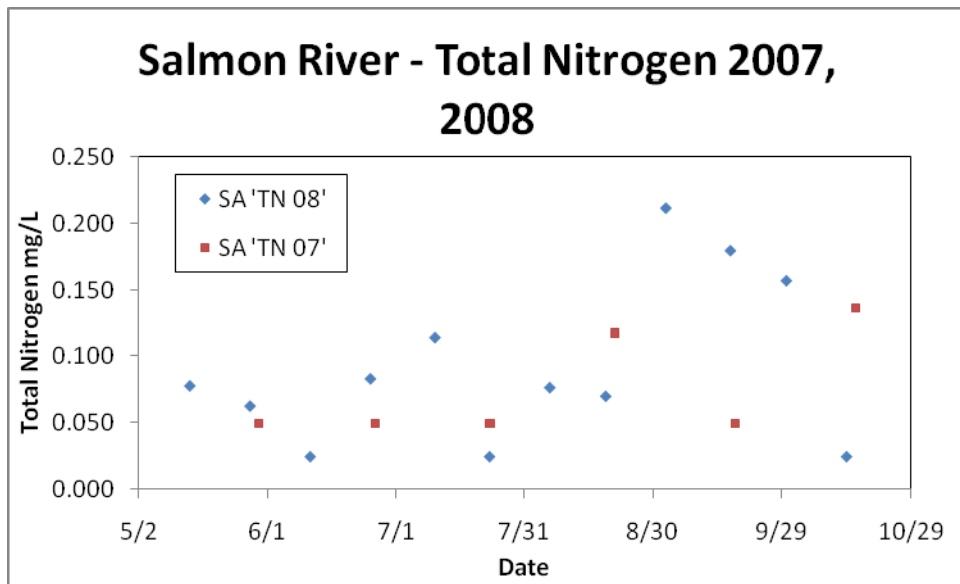


Figure 94 – Total Nitrogen for the Salmon River 2007, 2008

6.3 Turbidity

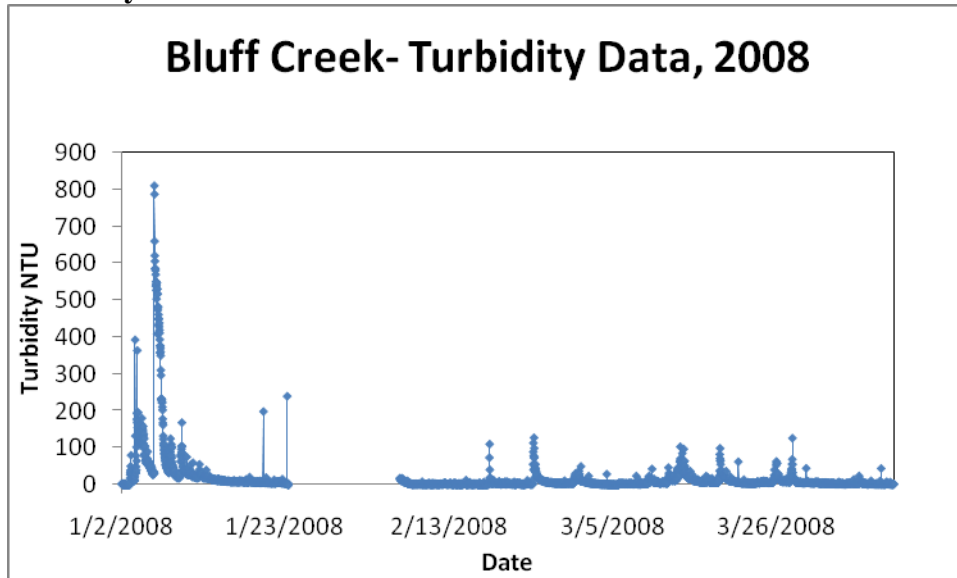


Figure 95 – Winter turbidity data for Bluff Creek taken every half hour.

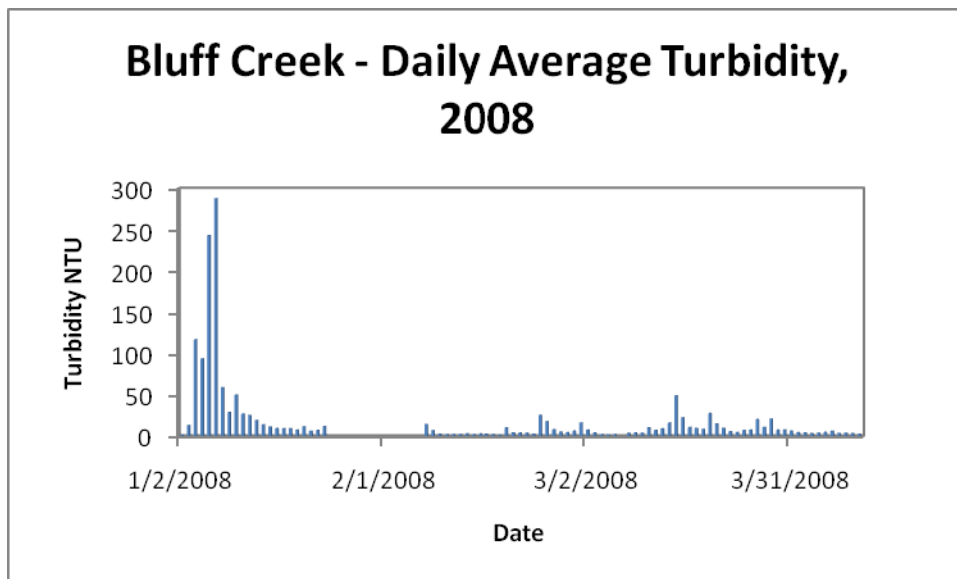


Figure 96 – Daily average turbidity data for Bluff Creek.

7.0 DISCUSSION

Water temperature, for all of the monitoring sites, increased rapidly during July (Figures [15](#), [26](#), [37](#), [56](#), [67](#), [77](#)). The Iron Gate site peaks and then levels off, while the Orleans site shows two peaks: one in July and one in August. The Seiad Valley site shows a spike in July. Missing data in August makes it difficult to determine if an additional temperature spike occurred in August. The Scott and Salmon Rivers showed the general trend of warming through June and July and peaking in August. Temperature in the Shasta River peaked earlier in July. The earlier

temperature peak on the Shasta River is related to the River being dewatered for agricultural use earlier than the Scott River (Figures [66](#), [76](#)). Water temperatures for all monitored sites exceeded tribally adopted water quality standards in the summer of 2008 and were therefore not supportive of beneficial uses. The Karuk Tribe is concerned about the high water temperatures and the duration of the high water temperatures in the Klamath River and major tributaries.

Floating weekly average temperatures (FWAT) are a common method of assessing water temperatures. These calculations require 7 consecutive days of data, thus if one day of data is missing FWAT cannot be calculated for the next 6 days. Gaps in the FWAT graphs are results of missing days of data however the general trends are clear (Figures [16](#), [27](#), [38](#), [57](#), [68](#), [78](#)). For all the monitored waters, water temperatures were continually above the chronic temperature level (upper limit for optimum growth for salmonids) from July to September. The mainstem sites were above the acute (lethal) level during temperature spikes and near the acute level July to August. The Salmon and Scott River had very few days over the acute threshold, but were in exceedance of the chronic threshold throughout July and August. The Shasta River was in exceedance of the acute threshold from early July through August. In the Salmon River, high temperatures are due in part to reduction of riparian vegetation, logging, inadequate management of the watershed for fire, and historical hydraulic mining operations. In the Scott and Shasta, high temperatures are due in part to agricultural use, groundwater pumping, logging practices, and historical hydraulic mining operations. The Shasta River experienced the highest temperatures for the longest period of time with 60 days above the acute temperature threshold ([Table 9](#)). The Klamath River mainstem was in exceedance of the temperature objectives throughout the summer till around October (Figures [16](#), [27](#), [38](#)) and showed higher overall temperatures for a longer duration as one moves down the river ([Table 8](#)). In comparing temperature during the summer of 2006, 2007 and 2008 we see similar overall trends regarding temperature increases and decreases, as well as the timing of peak temperature. 2008 had slightly lower peak temperatures than the preceding two years (Figures [17](#), [28](#), [39](#)).

Dissolved Oxygen levels (DO) in the Klamath increase as one moves down river from Iron Gate dam ([Table 8](#)). The Seiad Valley site is missing 23 days of DO data during the middle to end of August due to probe failure. The site below Iron Gate Dam had 67 monitored days primarily during June and August that the DO objective was not met (Figure [19](#)). Approximately 150 miles downriver, the Orleans site had no days when DO was below the minimum level ([Table 8](#)). The increase in DO levels downstream of Iron Gate dam is expected due to increased mixing, increased distance from the reservoir, and addition of tributary water. The Scott and Salmon Rivers maintained DO levels above the standard throughout the summer months (Figures [71](#), [81](#)). The Shasta River had 1 day during the monitoring season when average DO was below the objective ([Table 9](#), Figure [60](#)). In comparing 2006, 2007 and 2008 DO levels, slightly higher overall concentrations were recorded in 2008 (Figures [20](#), [31](#), [42](#), [61](#), [72](#), [82](#)). This trend is more apparent in the tributary data than the mainstem. This could be due in part to the use of newer optical DO probes and better calibration practices. The Salmon River and the Klamath River near Orleans sites show signs of drift (Figure [40](#), [81](#)). This was caused by inaccurate field calibrations. The data was included because these errors can be corrected for, but we do not currently have the capability to do this.

All the monitoring sites had pH measurements on the basic side (Figures [22](#), [33](#), [44](#), [63](#), [74](#), [84](#)). The Shasta River had 102 monitored days in non compliance with the pH objective ([Table 9](#)). The Klamath River site near Seiad had 5 days in exceedance of the pH water quality standard

([Table 8](#)). We experienced probe failures at the Klamath River near Iron Gate and Seiad sites that resulted in pH data gaps ([Figures 22, 33](#)). Salmon River has a data shift during the month of July ([Figure 83, 84](#)). This data although not accurate can be corrected at a later time.

The Shasta River was the only tributary site to exceed the objective for specific conductance. The Shasta was not in compliance with this objective throughout the summer months ([Figure 65](#)). All other sites were well below the threshold for specific conductivity ([Figures 23, 34, 45, 64, 75, 85](#)).

The 2008 nutrient data for the Klamath River showed the Iron Gate and Walker Bridge sites had higher concentrations of both total nitrogen and total phosphorus than downriver sites throughout the monitoring season ([Figures 48, 49](#)). This could be due to nutrient spiraling occurring in the free-flowing stretch of the River leading to nutrient assimilation and dilution from tributary inputs. At Klamath River sites sampled, total phosphorus peaked around the end of September. In the tributaries the Shasta River had the highest total phosphorus and nitrogen concentrations throughout the monitoring season ([Figure 87, 88](#)). Looking at the 2007 and 2008 data, the general trends between years seem to be very similar ([Figures 50-55, 89-94](#)).

Turbidity data for Bluff creek showed a peak during January ([Figure 95, 96](#)). Daily turbidity averages show Bluff Creek leveling off at under 50 NTU February through March ([Figure 96](#)). The Salmon River probe did not function properly.

Some of the changes and improvements anticipated for the 2009 monitoring season include hooking up the Iron Gate site for real-time monitoring. This will allow all 3 datasondes stations in the mainstem Klamath to be accessed real-time on the web. We are continuing to pursue the use of data correction software to allow for adjusting drift in the data. Turbidity data will be collected using YSI sondes. This will hopefully address the numerous problems we had with the older HydroLab probes. We also experienced pH probe failures this year at the Klamath River near Iron Gate and Klamath River near Seiad sites. Upon investigation we learned that these probes have a lifespan of 2-3 years and then must be replaced. We are planning on keeping a few extras on hand to allow for timely replacement of damaged probes. BGA probes can be checked periodically for accuracy using a rhodamine dye solution. This process will become a part of our calibration procedure.

The information collected by the Karuk Tribe and presented in this report will be put to use in land management decisions concerning water quality within the Klamath Basin. The Karuk Water Quality Program wishes to express gratitude to the EPA for their generous grants that make water quality monitoring a reality and the restoration of the native fisheries a possibility.

Number of Monitored Days Klamath River Was in Exceedance of Tribal Water Quality Objectives			
Water Quality Objective	Klamath River near Iron Gate 2008	Klamath River near Seiad 2008	Klamath River near Orleans 2008
Temperature Chronic (Daily Average >15.5C)	119	92	114
Temperature Acute (Daily Average >21.0C)	18	33	34
Dissolved Oxygen (Daily Average <8 mg/L)	67	0	0
Specific Conductance (Monthly Average >350 us/cm)	0	0	0
pH (Daily Average <6.5 or >8.5)	0	5	0

Table 8 – Temperature based on 7-day floating average temperature. DO and pH use daily average, specific conductance is based on a monthly average.

Number of Monitored Days Tributaries Were in Exceedance of Tribal Water Quality Objectives			
Water Quality Objective	Shasta River 2008	Scott River 2008	Salmon River 2008
Temperature Chronic (Daily Average >15.5C)	112	110	95
Temperature Acute (Daily Average >21.0C)	67	14	0
Dissolved Oxygen (Daily Average <Basin Plan Specific Objective)	1	0	0
Specific Conductance (Monthly Average >350 us/cm)	3	0	0
pH (Daily Average <6.5 or >8.5)	102	0	0

Table 9 - Temperature based on 7-day floating average temperature. DO and pH use daily average, specific conductance is based on monthly average.