KARUK TRIBE OF CALIFORNIA

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

WATER YEAR 2002 WATER QUALITY MONITORING REPORT

Klamath River at Iron Gate, Klamath River at Seiad Valley, Klamath River at Orleans, Indian & Steinacher Creeks

Karuk Tribe of California

Water Quality Monitoring Report
Water Years 2002

Prepared by
Karuk Tribe of California
Water Resources
March 2003

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1.0 BACKGROUND

The Karuk Tribe began monitoring daily water quality conditions on the Klamath River mainstem in January of 2000 and Klamath River tributaries in 1998. Monitoring efforts were expanded this year to include the Klamath River at Orleans and Steinacher Creek.

During water years (WY) 2002, Karuk tribal members performed all data collection and quality assurance processes, as well as administrative oversight and report writing. Funding for this project has come mainly through the Karuk Tribe's EPA 106 Water Pollution Control Program.

2.0 WATER QUALITY STATIONS

All Karuk water quality stations along the Klamath River are located near U.S. Geological Survey (USGS) flow gauges. The relationship of flow to a measured pollutant at the same location is important. This relationship allows the observer to determine the total volume of the pollutant being passed through the system. Flow data for the water quality stations on the Klamath can be accessed through the USGS web site.

The water quality station on Steinacher Creek was monitored to help evaluate the affects of the Steinacher road-decommissioning project. Steinacher Creek flows into Wooley Creek, a tributary to the Salmon River.

2.1 Klamath River at Iron Gate

The water quality station at Iron Gate is located on the Klamath River approximately 767 meters below the Iron Gate Reservoir spillway, and about 150 meters below the influence of Bogus Creek. The exact location is:

Latitude: 41° 55.664' 0'' N
Longitude: 122° 26.615' 0'' W
Elevation: 2176 ft.

The drainage area for the Iron Gate water quality gauge is 5,194,092 acres. The Bureau of Reclamation's Klamath Project, and subsequent operations plan, regulates Klamath River flows at Iron Gate.

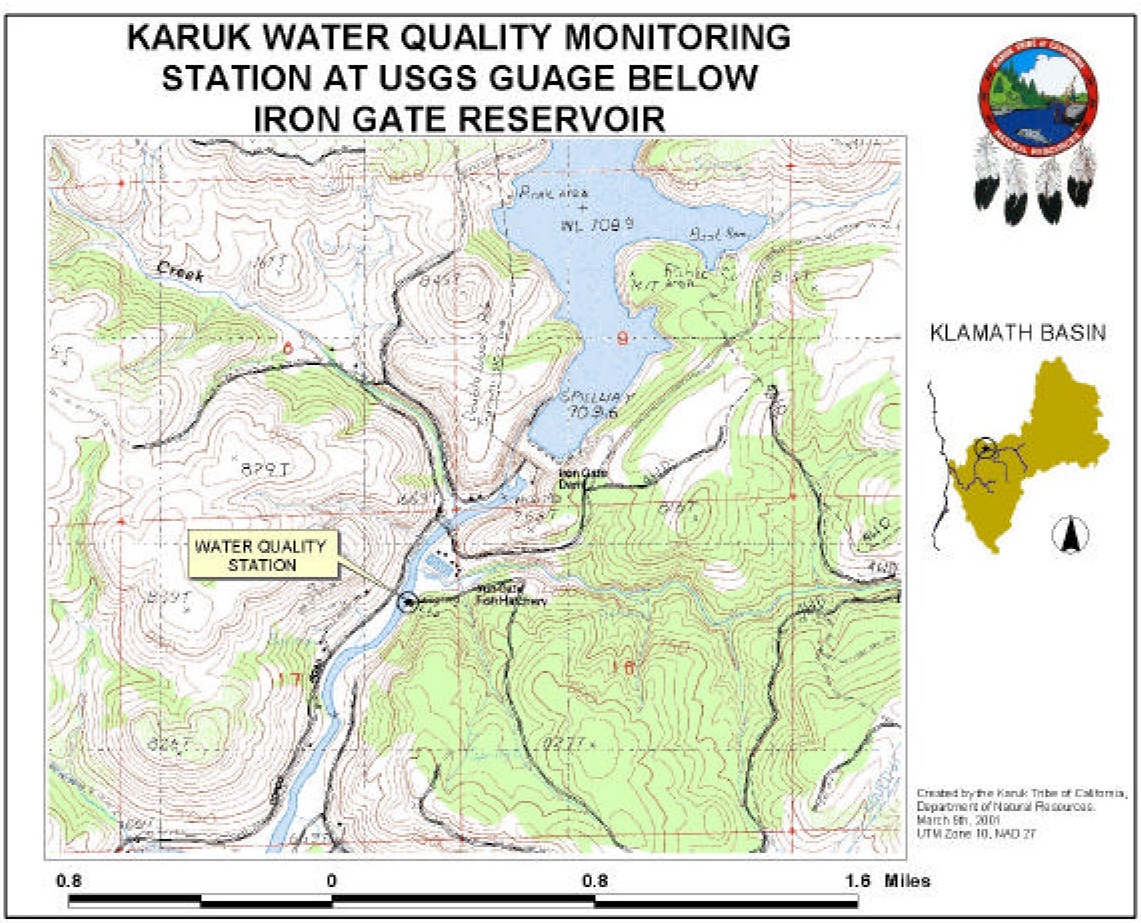

Fig. 1. Iron Gate water quality station.

2.2 Klamath River at Seiad Valley

The Seiad Valley water quality gauge is located 2.2 miles west of the town of Seiad on the Klamath River. The drainage area for the Seiad Valley water quality gauge is 6,672,492 acres. The exact location of this station is:

Latitude: 41° 51.227' 0'' N
Longitude: 123° 13.944' 0'' W
Elevation: 1350 ft.

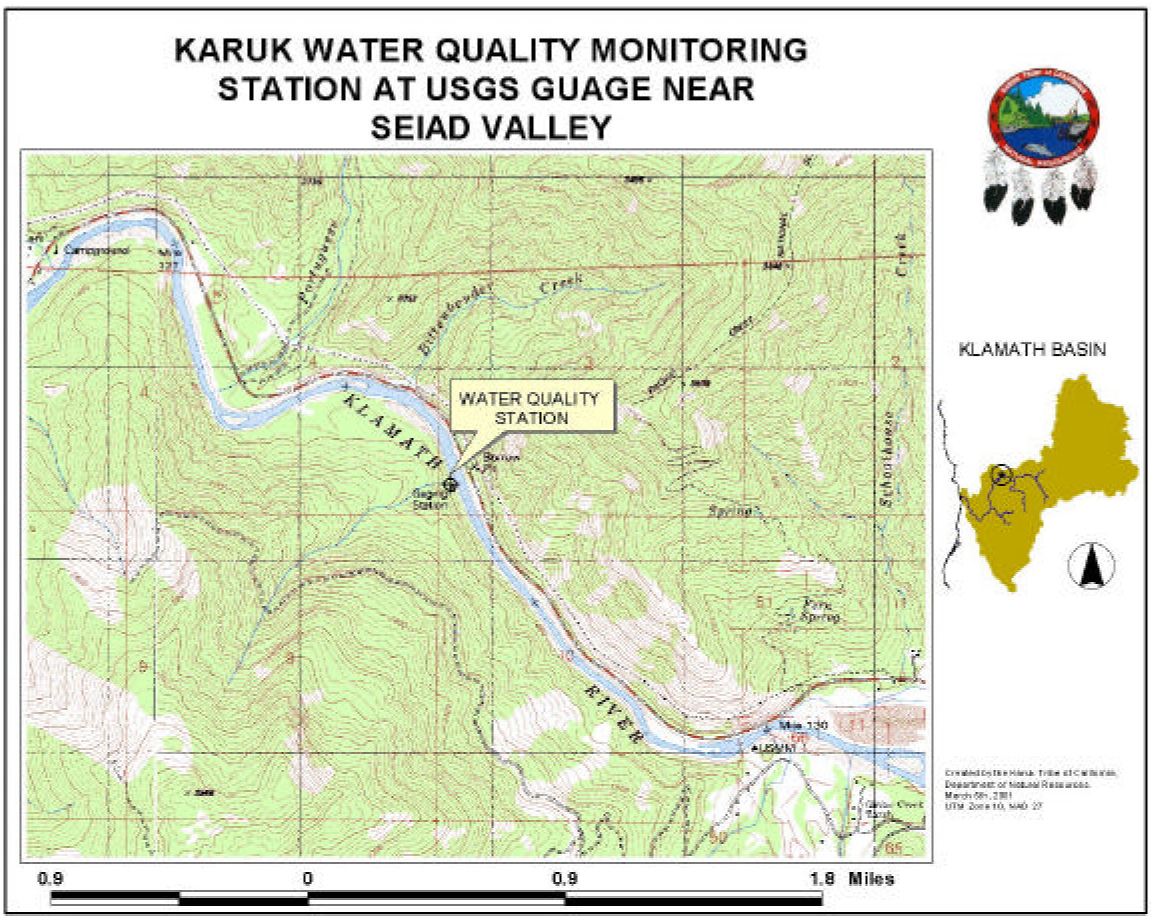

Fig. 2. Seiad Valley water quality station.

2.3 Klamath River at Orleans

The Orleans water quality gauge is located on the Klamath River under the Klamath River Bridge in the town of Orleans. The drainage area for the Orleans water quality gauge is 7,654,982 acres. The exact location of this station is:

Latitude: 41° 18.204’ 0’’ N
Longitude: 123° 32.069’ 0’’ W
Elevation: 389 ft.

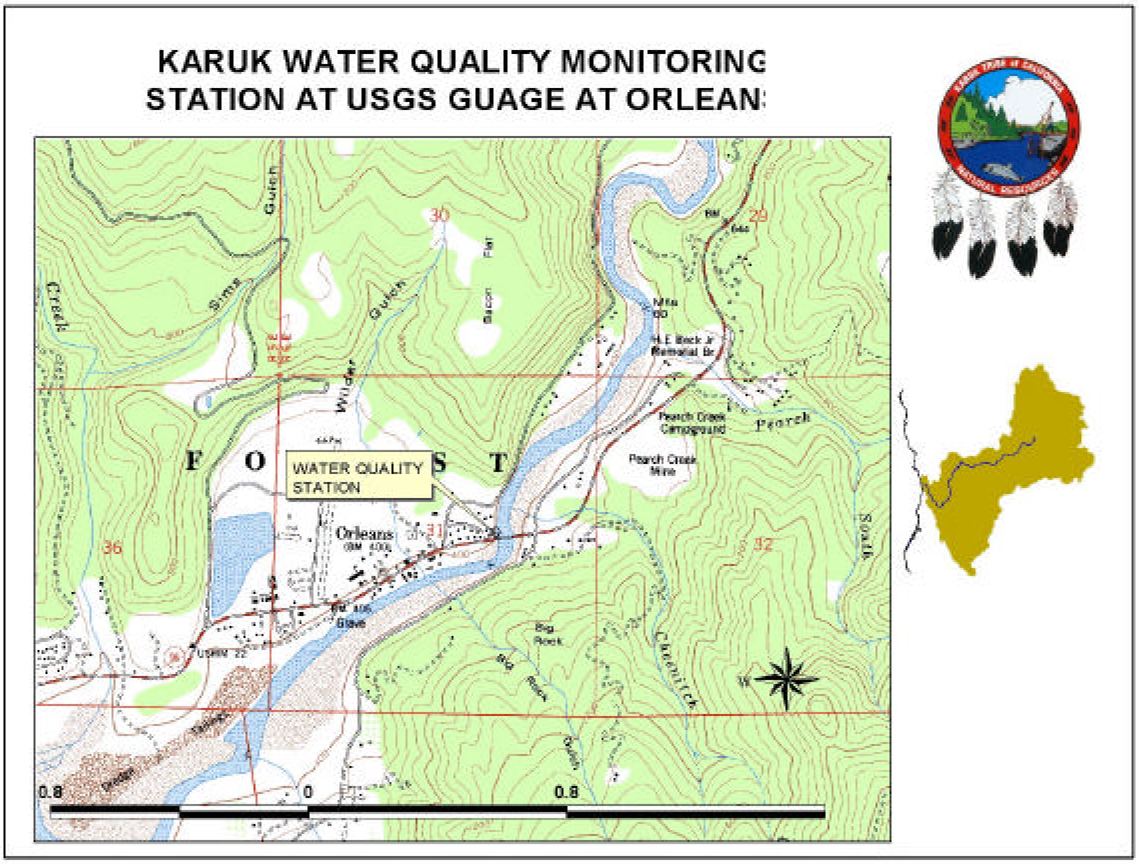

Fig. 3. Orleans water quality station.

2.4 Indian Creek

The Indian Creek flow gauge is located near the town of Happy Camp. Indian Creek is a minor tributary to the Klamath River. The drainage area for the Indian Creek flow gauge is 76,800 acres. The exact location of this station is:

Latitude: 41° 50’ 07’’ N
Longitude: 123° 22’ 58’’ W
Elevation: 1213 ft.

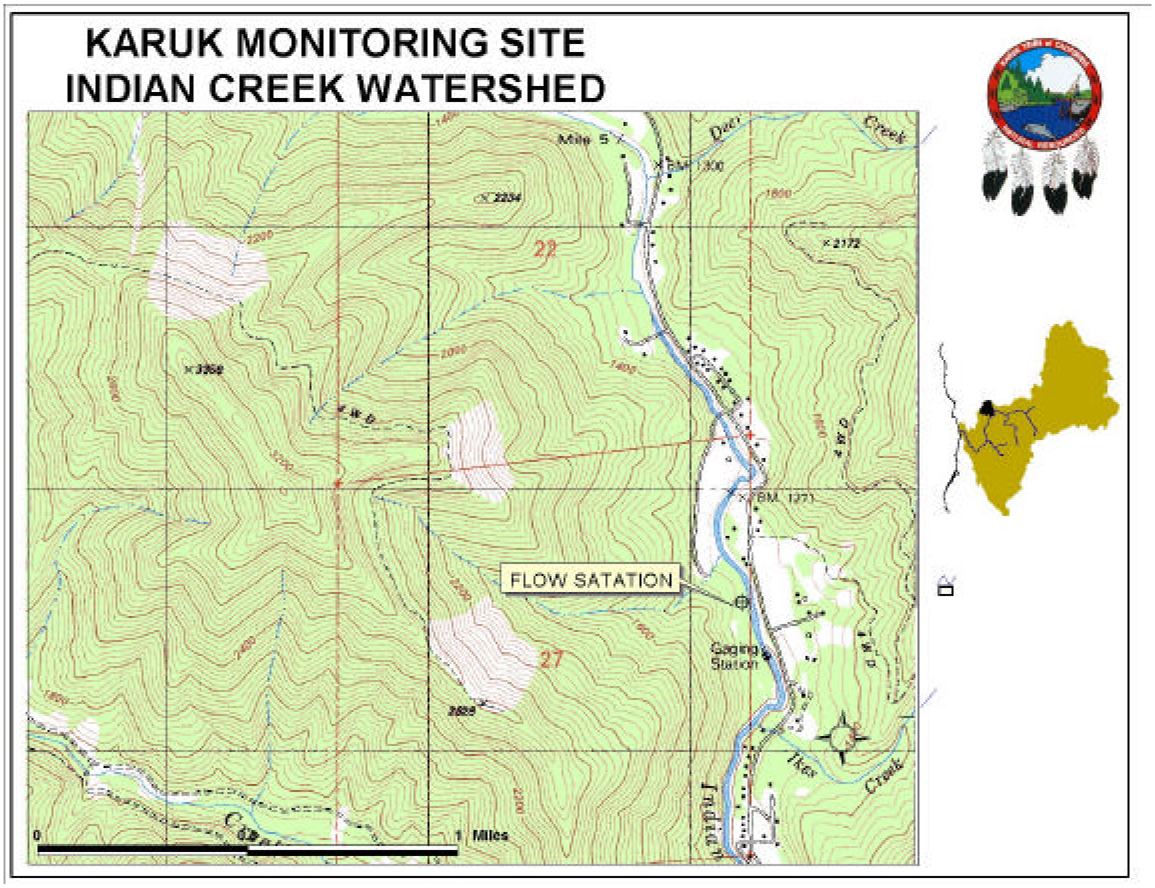

Fig. 4. Indian Creek flow gauge.

2.5 Steinacher Creek

The Steinacher Creek water quality gauge is located 0.6 miles up Wooley Creek and 500 feet up Steinacher creek. Wooley Creek flows into the Salmon River, which is a major tributary to the Klamath. The drainage area for the Steinacher water quality station is 9,180 acres. The exact location of this station is:

Latitude: 41° 23’ 00’’ N
Longitude: 123° 25’ 06’’ W
Elevation: 739 ft.

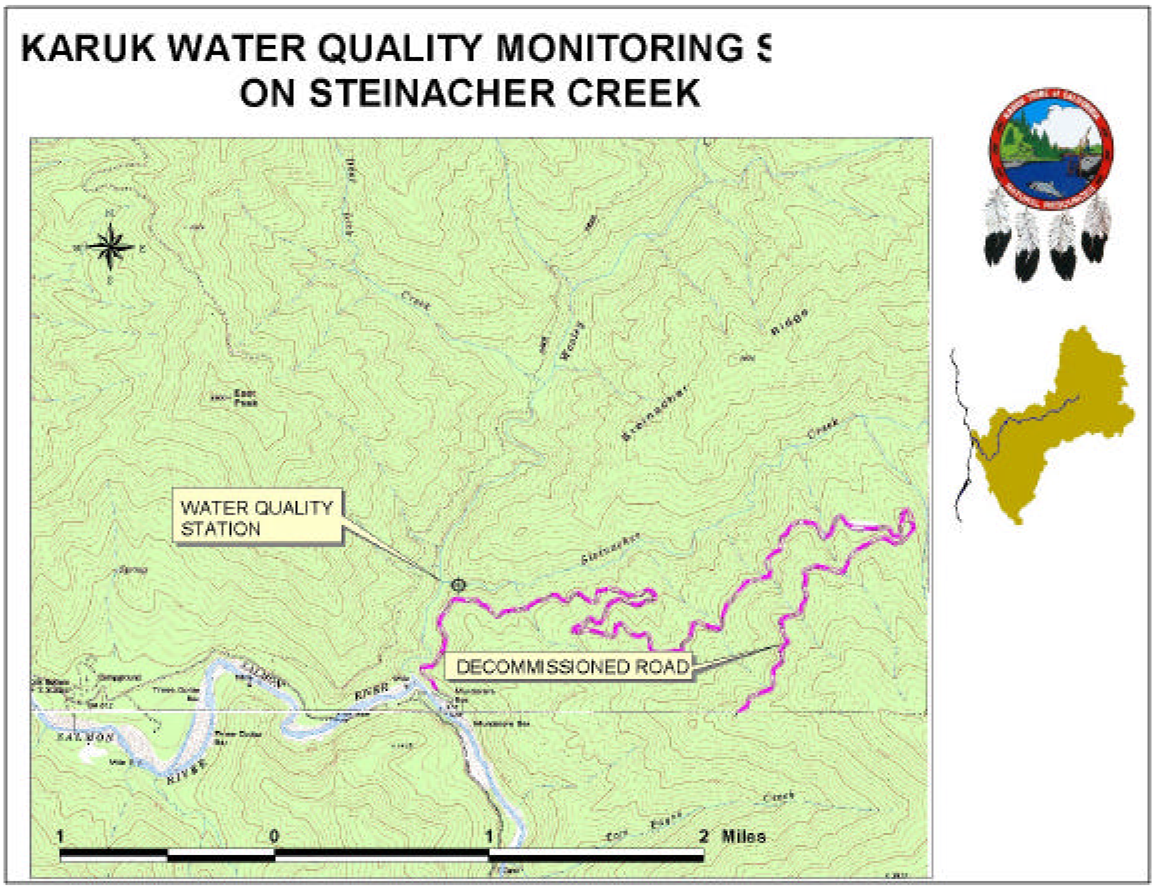

Fig. 5. Steinacher Creek water quality station.

3.0 PURPOSE

The value of water is determined by its potential uses, by both man and environment. In turn, the uses that can be made of water are determined by its quality. The Klamath River supports the Karuk Tribal fishery located at Ishi Pishi Falls, near Somes Bar California. The Karuk fishery once consisted of over a hundred families owned fishing areas that supported a population of over 2500 people. Today only the sacred fishery at Ishi Pishi Falls, near the world renew site of Katamin, can be legally fished.

The purpose of this study is to collect essential water quality data, and to continue the goals of the Karuk Tribe of California and it's water resources program. The information produced allows the Karuk Tribe to give valuable input on land management decisions and demonstrates Karuk Tribe's commitment to sound resource management. The data produced is essential in helping to prove the degraded water quality conditions that exist within the Klamath River.

4.0 IMPLEMENTATION DATA COLLECTION

The Karuk Tribe's water quality stations at Iron Gate, Seiad Valley, Orleans, and Steinacher Creek collect water temperature, dissolved oxygen (DO), pH, specific conductance, and in some instances, air temperature. This information provides interested stakeholders with sub-daily response of multiple water quality parameters. This data is critical to interpretation and definition of water quality response throughout the river system, as well as valuable maximum, minimum, mean values, and the rate of change of constituents.

The USGS and Karuk Tribe have provided staff to maintain and calibrate the water quality stations. Quality Assurance procedures are followed, and a high level confidence in the quality of the data is obtained before it is published.

5.0 WATER QUALITY MONITORING/QUALITY ASSURANCE

The Karuk Tribe has an interim Quality Assurance Project Plan (QAPP) for monitoring water quality conditions throughout the Karuk Tribes Ancestral Waters. The QAPP documents the best available scientific methods for testing water quality. During WY 2002 water quality probes were calibrated and serviced according to U.S. Fish & Wildlife Service (USF&W) QA/QC protocol. These calibrations followed the manufacturer's instructions as outlined in the ***Maintenance/Calibration/Logging Procedures*** for that specific probe. Standards or reference solutions were used for calibration of equipment that measured a particular environmental parameter. Use of reference standards is an integral component of quality control. Both water quality field equipment and laboratory equipment must be periodically calibrated to assure the instrument's accuracy. Automated water quality field equipment requires regular calibration.
During WY 2002 water quality probes were maintained at weekly intervals during the summer months (May-September) when water temperatures are high. This procedure helped to minimize lost DO data due to bio fouling of the DO membrane. During the winter months (October to April), the probes were maintained bi-weekly. The Karuk Tribes current Quality Assurance Protocol is based on past experience working with both the USGS and USF&W water quality staff.

6.0 WATER QUALITY PARAMETERS

Data for the water quality parameters listed below was collected using YSI 6820 multi-parameter probes at the Iron Gate and Seiad sites. A Hydrolab Datasonde 4a was used in Orleans and at the Steinacher Creek water quality station.

6.1 Flow

Through a cooperative agreement with the U.S. Geological Survey, discharge was measured at Indian Creek during water year 2002.

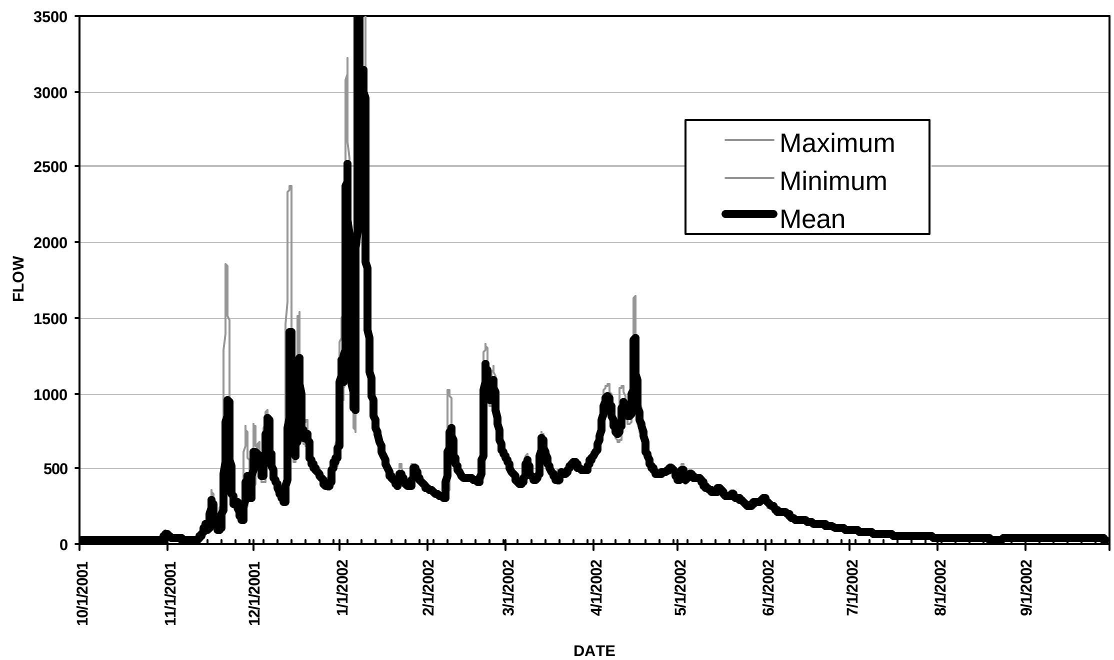

Fig. 6. Maximum, Minimum and Mean discharge at Indian Creek for WY 2002.

6.2 Water Temperature

Water temperature varies through space and time, both seasonally and diurnally (within a twenty-four hour period). Elevated temperatures may lead to increased metabolic rates in organisms and algal growth. Stream temperature is neither uniform in space nor time. Many factors can affect stream temperature, including 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, and the length the stream must travel, which gives it the potential to heat up.

The most common method to assess water temperature for streams that support salmonids is to compare the temperature to an acute (lethal) and chronic (sub-lethal) temperature standard. The acute standard represents the temperature at which life cannot continue for the salmonids. The chronic temperature standard represents the maximum weekly average (mean) temperature (MWAT). This number represents an upper limit for optimum growth for salmonids. The Karuk Tribe's interim water quality objectives have set chronic and lethal temperatures at 15.5°C and 21°C respectively. The state of California currently has no numeric temperature objectives on the Klamath, although it is on their 303(d) list.

The Karuk Tribe's interim water quality objectives were violated at Iron Gate numerous times and for extended periods. The Chronic objective was violated in the beginning of the 2002 water year from October 1st, 2001 to October 13th, 2001 and from May 29th, 2002 to September 25th, 2002. . The lethal objective was violated continually from June 27th, 2002 until September 3rd, 2002. The characterization of water temperature below was conducted to assess the number of days of violation to the Karuk Tribe's interim water quality objectives. The violations are based on the available data. In cases where there was no data, a violation was not recorded.

Klamath River at Iron Gate Water Temperature Characterization

Days of Temperature Violation (Chronic) = 134 (119 measured)
Days of Temperature Violation (Lethal) = 51 (44 measured)

Klamath River at Seiad Valley Water Temperature Characterization

Days of Temperature Violation (Chronic) = 112 (74 measured)
Days of Temperature Violation (Lethal) = 56 (46 measured)

Klamath River at Orleans Water Temperature Characterization

Days of Temperature Violation (Chronic) = 136 (126 measured)
Days of Temperature Violation (Lethal) = 72 (69 measured)

Steinacher Creek Water Temperature Characterization

Days of Temperature Violation (Chronic) = 36 (36 measured)
Days of Temperature Violation (Lethal) = 0 (0 measured)

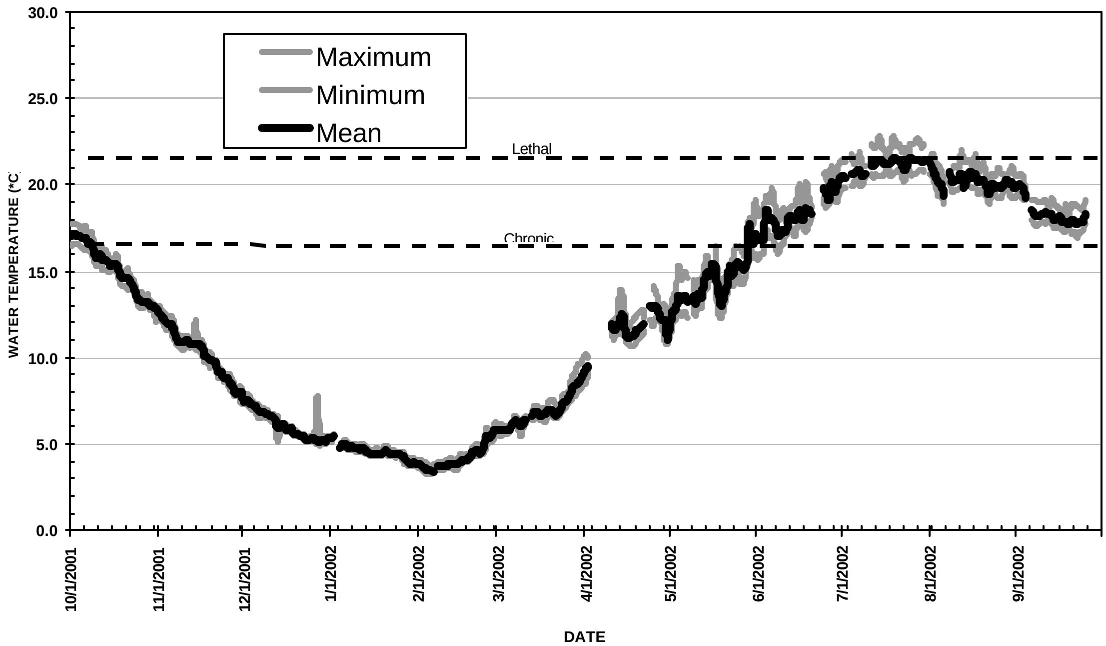

Fig. 7. Maximum, minimum and mean water temperature at Iron Gate for WY 2002.

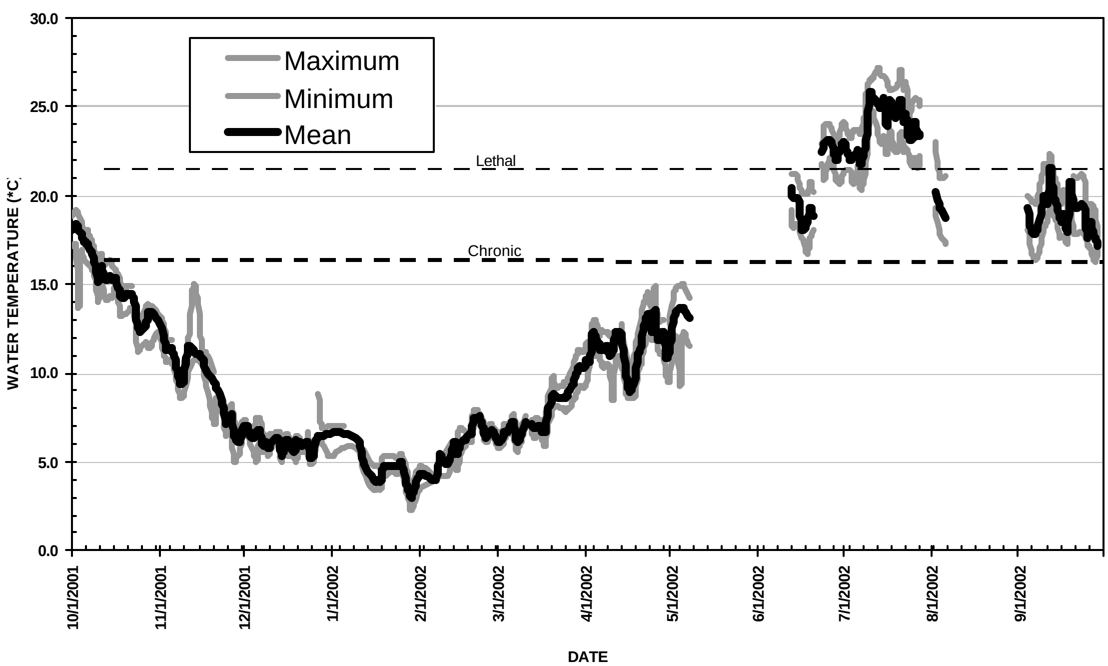

Fig. 8. Maximum minimum and mean water temperature near Seiad Valley WY 2002.

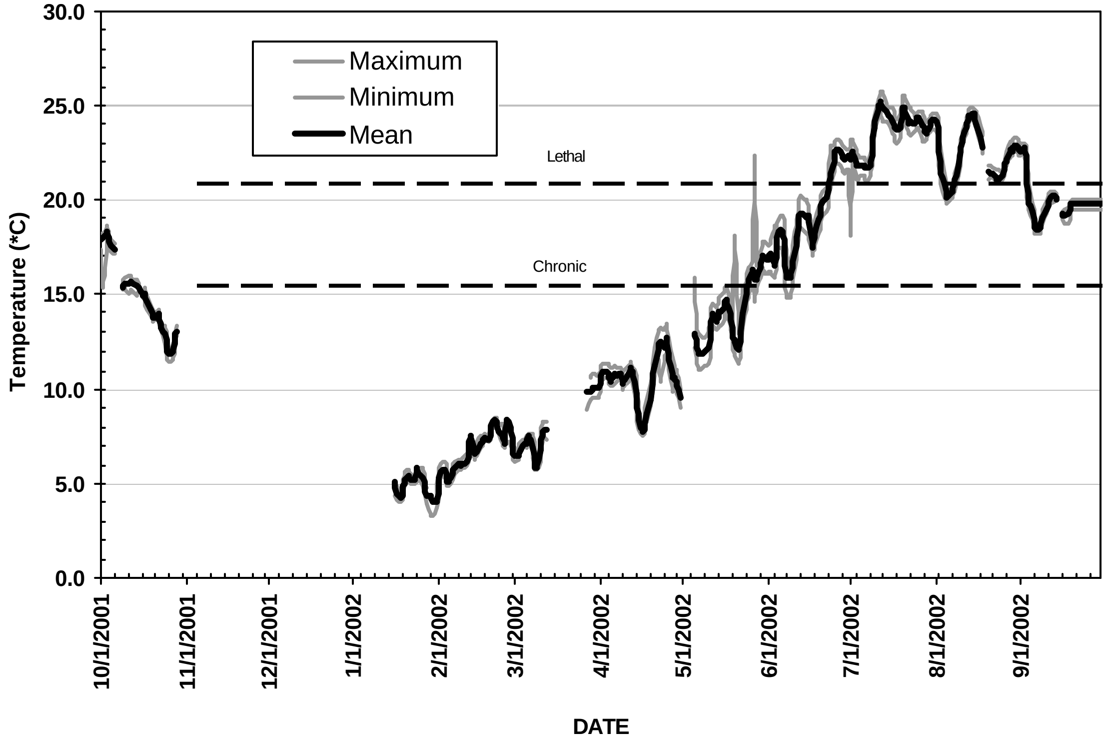

Fig. 9. Maximum minimum and mean water tempe rature at Orleans WY 2002.

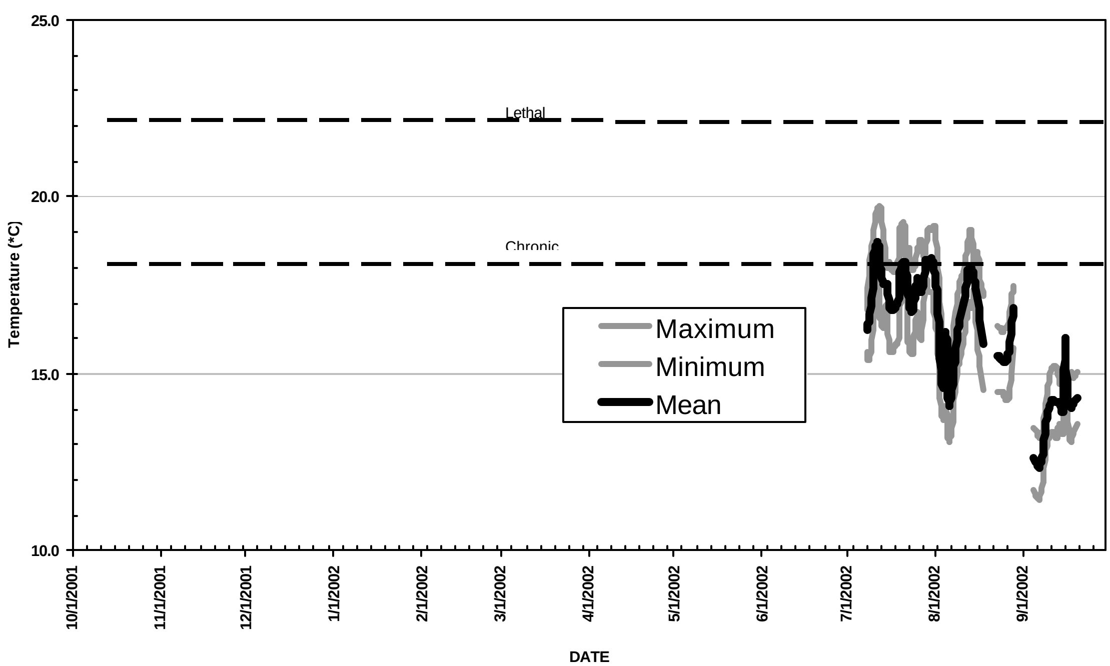

Fig. 10. Maximum minimum and mean water tempe rature on Steinacher WY 2002.

6.3 Dissolved Oxygen

Dissolved oxygen varies both seasonally and diurnally, particularly in the spring and summer when photosynthesis adds oxygen to the system during the day and respiration consumes it at night (Clawson, 1986). In cold water, oxygen is more soluble; therefore the amount of available oxygen for salmonids is greater. Oxygen levels become reduced when water temperatures are elevated. 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 interim water quality objectives have established minimum DO levels for waters designated as COLD Waters to be 6.0 mg/L, and SPWN (spawning) Waters to be 9.0 mg/L during egg incubation of tribal trust aquatic species. The state of California has established a minimum DO level of 8.0 mg/L, and put the Klamath on their 303(d) list for having DO levels that do not meet their Basin Plan Objectives.

Klamath River at Iron Gate Dissolved Oxygen Characterization

Days of DO Violation (COLD) = 63 (53 measured)
Days of DO Violation (SPAWN) = 213 (187 measured)

Klamath River at Seiad Valley Dissolved Oxygen Characterization

Days of DO Violation (COLD) = 3 (3 measured)
Days of DO Violation (SPAWN) = 192 (144 measured)

Klamath River at Orleans Dissolved Oxygen Characterization

Days of DO Violation (COLD) = 5 (5 measured)
Days of DO Violation (SPAWN) = 148 (143 measured)

Steinacher Creek Dissolved Oxygen Characterization

Days of DO Violation (COLD) = 0 (0 measured)
Days of DO Violation (SPAWN) = 60

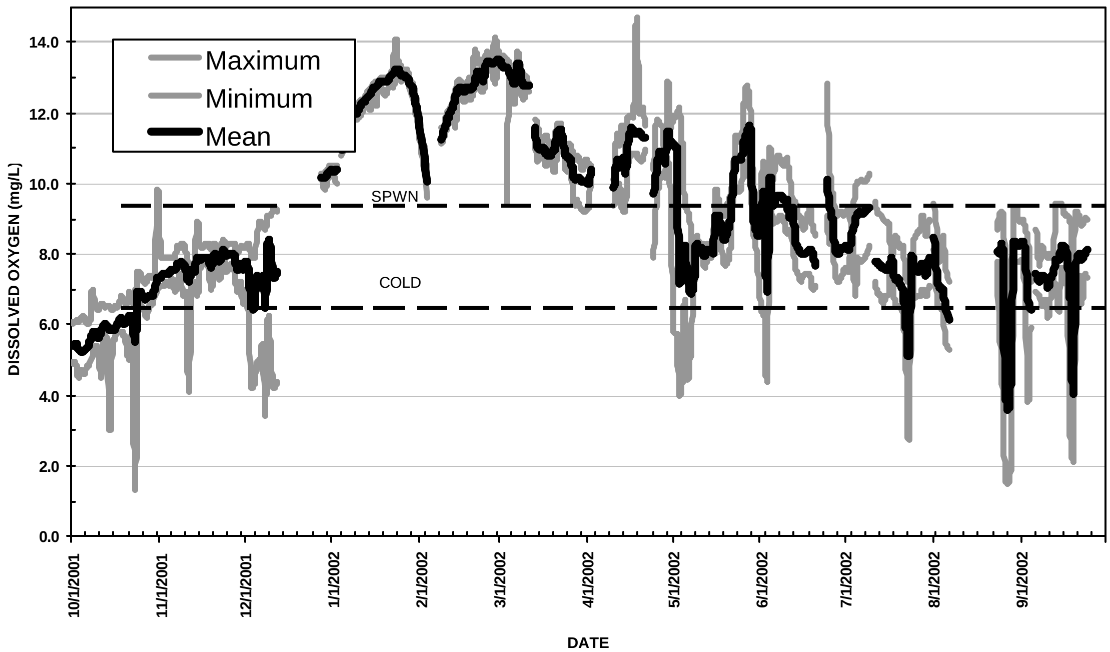

Fig. 11. Maximum, minimum, and mean dissolved oxygen at Iron Gate for WY 2002.

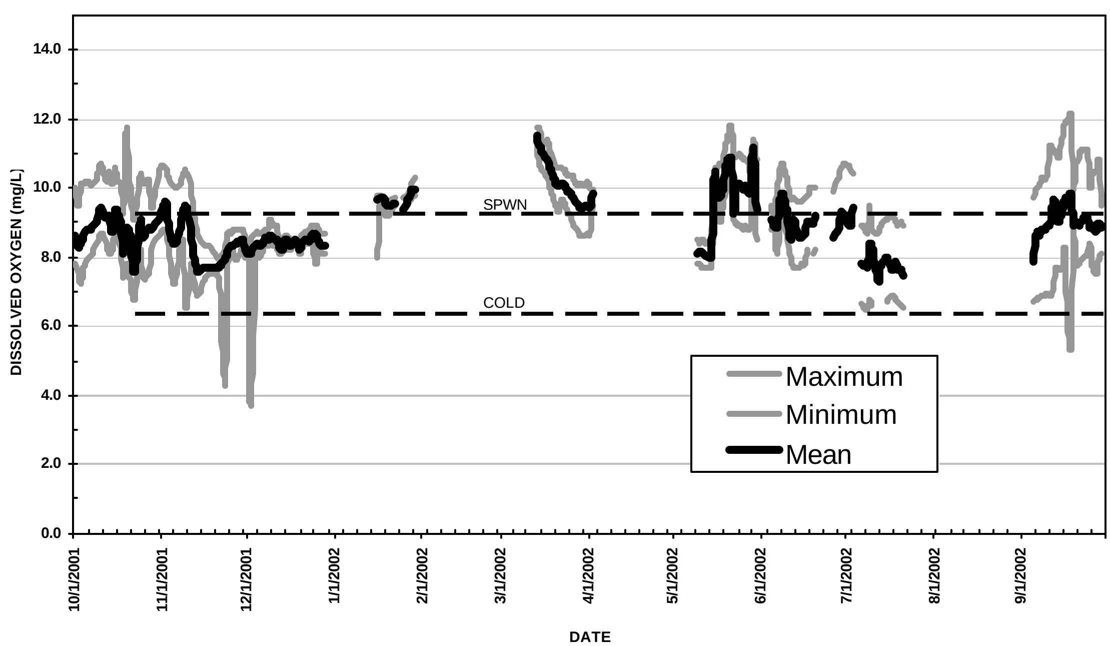

Fig. 12. Maximum, minimum, and mean dissolved oxygen at Seiad Valley for WY 2002.

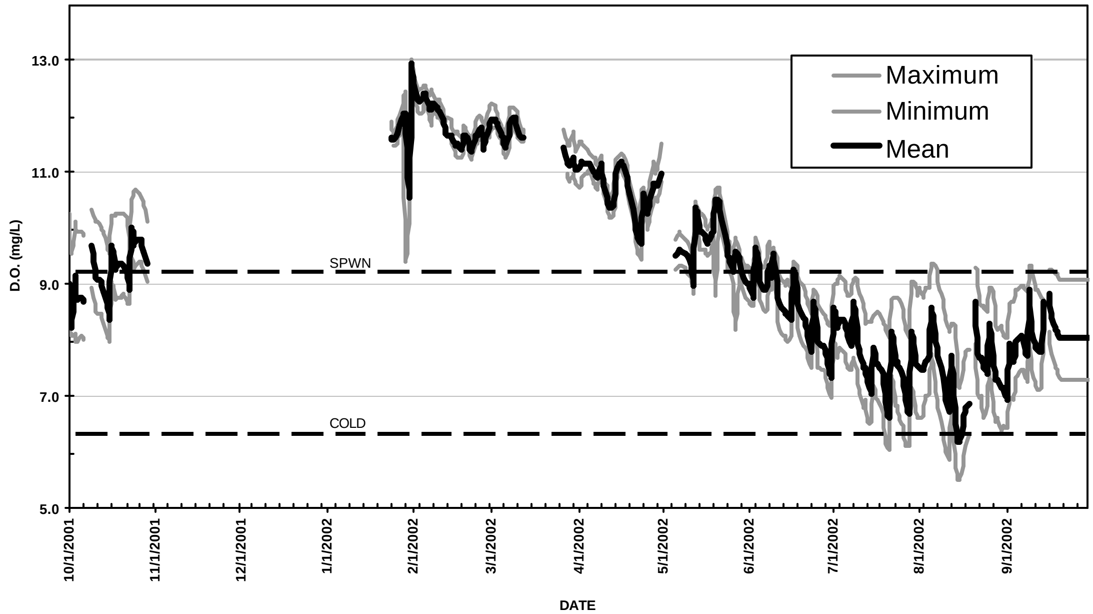

Fig. 13. Maximum, minimum, and mean dissolved oxygen at Orleans for WY 2002.

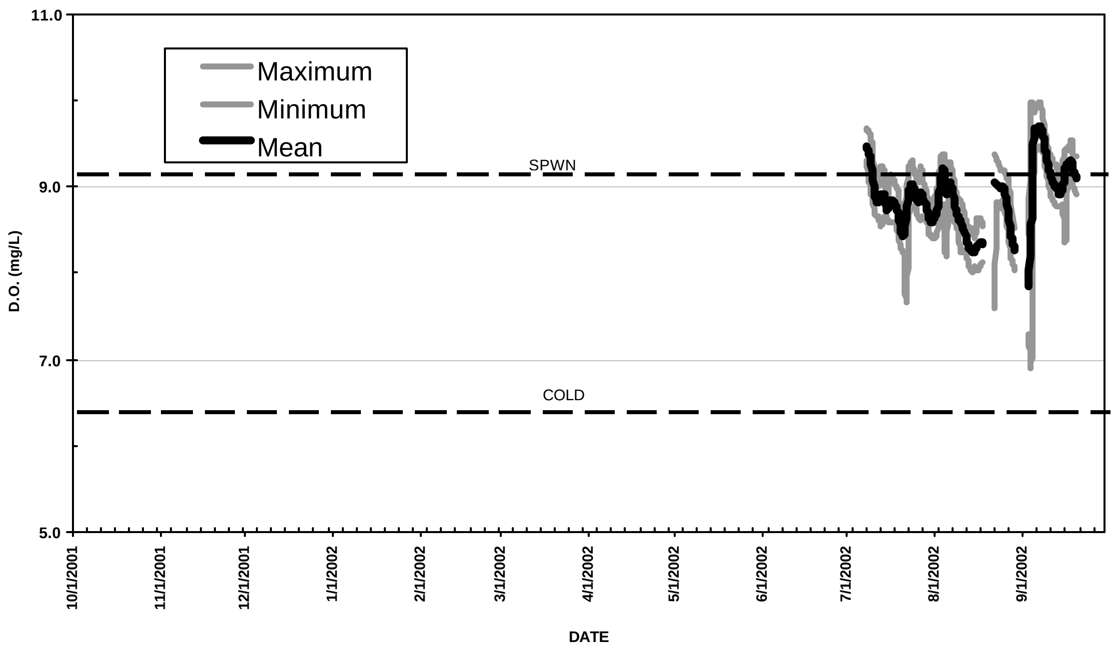

Fig. 14 Maximum, minimum, and mean dissolved oxygen at Steinacher Cr. for WY 2002.

6.4 pH/Alkalinity

Alkalinity of water refers to an ability to accept hydrogen ions, to neutralize acid, and is a direct counterpart to acidity. High alkalinity has the effect of buffering or resisting pH change, and consequently reducing effects on pH from biological sources (Gwynne, 1993). Buffering occurs in the presence of carbon monoxide (CO). CO enters the water through decomposition, plant and algal respiration, and from the atmosphere. Diel fluctuations are caused by increased photosynthesis during the day, removing CO from the water, and allowing the pH to rise. The reverse occurs at night, with plant respiration and decomposition releasing CO to the water and driving pH downward (Gwynne, 1993). The Karuk Tribe has established a minimum pH objective of 7 and a maximum of 8.5. These objectives reflect the State of California's numeric standard for pH.

Klamath River at Iron Gate pH Characterization

Days of pH Violation (Maximum) = 50 (42 measured)
Days of pH Violation (Minimum) = 6 (1 measured)

Klamath River at Seiad Valley pH Characterization

Days of pH Violation (Maximum) = 80 (30 measured)
Days of pH Violation (Minimum) = 7 (7 measured)

Klamath River at Orleans pH Characterization

Days of pH Violation (Maximum) = 50 (49 measured)
Days of pH Violation (Minimum) = 0 (0 measured)

Steinacher Creek pH Characterization

Days of pH Violation (Maximum) = 0 (0 measured)
Days of pH Violation (Minimum) = 0 (0 measured)

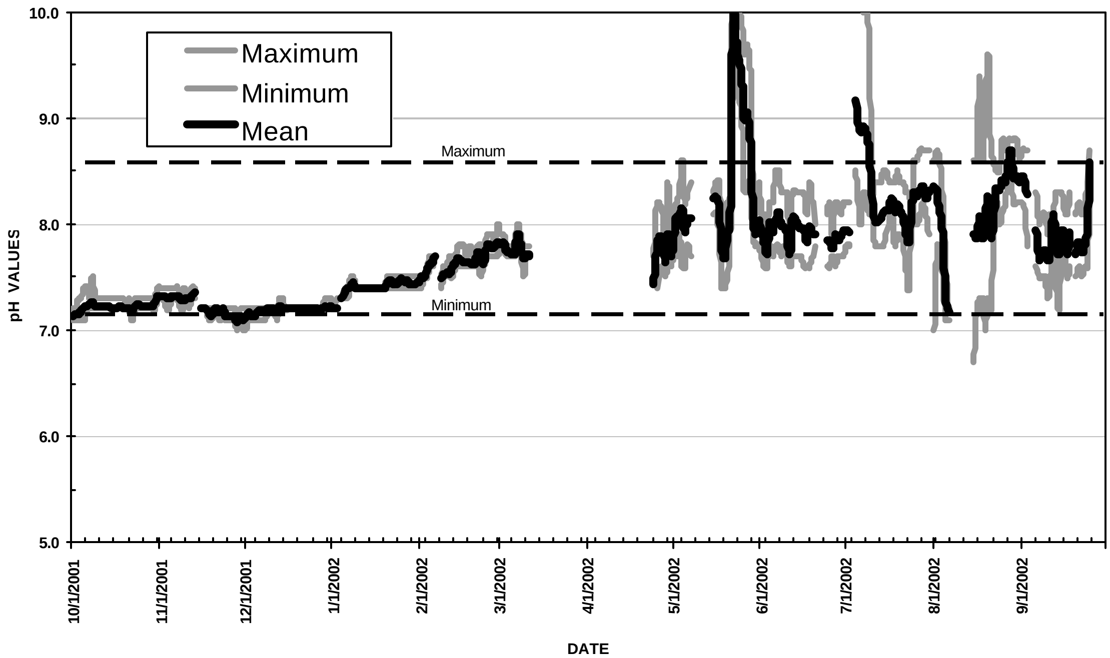

Fig. 15. Maximum, minimum and mean pH values at Iron Gate for WY 2002.

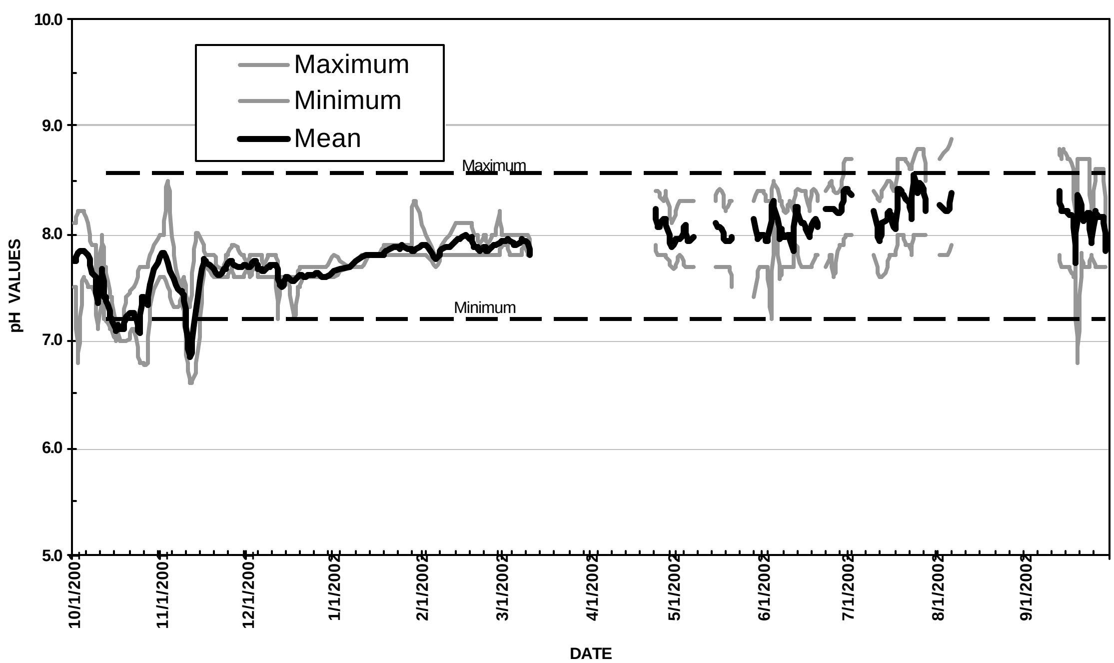

Fig. 16. Maximum, minimum and mean pH values at Seiad Valley for WY 2002.

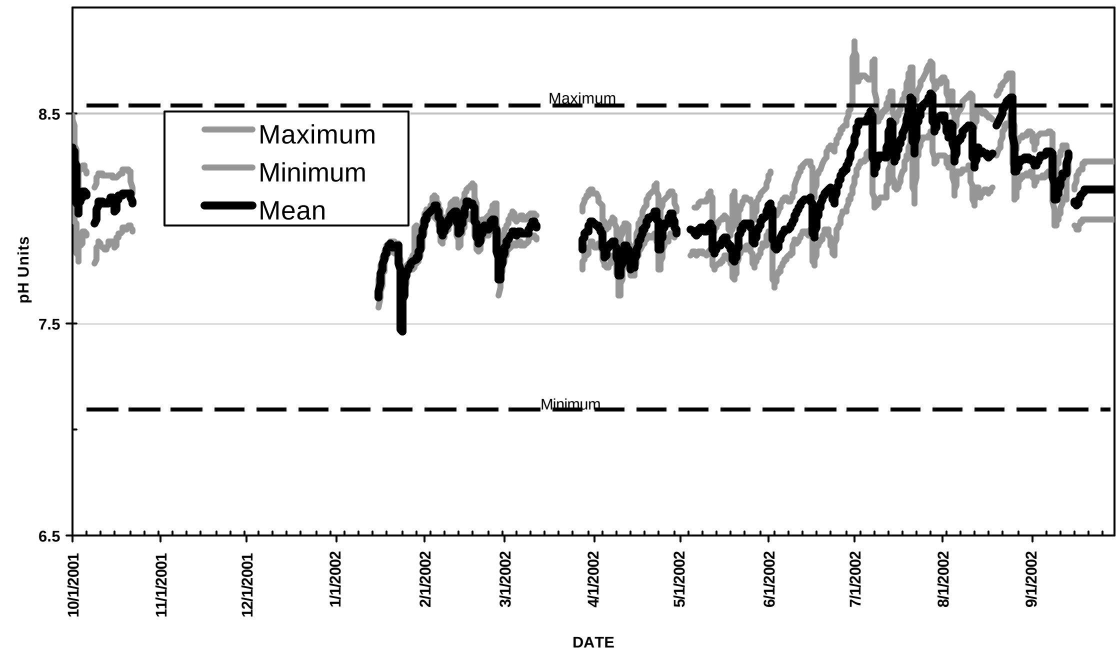

Fig. 17. Maximum, minimum and mean pH values at Orleans for WY 2002.

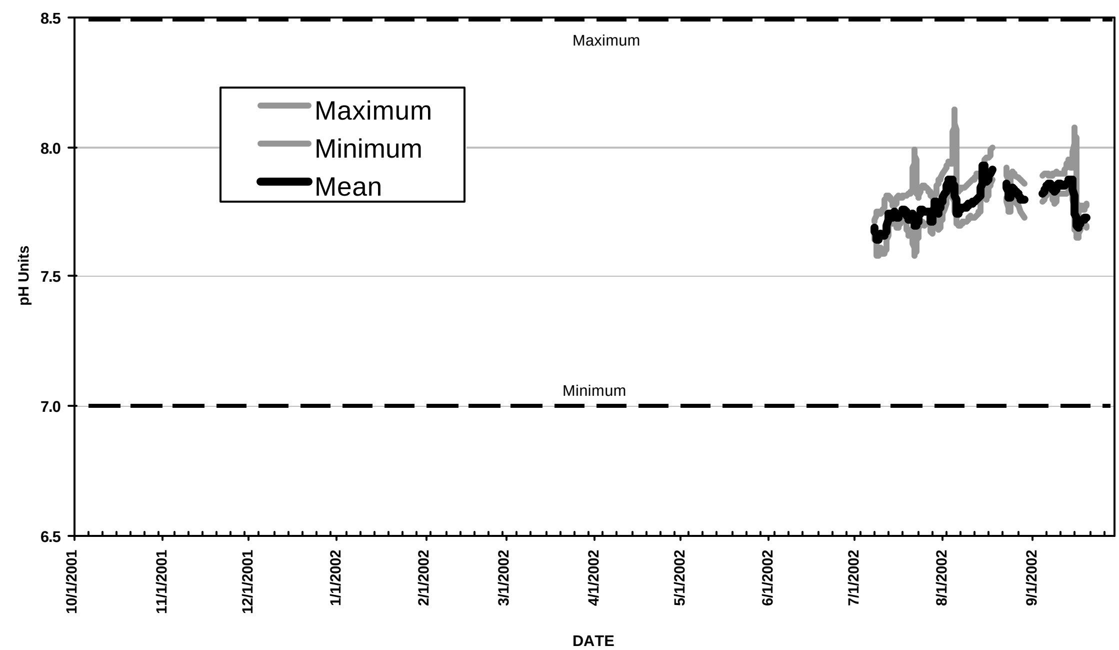

Fig. 18. Maximum, minimum and mean pH values on Steinacher Creek for WY 2002.

6.5 Specific Conductance

Specific conductance (SC) is a measure of the electrical conductance by water at 25°C, and is a function of the concentration of dissolved solids in solution. The higher the concentration of dissolved solids in solution, the higher the SC of the water (Gwynne, 1993). SC measures how well water can conducts an electrical current across a particular length.

Conductivity increases with increasing amount and mobility of ions. These ions, which come from the breakdown of compounds, conduct electricity because they are negatively or positively charged when dissolved in water. Therefore, SC 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 pH objective is consistent with the state of California's, which is 350 µmhos/cm for a 90% upper limit and 275µmhos/cm for a 50% upper limit. The 90% upper and lower limits represent the 90 percentile values for a calendar year. 90% 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 50 percentile values of the monthly means for a calendar year. 50% 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.

Klamath River at Iron Gate Conductivity Characterization

Upper 90% for Calendar Year = 192 (In Compliance)
Upper 50% for Monthly Means = 172 (In Compliance)

Klamath River at Seiad Valley Conductivity Characterization

Upper 90% for Calendar Year = 216 (In Compliance)
Upper 50% for Monthly Means = 187 (In Compliance)

Klamath River at Orleans Conductivity Characterization

Upper 90% for Calendar Year = 188 (In Compliance, but with incomplete data set)
Upper 50% for Monthly Means = 139 (In Compliance, but with incomplete data set)

Steinacher Creek Conductivity Characterization

Upper 90% for Calendar Year = 107 (In Compliance, but with incomplete data set) Upper 50% for Monthly Means = 101 (In Compliance, but with incomplete data set)

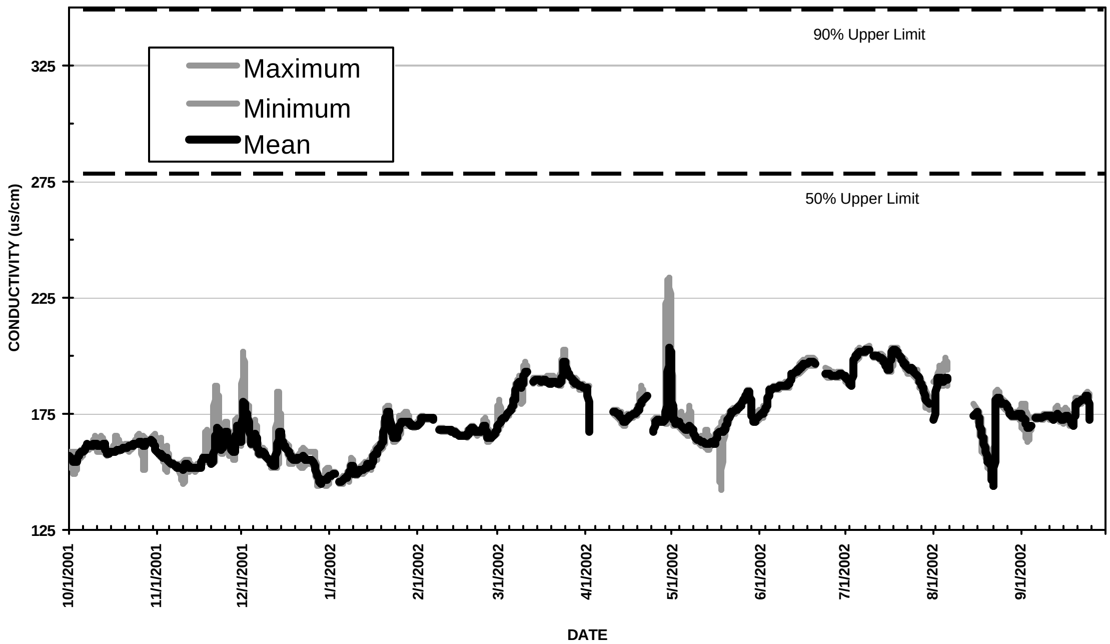

Fig. 19. Maximum, minimum, and mean conductivity values at Iron Gate for WY 2002.

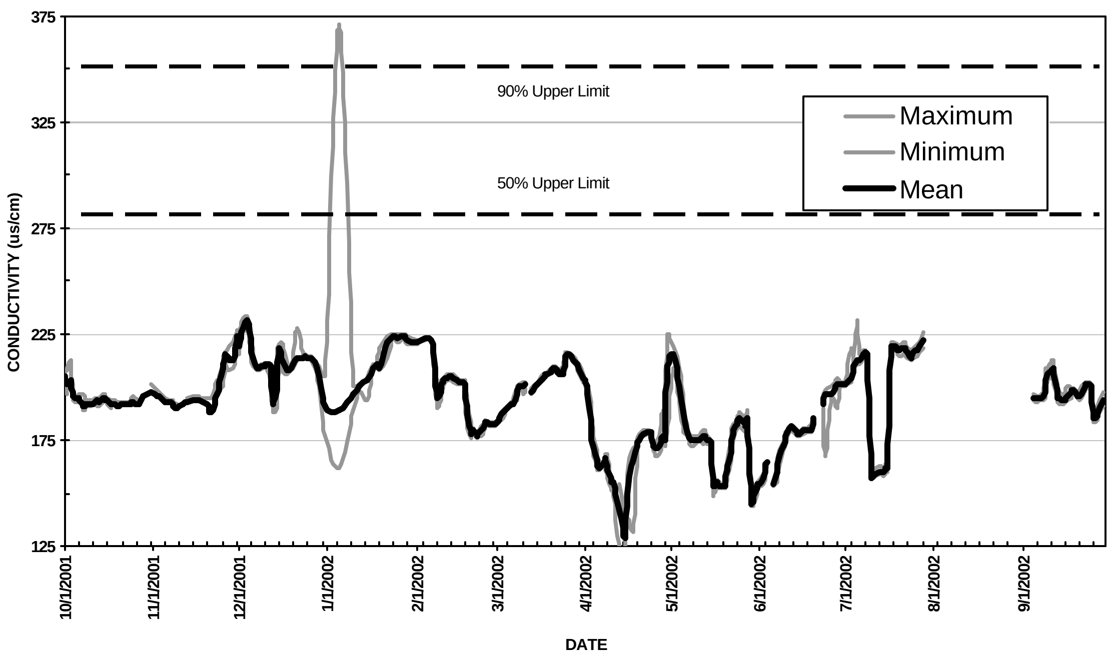

Fig. 20. Maximum, minimum, and mean conductivity values at Seiad Valley for WY 2002.

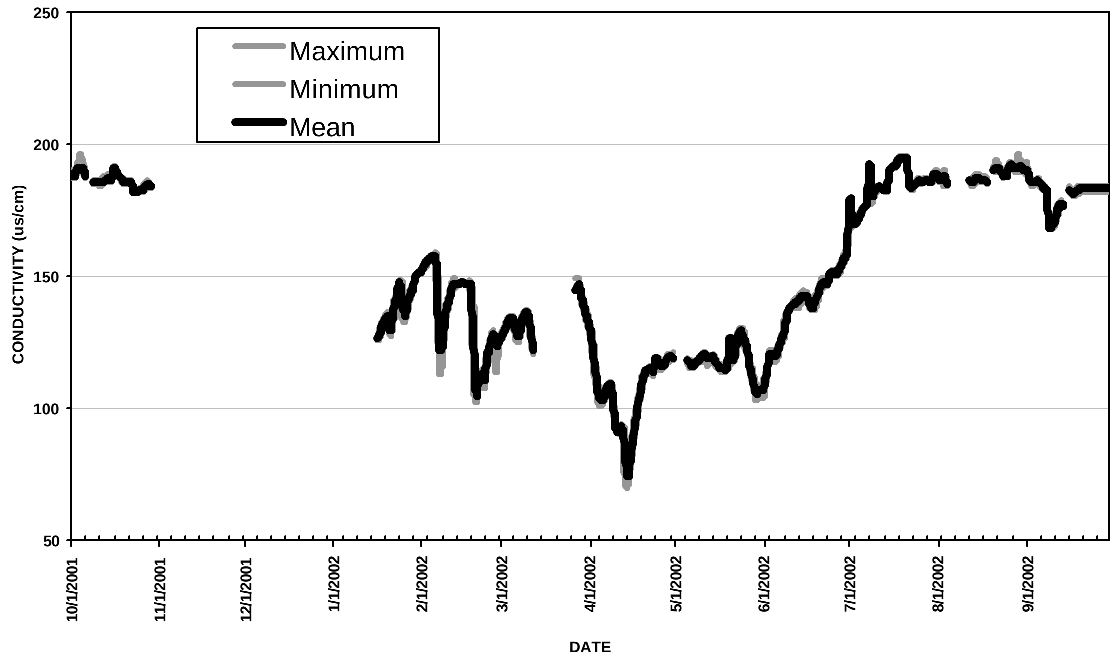

Fig. 21. Maximum, minimum, and mean conductivity values at Orleans for WY 2002.

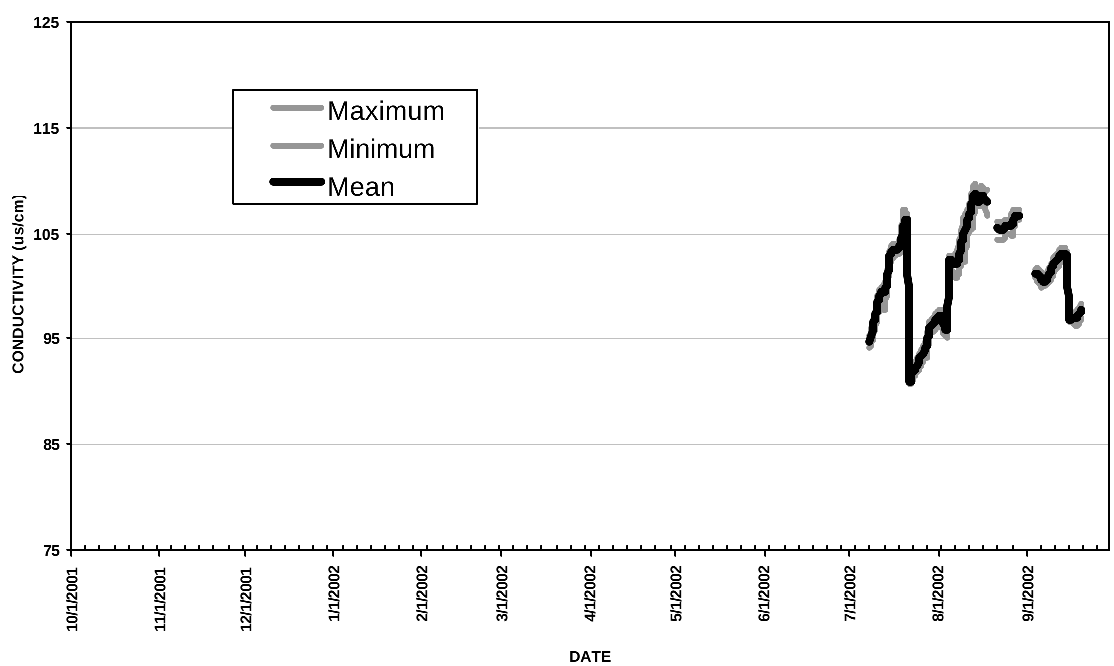

Fig. 22. Maximum, minimum, and mean conductivity on Steinacher Cr. for WY 2002.

6.6 Air Temperature

Air temperature has a direct and substantial effect on the temperature of water. Aside from possible global warming, most air temperature fluctuations can be thought of as natural. Water possesses many important thermal qualities. For instance, water has a high specific heat, which means water is not subject to rapid temperature fluctuations because it can absorb or lose large amounts of heat with relatively small changes in temperature. Small water bodies will be influenced by air temperature more quickly than larger water bodies. This attribute causes water temperature to change gradually in response to seasonal changes. Water temperature is most influenced by the temperature of the air during the summer season, when we have both long and hot days and nights.

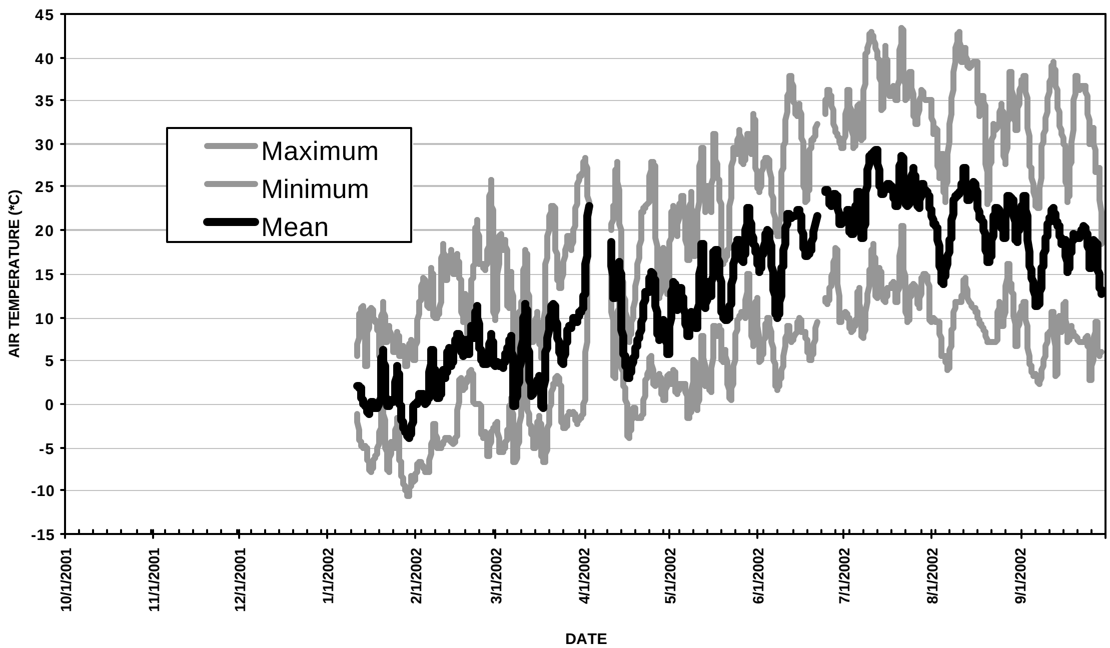

Fig. 23. Maximum, minimum, and mean air temperature at Iron Gate for WY 2002.

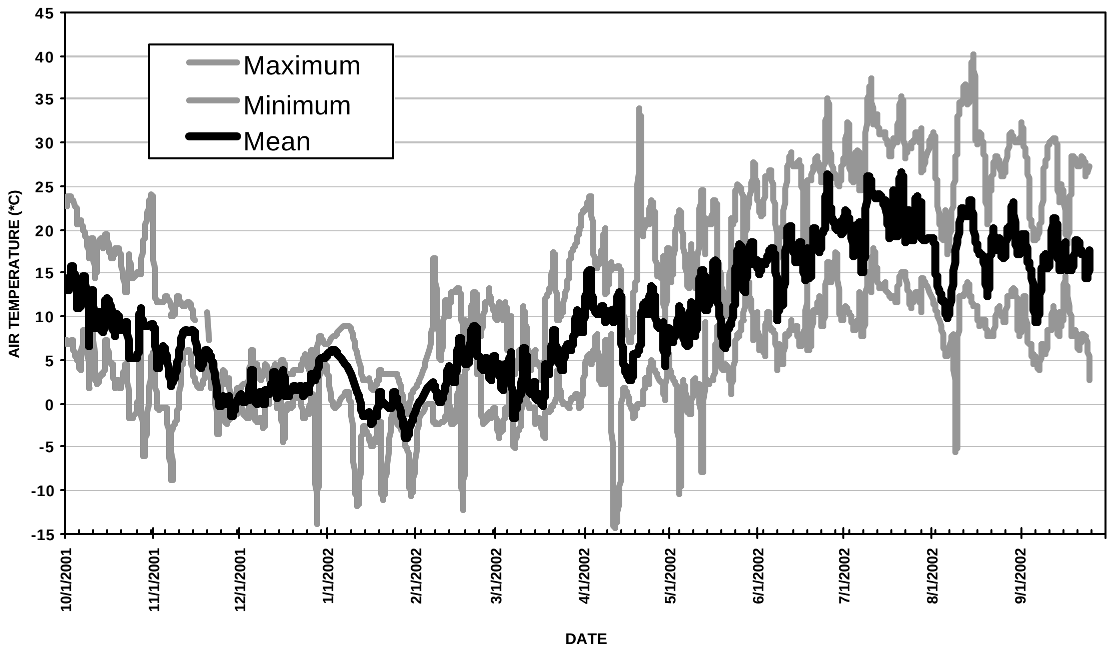

Fig. 24. Maximum, minimum, and mean air temperature at Seiad Valley for WY 2002.

7.0 DATA MANAGEMENT

During water year 2002 the Karuk Tribe of California collected all water quality data via a data collection platform located at each water quality station. Data was downloaded through the California Data Exchange Center. Once the data was downloaded, outliers and data associated with maintenance activity were omitted, and daily values were obtained an Excel spreadsheet.

Water quality data, as well as reports and appendixes, are available via the Karuk Tribe's Department of Natural Resources web site at www.pcweb.net/karukdnr, or through the California Data Exchange Center (CDEC) at http://cdec.water.ca.gov/. Search for KIW for the Iron Gate water quality station, and KSW for the Seiad Valley water quality station.

8.0 SUMMARY

The purpose of this study is to develop baseline information that the Tribe, other agencies, and interested groups, can utilize in assessing the condition of the Klamath River. During this ongoing water quality monitoring effort, a significant amount of resources have been expended to produce the data. Included are the Karuk Tribe's "Draft", as well as the state of California's numeric, Water Quality Control Control Plan objectives, where appropriate.

Figure 25 below shows that both the state of California as well as the Karuk Tribe's water quality objectives were violated numerous times during this study. The most alarming violations were to lethal and chronic water temperatures, dissolved oxygen for spawning (SPWN) waters, and pH maximums. These objectives are continually exceeded between May and October at the Iron Gate, Seiad Valley and Orleans gauges.

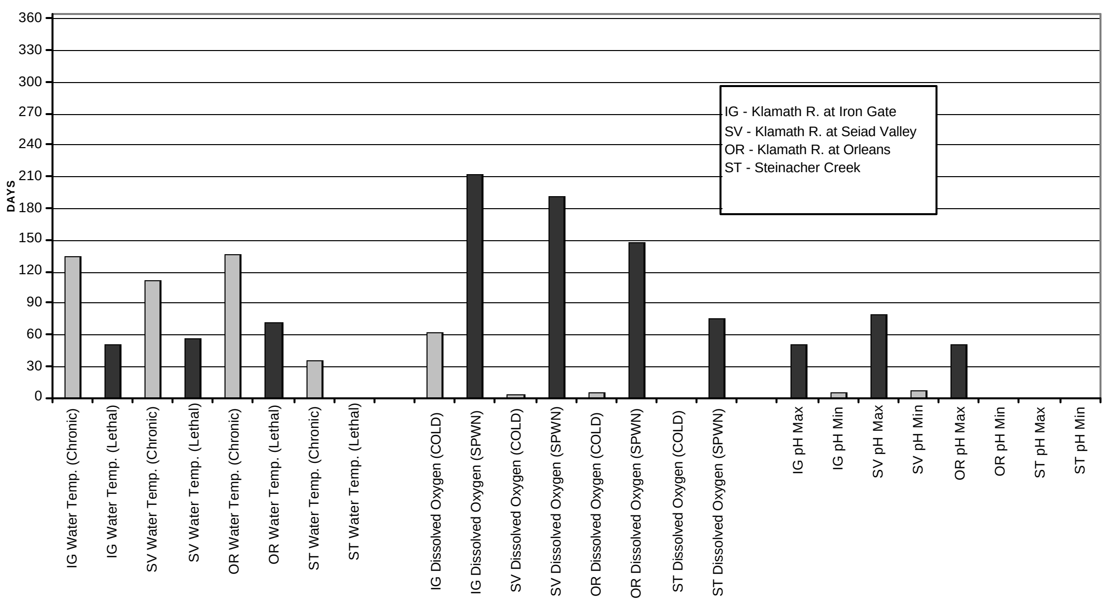

Fig. 25. Days of Karuk water quality objective violations during WY 2002

The data within this document should help the reader develop an opinion as to the water quality conditions that exist along the middle portion of the Klamath River. It is the intention of the Karuk Tribe's Water Resources staff to paint an accurate picture as possible of the condition of our water resources, using the best available science.

Appendix A

Klamath River at Iron Gate Water Quality Data

Water Year 2002

Appendix B

Klamath River at Seiad Valley Water Quality Data

Water Year 2002

Appendix C

Klamath River at Orleans Water Quality Data

Water Year 2002

Appendix D

Indian Creek Flow Data

Water Year 2002

Appendix E

Steinacher Water Quality Data

Water Year 2002