FINAL
2009 Klamath River Datasonde Report

Yurok Tribe Environmental Program:
Water Division

December 2010

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I. Introduction

This report summarizes the trends in water quality as measured by Yellow Springs Incorporated (YSI) 6600EDS multiparameter datasondes on the Klamath River from May through November, 2009. The Yurok Tribe Environmental Program (YTEP) measured water quality at several monitoring sites from Weitchpec to the USGS gaging station at Blake's Riffle at half-hour intervals starting in mid-May and ending in early November. This monitoring was performed in an effort to track both temporal and spatial patterns on the lower reaches of the Klamath River during the sampling period. This data was added to previous years' water quality data as part of an endeavor to build a multi-year database on the Lower Klamath River. This summary is part of YTEP's comprehensive program of monitoring and assessment of the chemical, physical, and biological integrity of the Klamath River and its tributaries in a scientific and defensible manner. Datasonde placement along the mainstem of the Klamath River and measured parameters were coordinated with the Karuk Tribe and PacifiCorp to expand our understanding of the water quality dynamics in the Klamath basin.

II. Background

The Klamath River Watershed

The Klamath River system drains much of northwestern California and south-central Oregon (Figure 2-1). Thus, even activities taking place on land hundreds miles off the Yurok Indian Reservation (YIR) can affect water conditions within YIR boundaries. For example, upriver hydroelectric and diversion projects have altered natural flow conditions for decades. The majority of water flowing through the YIR is derived from scheduled releases of impounded water from the Upper Klamath Basin that is often of poor quality with regards to human needs as well as the needs of fish and wildlife.

Some historically perennial streams now have ephemeral lower reaches and seasonal fish migration blockages because of inadequate dam releases from water diversion projects along the Klamath and Trinity Rivers. The releases contribute to lower mainstem levels and excessive sedimentation which in turn causes subsurface flow and aggraded deltas. Additionally, the lower slough areas of some of the Lower Klamath

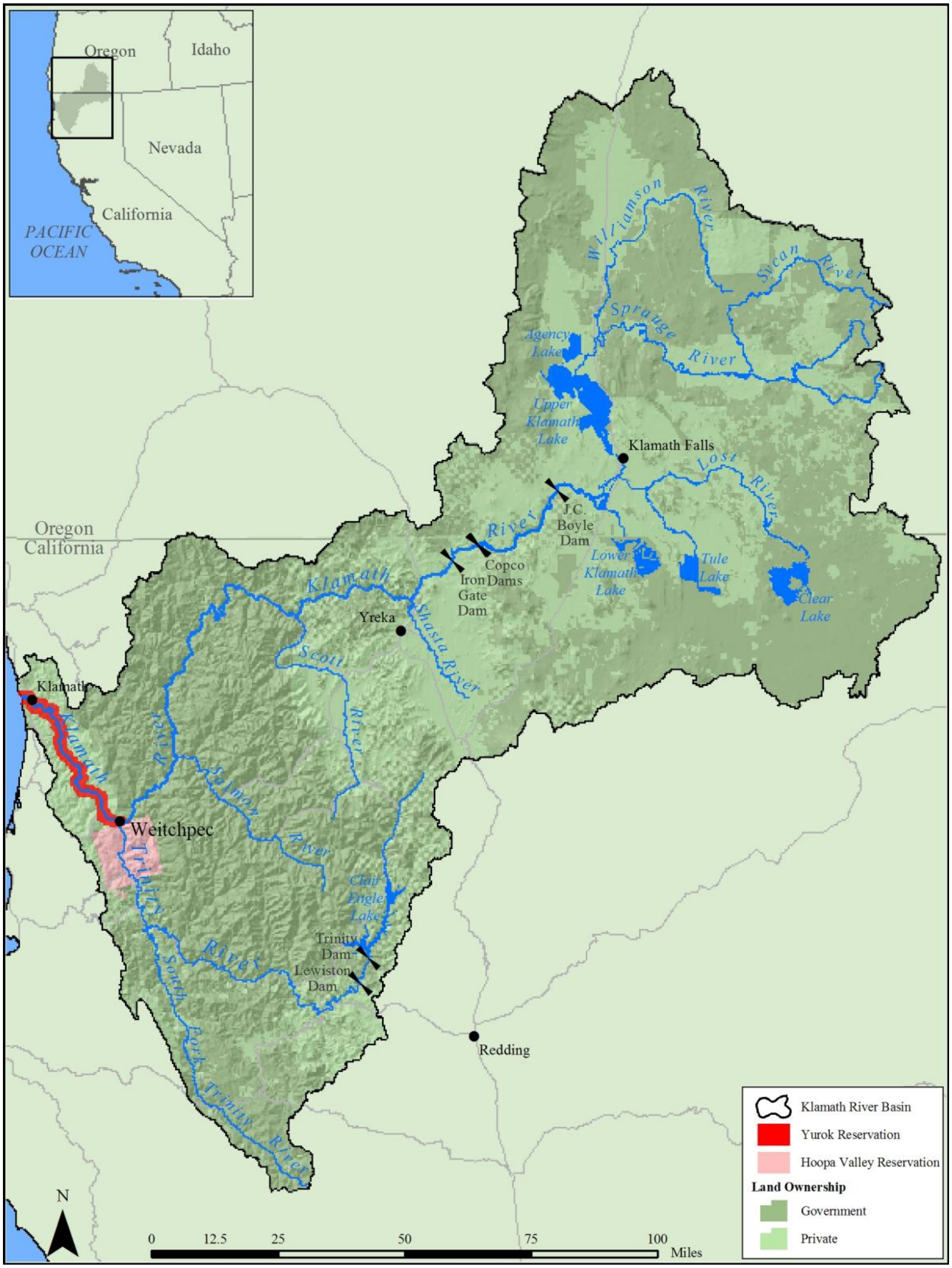

Figure 2-1. Klamath River Basin Map

tributaries that enter the estuary experience eutrophic conditions during periods of low flow. These can create water quality barriers to fish migration when dissolved oxygen levels are inadequate for migrating fish. The Klamath River is on California State Water Resource Control Board's (SWRCB) 303(d) List as impaired for temperature, dissolved oxygen, and nutrients and portions of the Klamath River were recently listed as impaired for microcystin and sedimentation in particular reaches.

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

The Klamath River

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

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

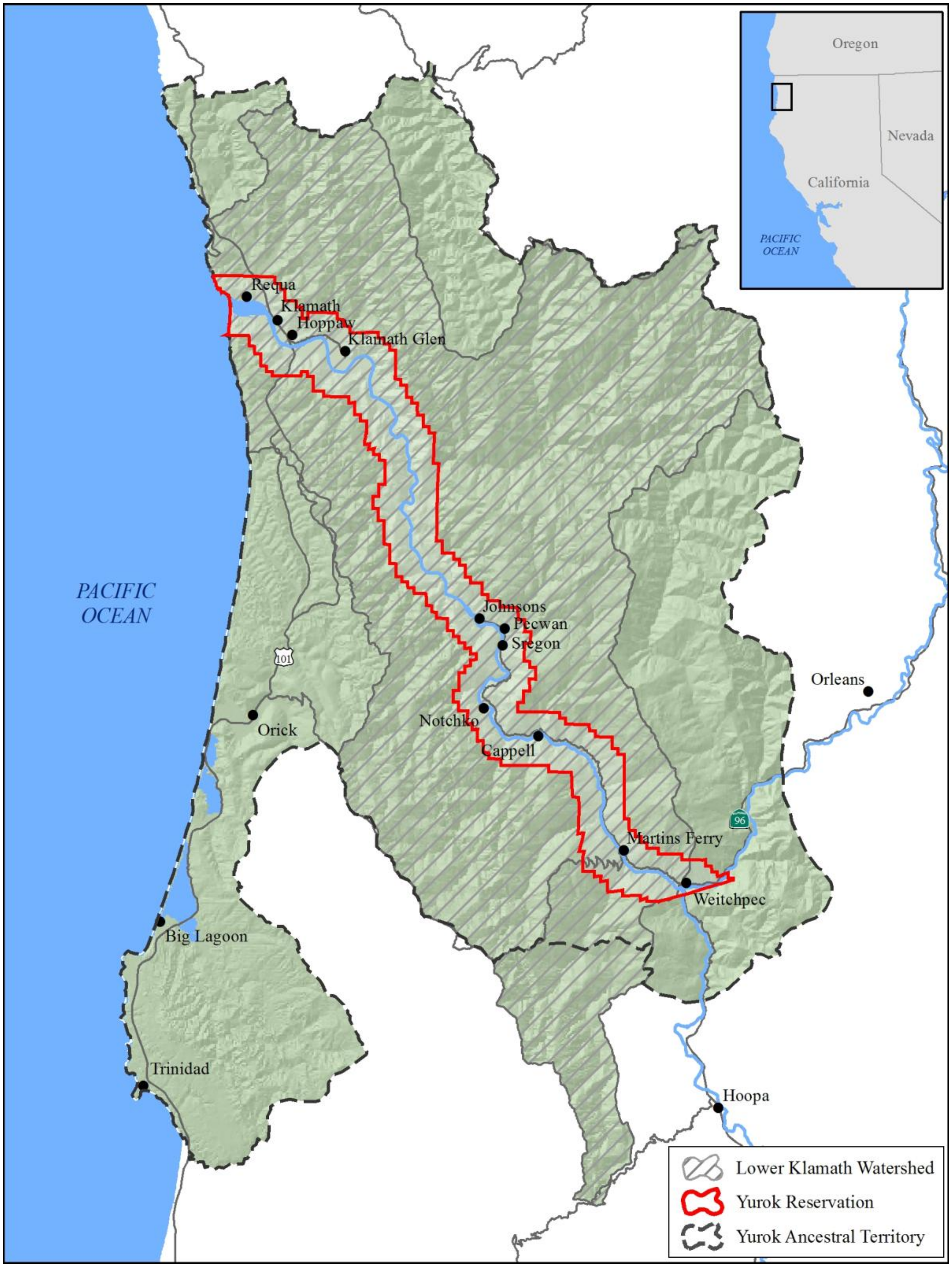

Figure 2-2. Yurok Indian Reservation and Yurok Ancestral Territory Map

The Yurok Indian Reservation

The current YIR consists of a 59,000-acre corridor extending for one mile from each side of the Klamath River from just upstream of the Trinity River confluence to the Pacific Ocean, including the channel and the bed of the river (Figure 2-2). There are approximately two dozen major anadromous tributaries within that area. The mountains defining the river valley are as much as 3,000 feet high. Along most of the river, the valley is quite narrow with rugged steep slopes. The vegetation is principally redwood and Douglas fir forest with little area available for agricultural development. Historically, prevalent open prairies provided complex and diverse habitat.

Yurok Tribe Water Monitoring Division

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

III. Methods

The monitoring study initiated in the middle of May, continued throughout the summer months and ended in early November. Continuous water quality information was collected using YSI 6600EDS multiparameter sondes equipped with specific conductivity/temperature, pH, ROX DO and phycocyanin probes. ROX DO probes detect concentrations of dissolved oxygen in bodies of water by measuring luminescence as it is affected by the presence of oxygen, while phycocyanin probes are designed to detect the presence of an accessory pigment known to occur in *Microcystis aeurginosa*. These sensors return consistent, high quality water quality measurements.

During this study, many QC measures were undertaken to ensure the data collected with the datasondes were of the highest quality. According to the 2008 datasonde operation protocol (Appendix A), datasondes were pre- and post-calibrated on site every two weeks order to account for electronic drift and bio-fouling. When the datasondes were deployed and extracted, an audit was performed with a freshly calibrated YSI 6600EDS, a portable multi-probe instrument. Effort was made to record the 6600EDS measurements as close as possible to the datasonde and within five minutes of the datasonde recording a measurement.

Once the datasonde was extracted, a pre-clean audit was performed, this time with the site sonde and reference sonde in a bucket filled with river water. Once this audit was performed, the site sonde was thoroughly cleaned and wiper pads were replaced. Next, a post-clean audit was performed with the site sonde and reference sonde in the same bucket of water. After the post clean audit was completed, the dissolved oxygen probe was calibrated using the wet towel method. This protocol requires the user to wrap the entire datasonde in a wet towel and then place it in a calibration chamber (cylindrical cooler). Dissolved oxygen percent saturation is then calibrated to the current barometric pressure.

Once dissolved oxygen was calibrated, specific conductivity was calibrated, followed by pH using fresh calibration standards. Once calibrations were completed the accuracy of the BGA probe was checked by recording readings from DI water, and, during periods of blue-green algae blooms, a solution of rhodamine dye (To view results of continuous blue-green algae data please see the Yurok Tribe's 2009 Blue-green Algae Report).

After all calibrations and audits were completed, the site sonde was returned to its housing and redeployed.

IV. Site Selection

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

YTEP collected continuous water quality data at the following mainstem Klamath River locations (Figure 4-1) (river miles are approximate):

- **WE - Klamath River at Weitchpec (upstream of Trinity River) – RM 43.5**
- **TC - Klamath River above Tully Creek – RM 38.5**
- **KAT - Klamath River above Turwar Boat Ramp – RM 8**

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

- **TR - Trinity River near mouth (above Klamath River confluence) – RM 0.5**

V. Quality Assurance

During this study, many quality assurance and quality control (QA/QC) measures were undertaken to ensure that the continuous water quality data collected was of the highest quality.

All field personnel that were involved in datasonde maintenance have been trained appropriately by the Water Division Program Manager and are supervised to ensure proper protocol is followed consistently throughout the monitoring season. Each field visit requires that staff fill out field data sheets and follow protocols appropriately in the field. Datasonde maintenance is always conducted by at least two staff for safety reasons and to maintain consistency.

Data is thoroughly reviewed once downloaded from the datalogger. YTEP is the primary organization responsible for data review. The data manager will visually inspect all entered data sets to check for inconsistencies with original field data sheets. Where inconsistencies are encountered, data will be re-entered and re-inspected until the entered data is found to be satisfactory or results will be discarded. Any unusual values outside the range of norm will be flagged and all aspects of field data sheets will be reviewed.

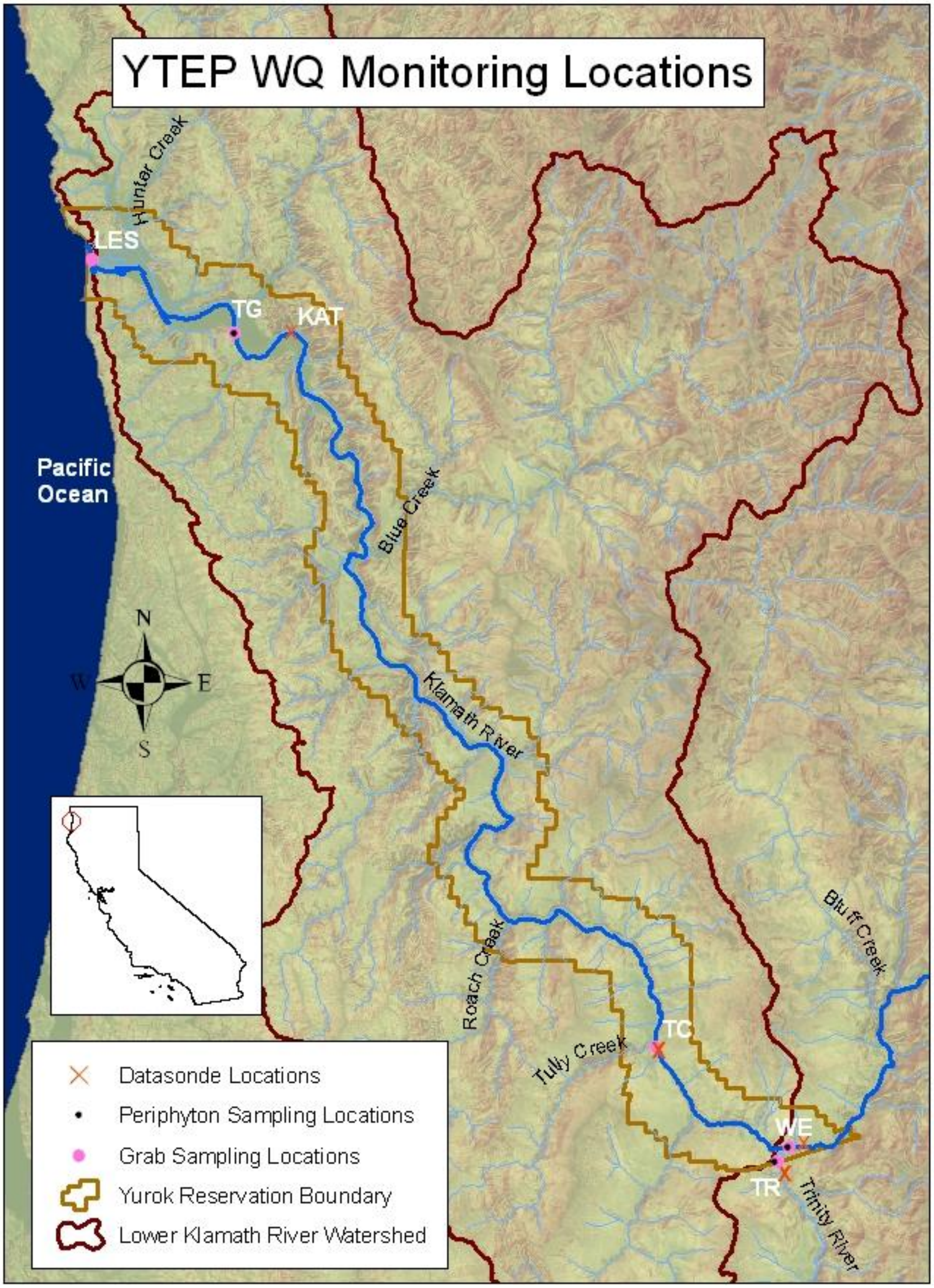

Figure 4-1. Datasonde Locations for 2009 (as indicated by the brown X's)

Outliers will be identified and removed from the dataset if deemed necessary by the QA Officer. The Project Manager will maintain field datasheets and notebooks in the event that the QA Officer needs to review any aspect of sampling for QA/QC purposes. Data is reviewed and finalized once data are merged or entered into a database.

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

VI. Results

Temperature

All Riverine Sites

Water temperatures on the Lower Klamath and Trinity River varied greatly during the 2009 monitoring season. The coolest daily water temperature was 11.12 °C on October 30 at WE. The warmest daily water temperature was 26.86 °C on July 28 at WE. In this discussion, the daily minimum and maximum water temperatures were compared to the Yurok Tribe's water temperature standards in order to assess the water temperatures of the Klamath and Trinity Rivers. The discussion reflects water temperature standards as of November 1, 2005. Temperature standards are under review and will be updated for all salmonid life stages.

Daily maxima and minima were disregarded when more than five measurements were missing from a 24-hour period and when the daily maximum or minimum was expected to occur during the gap. Gaps in data may occur during service or due to instrument malfunction or vandalism. Continuous water temperature data from the lower Klamath and Trinity River is available from the Yurok Tribe Environmental Program upon request.

Klamath River above Turwar (KAT)

In general, maximum water temperature at KAT increased from May until late July, with small peaks in late May and early July (Figure 6-1). After late July maximum temperature slowly decreased until late September, and then sharply declined into early October. Temperatures held steady until mid-October, at which time they increased slightly, then decreased until early November.

The lowest temperature recorded at KAT during 2009 was 12.31 °C on October 30 and the highest temperature recorded was 24.87 °C on July 27. The daily maximum water temperature at KAT exceeded 21 °C beginning on June 25 and remained above this standard until September 3, except for July 9-11 and August 26 and 27 (Figure 6-1).

Daily maximum water temperatures at KAT exceeded 21 °C 41.21% of the time, or 68 out of 165 days of the monitoring season (Figure 6-2). Water temperature exceeded 21 °C 32.28% of the time, or 2,578 out of 7,987 readings for all half-hour measurements during the monitoring season (Figure 6-2). The seven-day moving average of the daily maximum exceeded 15.5 °C from the beginning of the monitoring season and continued to exceed this standard until October 6, and then from October 19-26 (Figure 6-3).

Klamath River above Tully Creek (TC)

Similar to trends observed at KAT maximum water temperature at TC increased from May until late July, with small peaks in late May and early July (Figure 6-4). After late July maximum temperature slowly decreased until late September, and then sharply declined into early October. Temperatures held steady until mid-October, at which time they increased slightly, then decreased until early November.

The lowest temperature recorded at TC during 2009 was 11.48 °C on October 30 and the highest temperature recorded was 26.50 °C on July 28. The daily maximum water temperature at TC exceeded 21 °C beginning on June 25 and remained above this temperature until August 25, exceeding it again from August 30 through September 4 (Figure 6-4).

Daily maximum water temperatures at TC exceeded 21°C 40.72% of the time, or 68 out of 167 days of the monitoring season (Figure 6-5). Water temperatures exceeded

21ºC 34.71% of the time, or 2,790 out of 8,038 readings for all half-hour measurements during the 2009 monitoring season (Figure 6-5). The seven-day moving average of the daily maximum exceeded 15.5 ºC from the beginning of the monitoring season and continued to exceed this standard until October 6, and then again on October 22 and 23.(Figure 6-6).

Klamath River above the Trinity River (WE)

Maximum water temperature at WE increased from May until late July, with small peaks in late May and early July (Figure 6-7). After late July maximum temperature slowly decreased until late September, and then sharply declined into early October. Temperatures held steady until mid-October, at which time they increased slightly, then decreased until early November.

The lowest temperature recorded at WE during 2009 was 11.12ºC on October 30, while the highest recorded temperature was 26.86ºC on July 28. The daily maximum water temperature at WE exceeded 21ºC beginning on June 25 and remained above this temperature until September 4, exceeding it again on September 11,12,15, and 17-20 (Figure 6-7).

Daily maximum water temperature at WE exceeded 21 ºC 47.88% of the time, or 79 out of 165 days of the monitoring season (Figure 6-8). Water temperatures exceeded 21 ºC 37.43% of the time, or 3,001 out of 8,017 readings for all half-hour measurements during the 2009 monitoring season (Figure 6-8). The seven-day moving average of the daily maximum exceeded 15.5 ºC from the beginning of the monitoring season and continued to exceed this standard until October 6 and then again from October 21-24 (Figure 6-9).

Trinity River near Mouth (TR)

Maximum water temperature at TR increased from May until late July, with small peaks in late May and early July (Figure 6-10). Water temperature then generally decreased until late August, at which time there was a sharp decrease in temperature for a short period of time. Temperature then increased quickly, followed by a gradual decline from early to late September. In late September there was a sharp decrease in water temperature, after which temperatures held steady until mid October. In mid-October, temperatures increased slightly, and then decreased until early November.

The lowest temperature recorded at TR during 2009 was 11.53 °C on October 29 and the highest temperature recorded was 26.78 °C on July 30. The daily maximum water temperature at TR exceeded 21°C beginning on June 25 and remained above this temperature until August 25, exceeding it again on August 30 through September 4, and September 11 through 22 (Figure 6-10).

Daily maximum water temperature at TR exceed 21 °C 45.73% of the time, or 75 out of 164 days of the monitoring season (Figure 6-11). Water temperatures exceeded 21 °C 32.40% of the time, or 2,576 out of 7,951 readings for all half-hour measurements during the 2009 monitoring season (Figure 6-11). The seven-day moving average of the daily maximum exceeded 15.5 °C from the beginning of the monitoring season and continued to exceed this standard until October 6, and then again from October 21-26 (Figure 6-12).

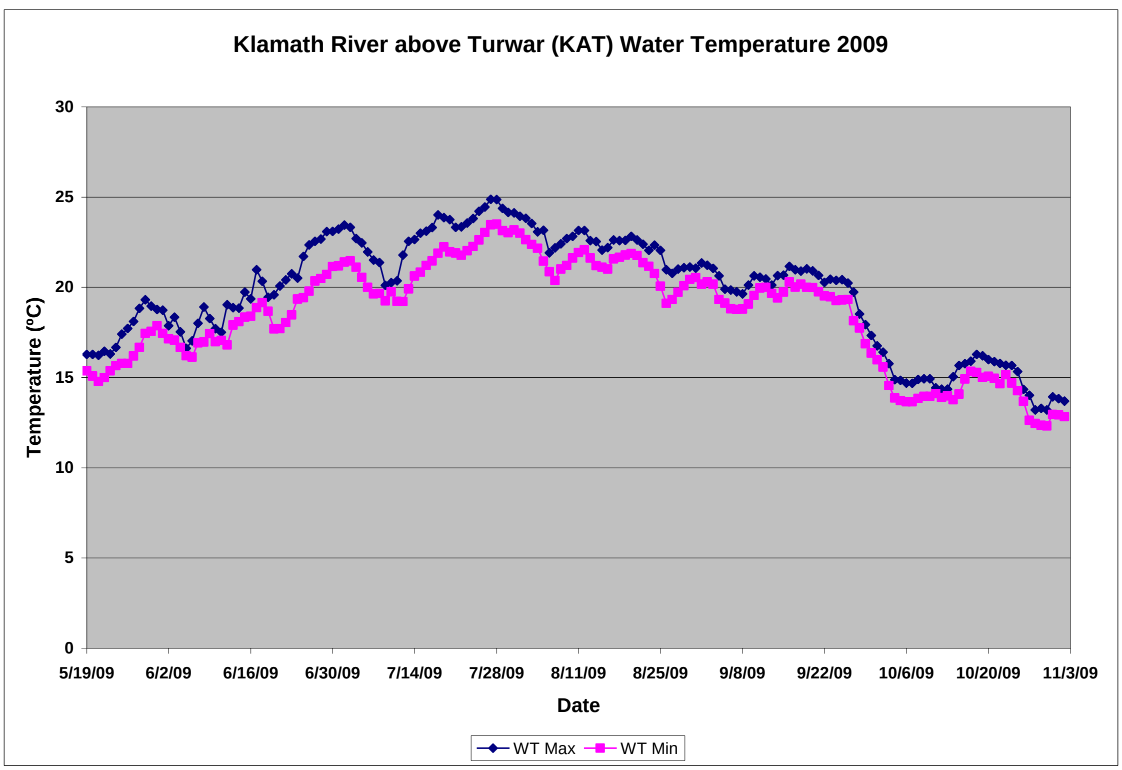

Figure 6-1. KAT Maximum/minimum Water Temperatures: 2009

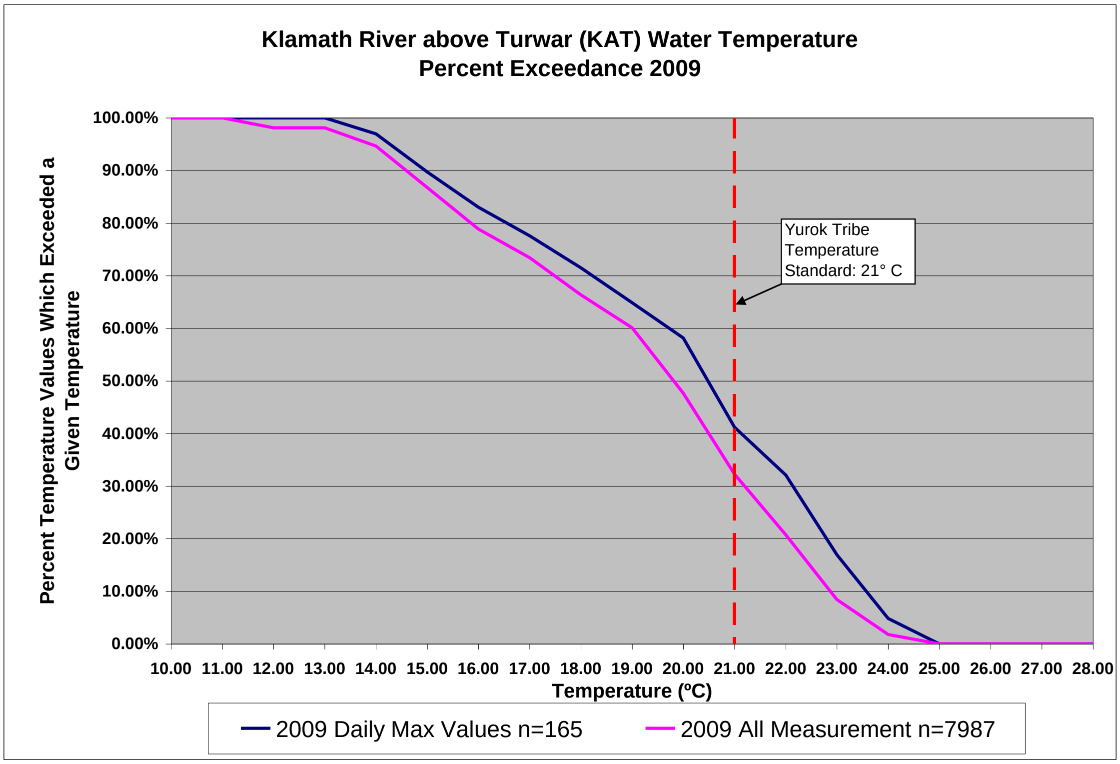

Figure 6-2. KAT Water Temperature Percent Exceedance: 2009

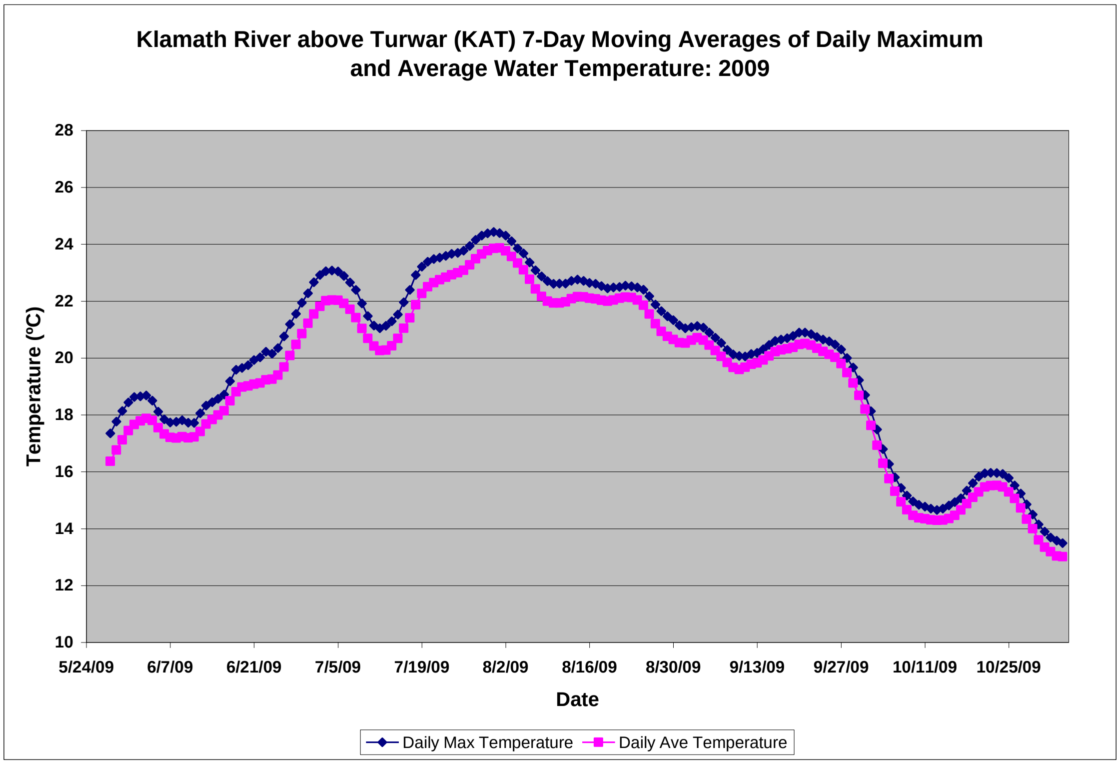

Figure 6-3. KAT 7-Day Moving Averages: 2009

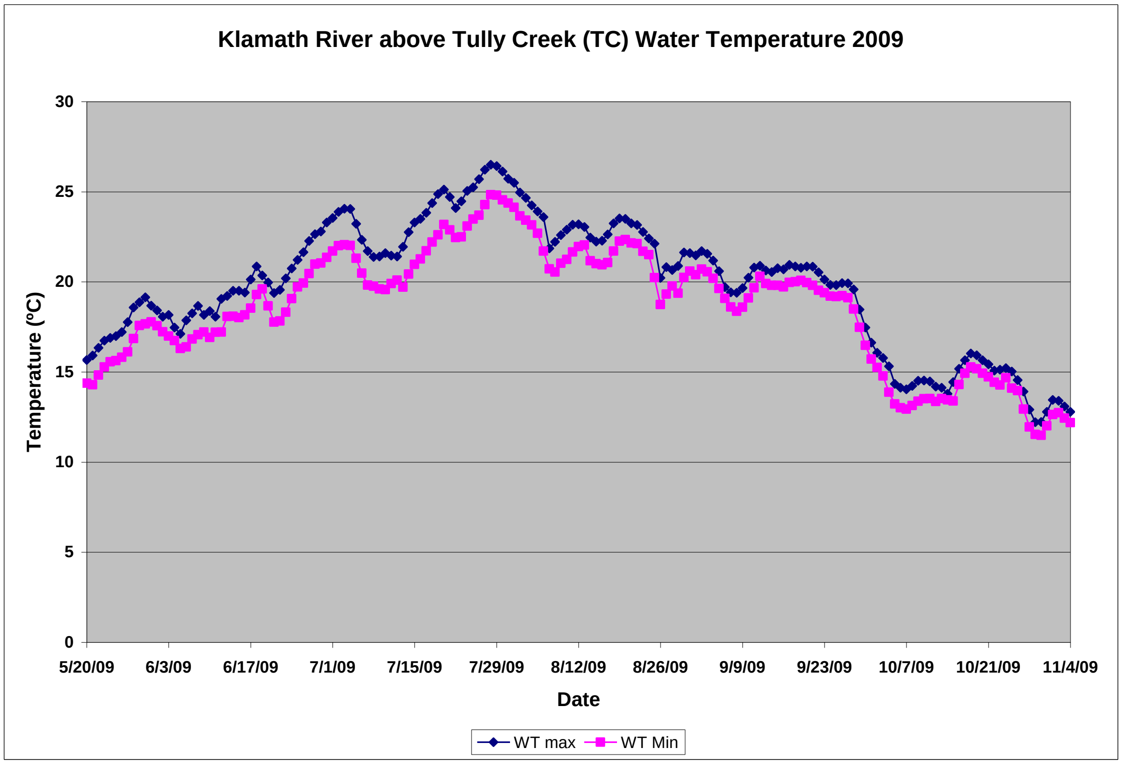

Figure 6-4. TC Maximum/minimum Water Temperature: 2009

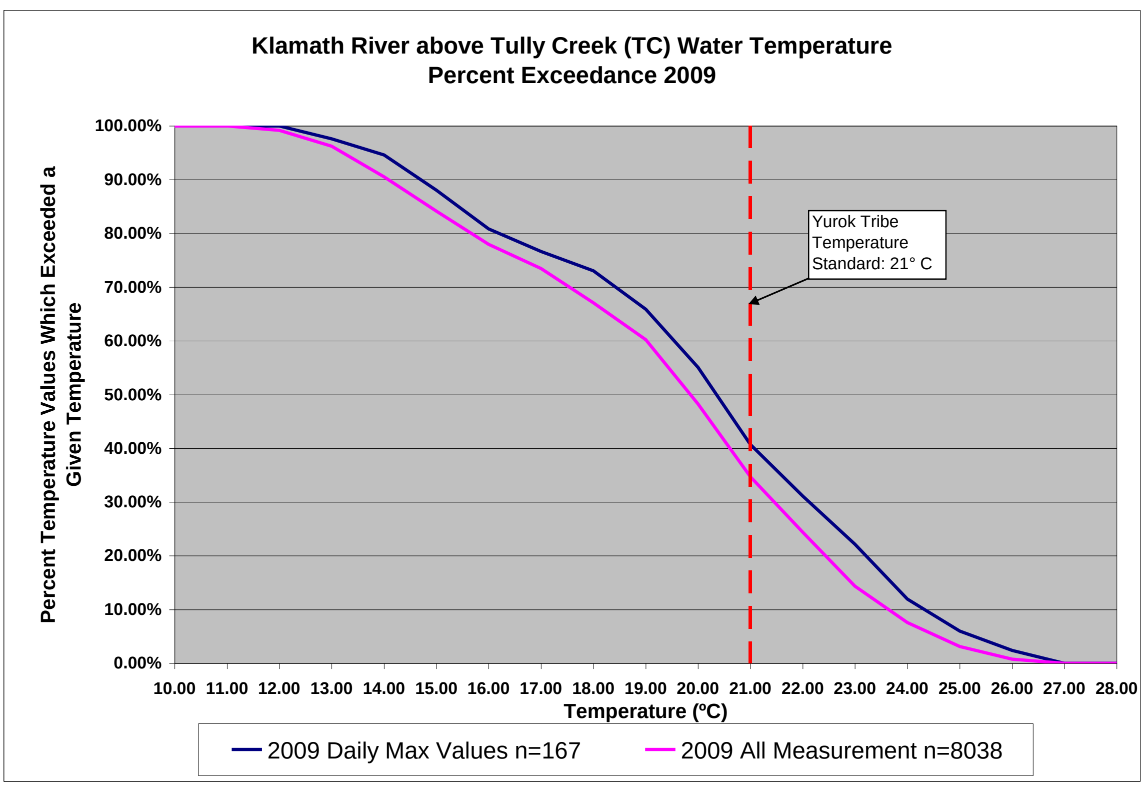

Figure 6-5. TC Water Temperature Percent Exceedance: 2009

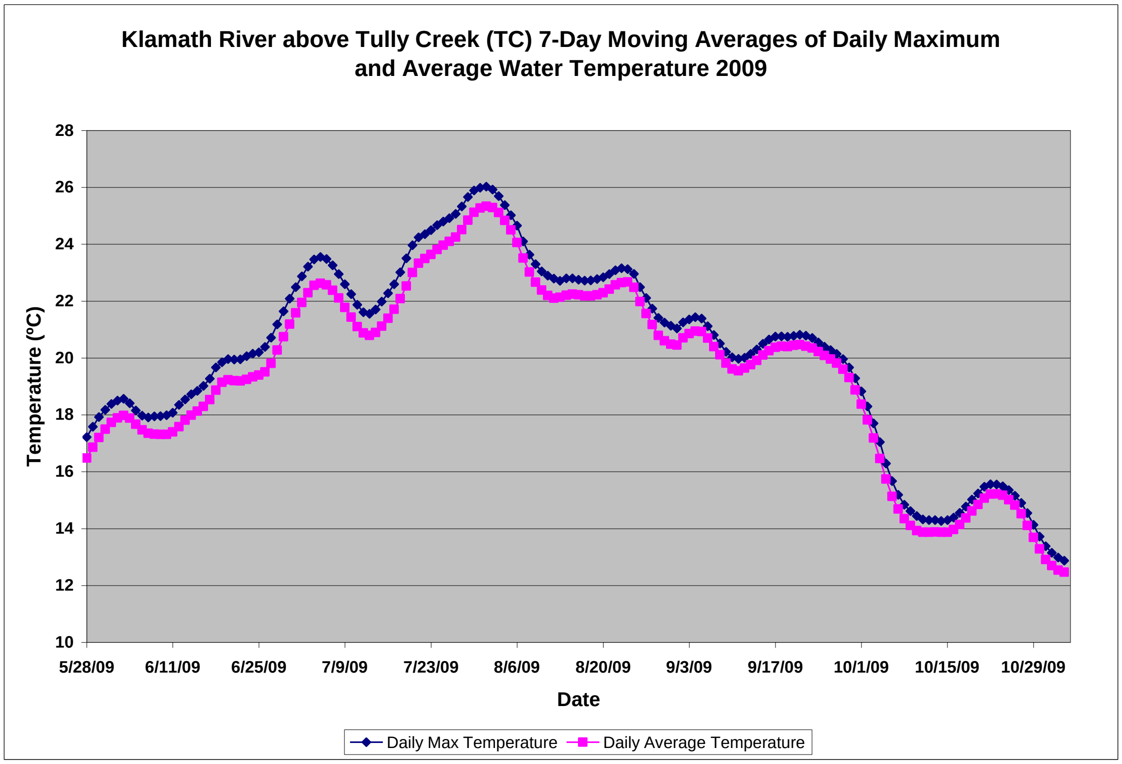

Figure 6-6. TC 7-Day Moving Averages: 2009

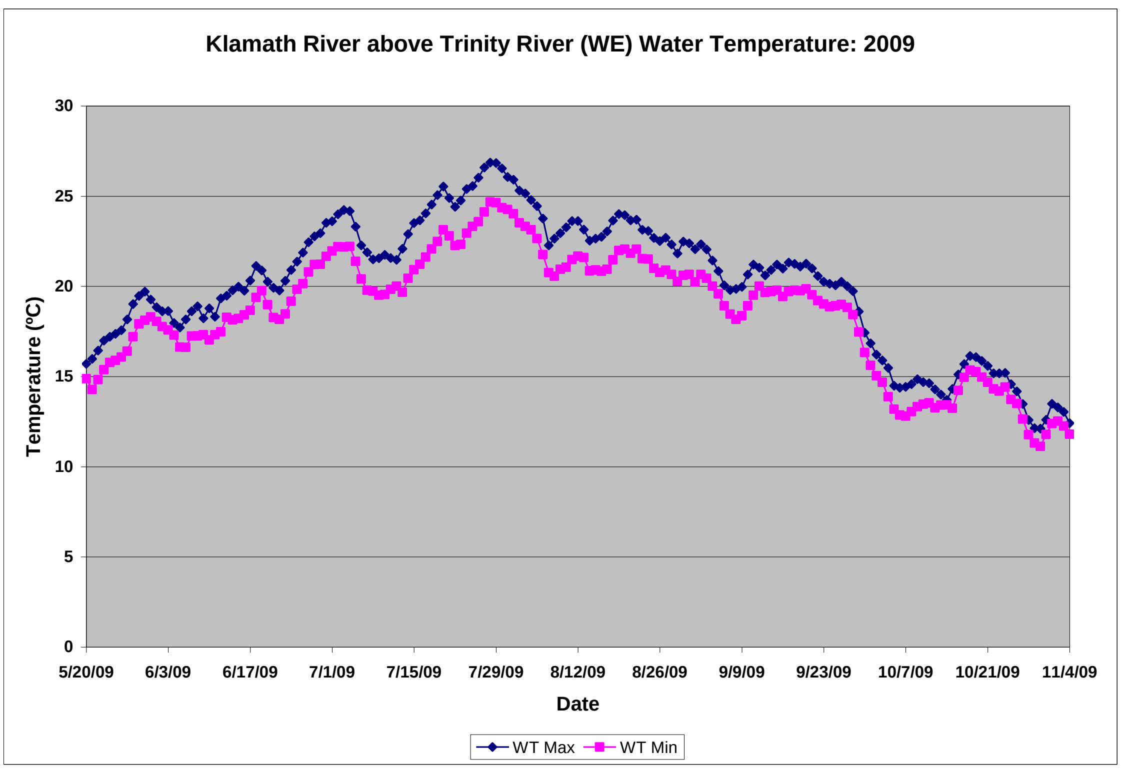

Figure 6-7. WE Maximum/minimum Water Temperature: 2009

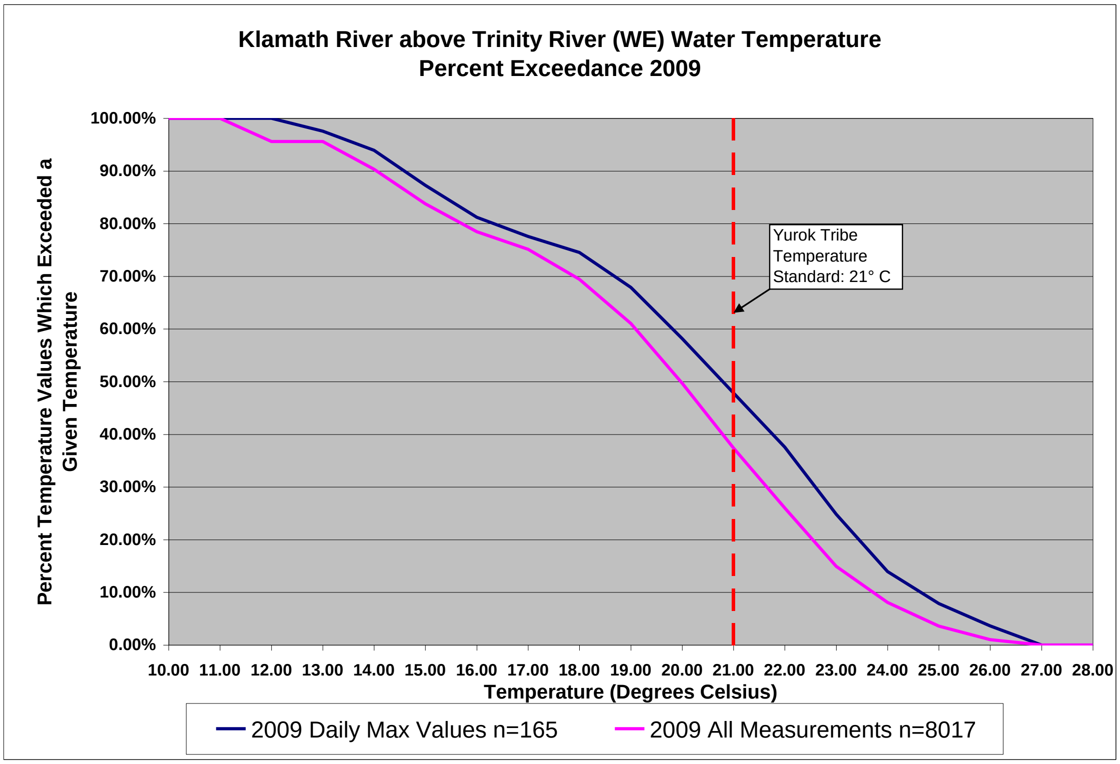

Figure 6-8. WE Water Temperature Percent Exceedance: 2009

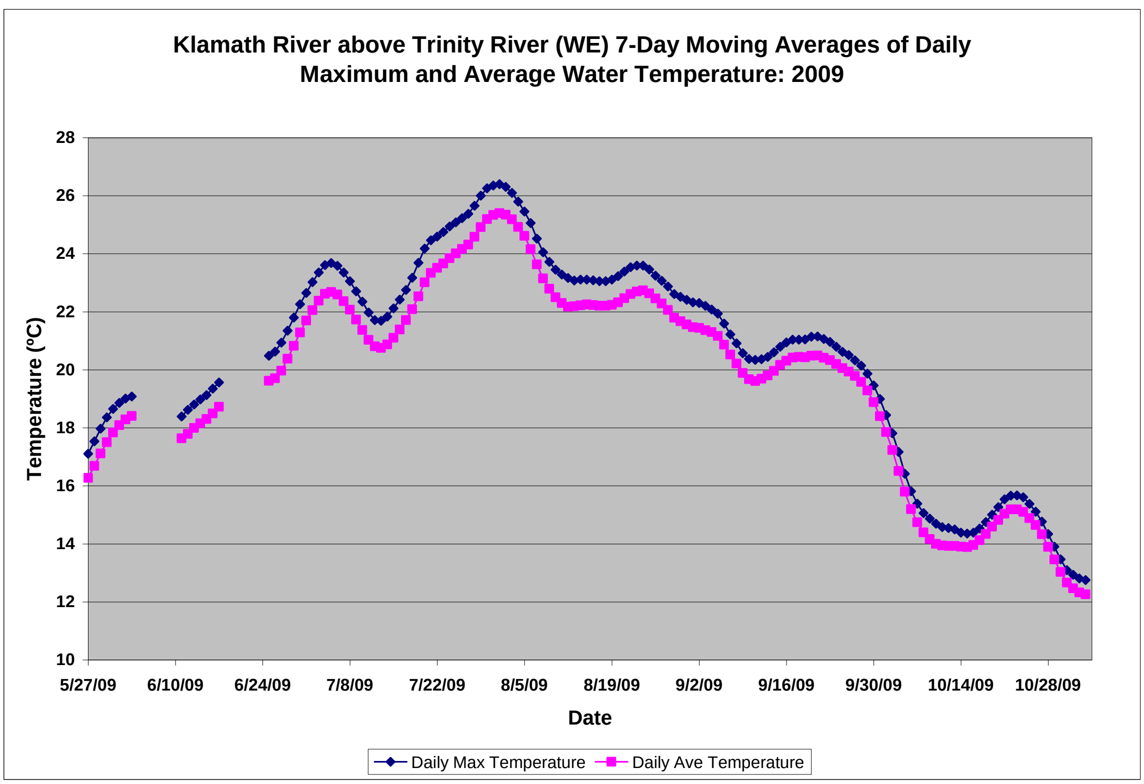

Figure 6-9. WE 7-Day Moving Averages: 2009

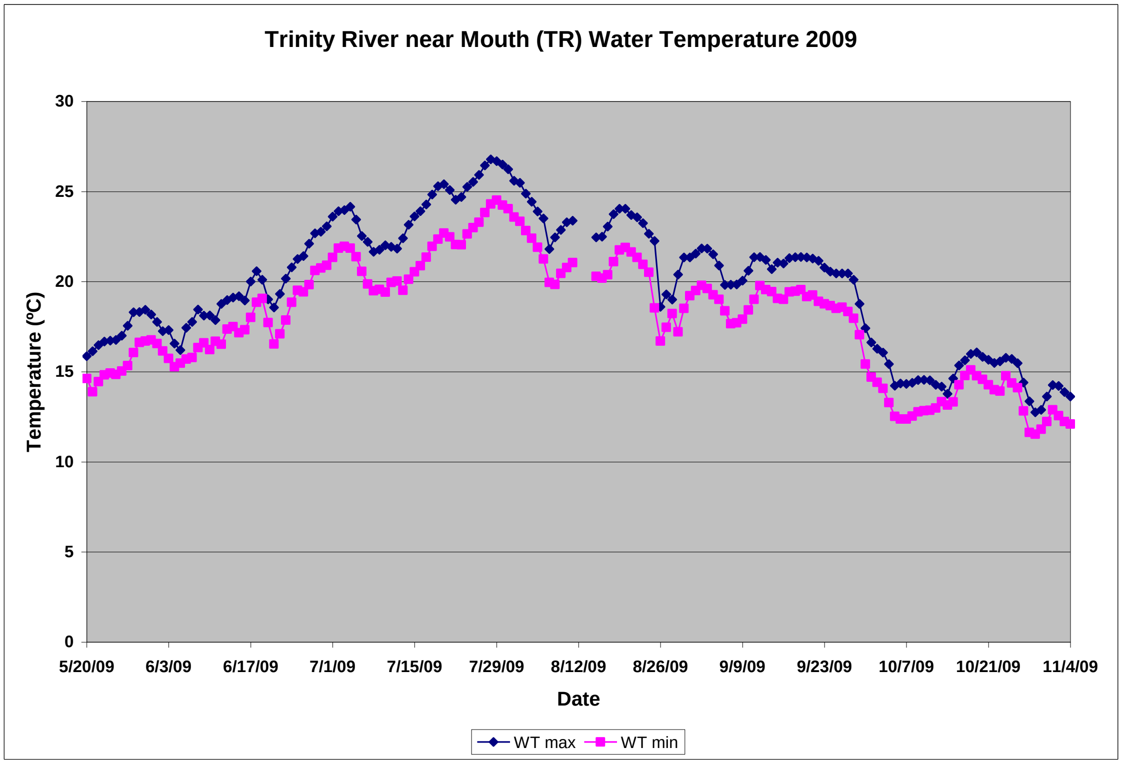

Figure 6-10. TR Maximum/minimum Water Temperature: 2009

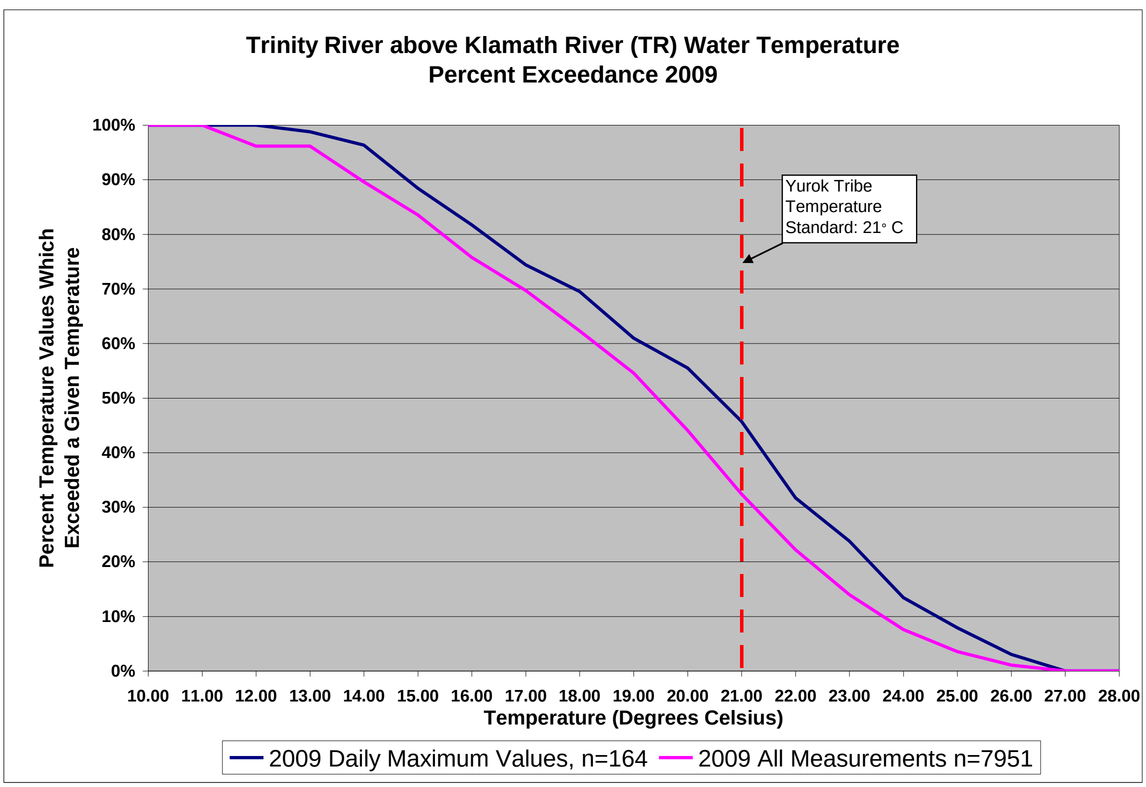

Figure 6-11. TR Water Temperature Percent Exceedance: 2009

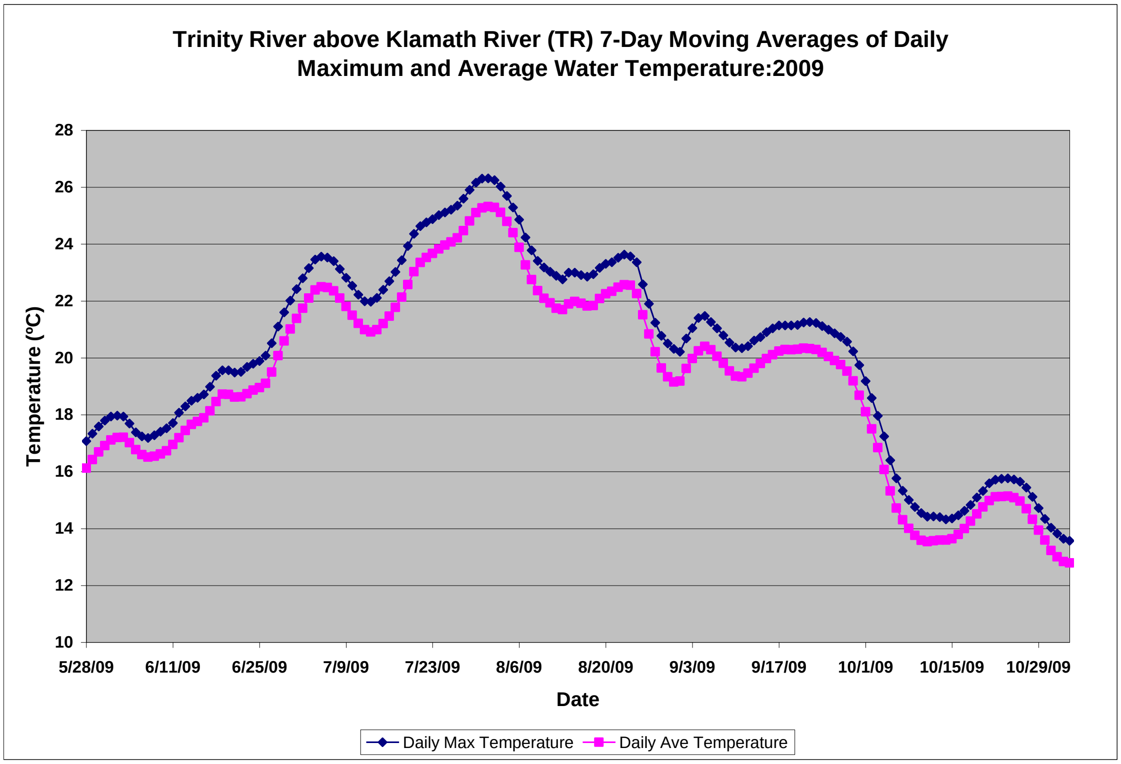

Figure 6-12. TR 7-Day Moving Averages: 2009

Dissolved Oxygen

All Riverine Sites

Dissolved oxygen concentrations are reported in milligrams per liter (mg/L). The datasonde calculates this concentration based on the dissolved oxygen sensor's percent saturation reading. Percent saturation is the amount of oxygen dissolved in the water compared to the maximum amount that could be present at the same temperature and barometric pressure. Water is said to be 100% saturated if it contains the maximum amount of oxygen at that temperature and pressure. Sometimes water can become supersaturated with oxygen, returning percent saturations readings above 100%. This happens in two main situations. One is in fast-moving, turbulent water, which encourages more air to mix with the water. The other is in situations with large numbers of aquatic plants. These aquatic plants release oxygen into the water during photosynthesis, which mixes with the water as it rises to the surface.

In general, DO levels of the Lower Klamath and Trinity River follow an inverse relationship compared to water temperature. As water temperature rises, its ability to hold oxygen in solution is decreased, causing DO levels to drop. Therefore, as water temperatures increase throughout the summer, DO levels tend to decrease. There is also a diurnal fluctuation within the system, with minimum DO levels occurring late at night and/or early in the morning when aquatic vegetation is respiring and photosynthesis is not occurring. Conversely, maximum levels occur late in the afternoon and/or early in the evening when aquatic vegetation is at peak photosynthesis. These diurnal fluctuations can cause large swings in DO throughout the day, which can be harmful to aquatic organisms dependent on dissolved oxygen for respiration.

Dissolved oxygen levels at all sites varied greatly during the 2009 monitoring season. The lowest DO concentration recorded was 7.14 mg/L at WE on August 31. The highest DO concentration recorded was 11.77 mg/L at WE on October 8. The lowest DO% saturation recorded was 81.2% at WE on August 31. The highest DO% saturation recorded was 123.8% at TC on July 2 and 3. Due to its implications for fish health, minimum dissolved oxygen concentrations are focused on in this summary. Optimal dissolved oxygen levels are above 7.00 mg/L and above 80% saturation. At no point in time did minimum DO levels at any of YTEP's real-time continuous water quality monitoring locations fall below these benchmarks during the 2009 monitoring season.

Daily maxima and minima were disregarded when more than five measurements were missing from a 24-hour period and when the daily maximum or minimum was expected to occur during the gap. Gaps in data may occur during service or due to instrument malfunction or vandalism. Continuous dissolved oxygen data from the Lower Klamath and Trinity River is available from the Yurok Tribe Environmental Program upon request.

Klamath River above Turwar (KAT)

Minimum dissolved oxygen concentrations at KAT tended to drop from May until late July, with a small peak in mid-July (Figure 6-13). DO concentrations then gradually increased until late September, with small peaks in early August, late August, and early September. In late September, there was a sharp increase in DO concentrations until early October, followed by a small decrease into mid-October, and then increasing DO until late October. DO concentrations were falling when sampling was suspended in early November.

The lowest DO concentration recorded at KAT was 7.27 mg/L on July 27, while the highest DO concentration recorded was 11.67 mg/L on October 29 (Figure 6-13). The lowest percent saturation was 85.50% on July 16, and the highest recorded was 123.40% on July 2 (Figure 6-14).

Klamath River above Tully Creek (TC)

Minimum dissolved oxygen concentrations at TC generally dropped from May until late July, with a small peak in mid-July (Figure 6-15). DO concentrations then gradually increased until late September, with small peaks in early August, late August, and early September. In late September, dissolved oxygen concentrations increased until sampling was suspended in early November with peaks in early October and late October.

The lowest DO concentration recorded at TC was 7.23 mg/L on July 28, while the highest was 11.72 mg/L on October 31 (Figure 6-15). The lowest recorded percent saturation was 88.5% on July 28, and the highest was 123.8% on July 2-3 (Figure 6-16).

Klamath River above Trinity River (WE)

Minimum dissolved oxygen concentrations at WE generally dropped from May until late July, with a small peak in mid-July (Figure 6-17). DO concentrations then gradually increased until late September, with small peaks in early and mid-August, and a sharp decline in late August/early September. In late September, dissolved oxygen concentrations increased until sampling was suspended in early November with peaks in early October and late October.

The lowest DO concentration recorded at WE was 7.14 mg/L on August 31, while the highest was 11.77 mg/L on October 8 (Figure 6-17). The lowest recorded percent saturation was 81.2% on August 31, and the highest was 123.1% on July 4 (Figure 6-18).

Trinity River near Mouth (TR)

Minimum dissolved oxygen concentrations at TR generally dropped from May until late July, with small peaks in mid-June and mid-July (Figure 6-19). Dissolved oxygen concentrations then slightly increased until early August followed by a decline until mid-August. In late August there was a large, sharp increase in DO that lasted several days, followed by a gradual decrease until late September, with a small peak in early September. In late September, dissolved oxygen concentrations increased until sampling was suspended in early November with peaks in early October and late October.

The lowest DO concentration recorded at TR was 7.77 mg/L on July 29, while the highest was 11.32 mg/L on October 29 (Figure 6-19). The lowest recorded percent saturation was 91.2% on September 28, and the highest was 112.2% on July 2 (Figure 6-20).

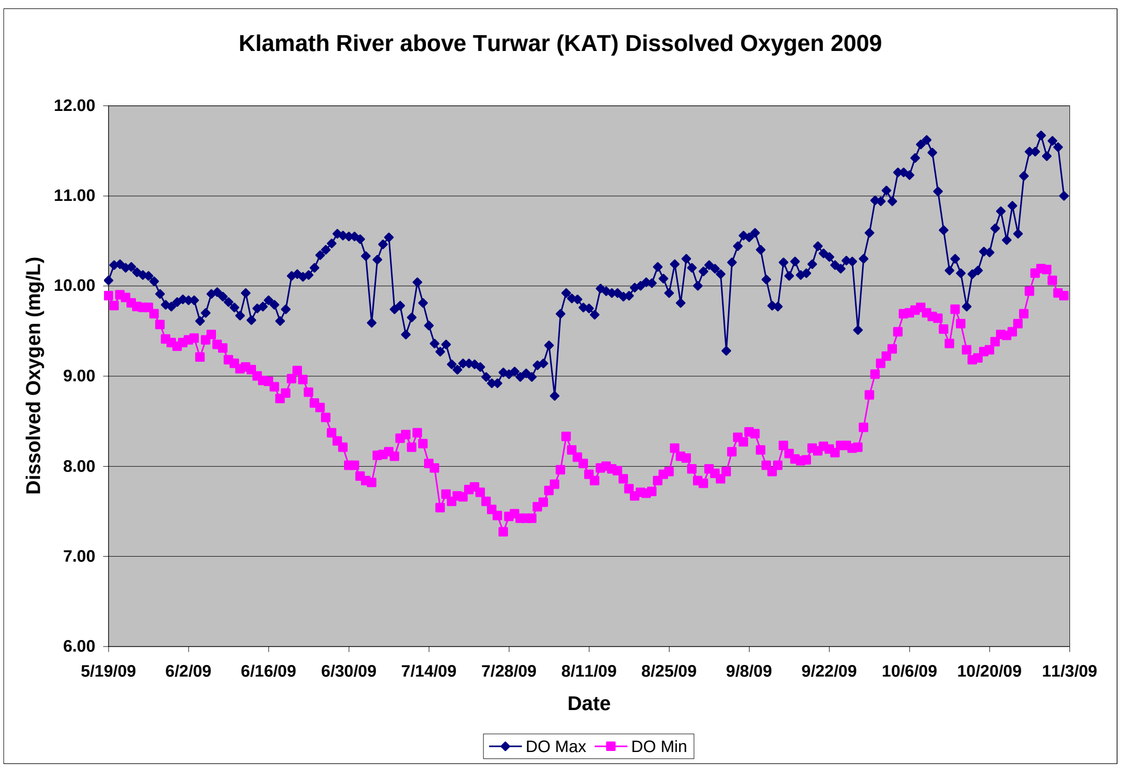

Figure 6-13. KAT Dissolved Oxygen: 2009

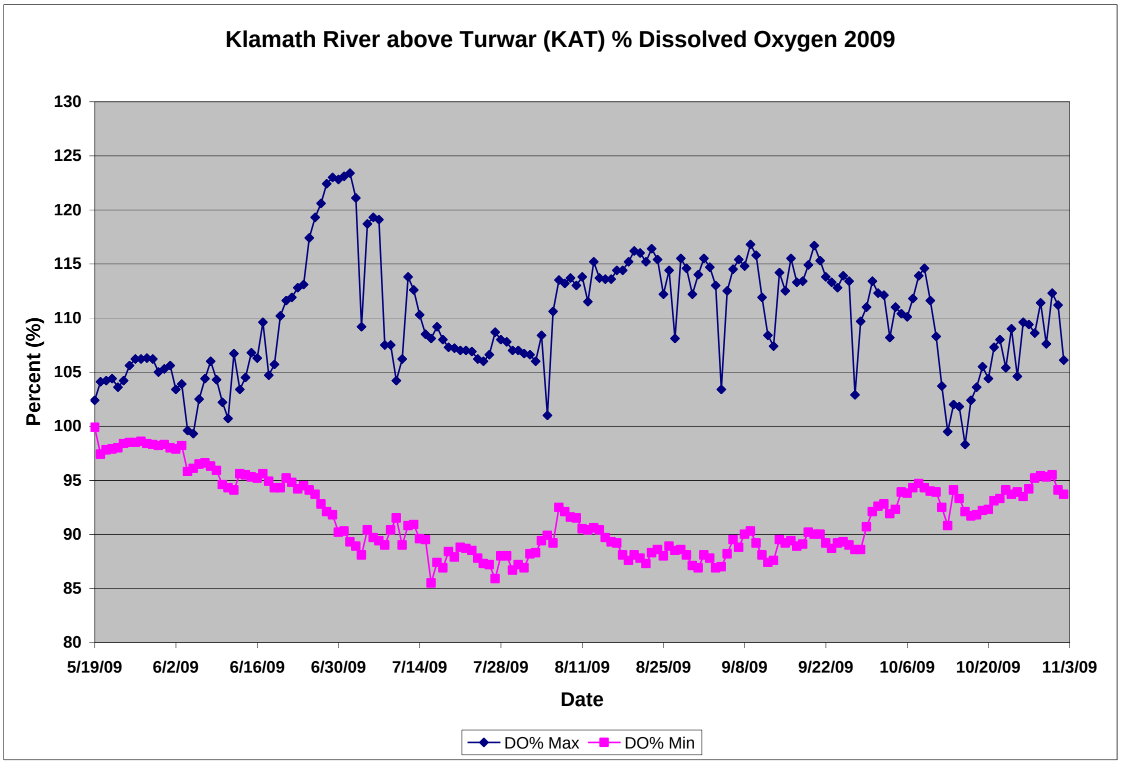

Figure 6-14. KAT Percent Dissolved Oxygen: 2009

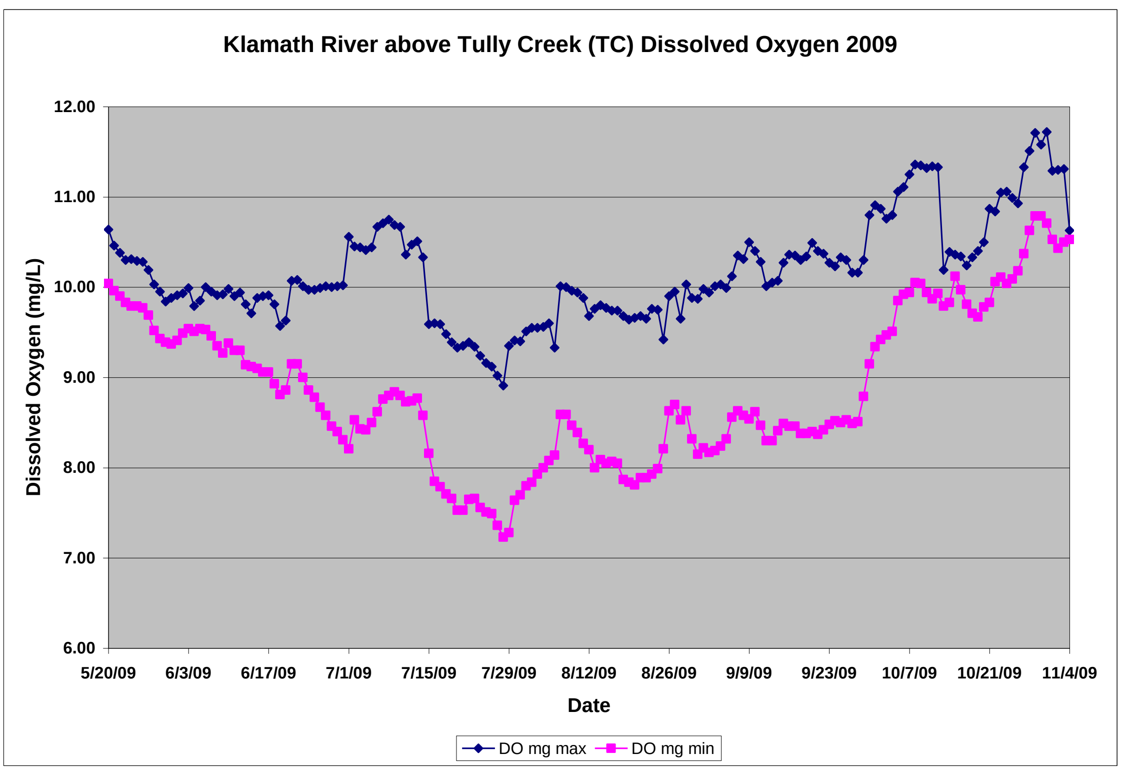

Figure 6-15. TC Dissolved Oxygen: 2009

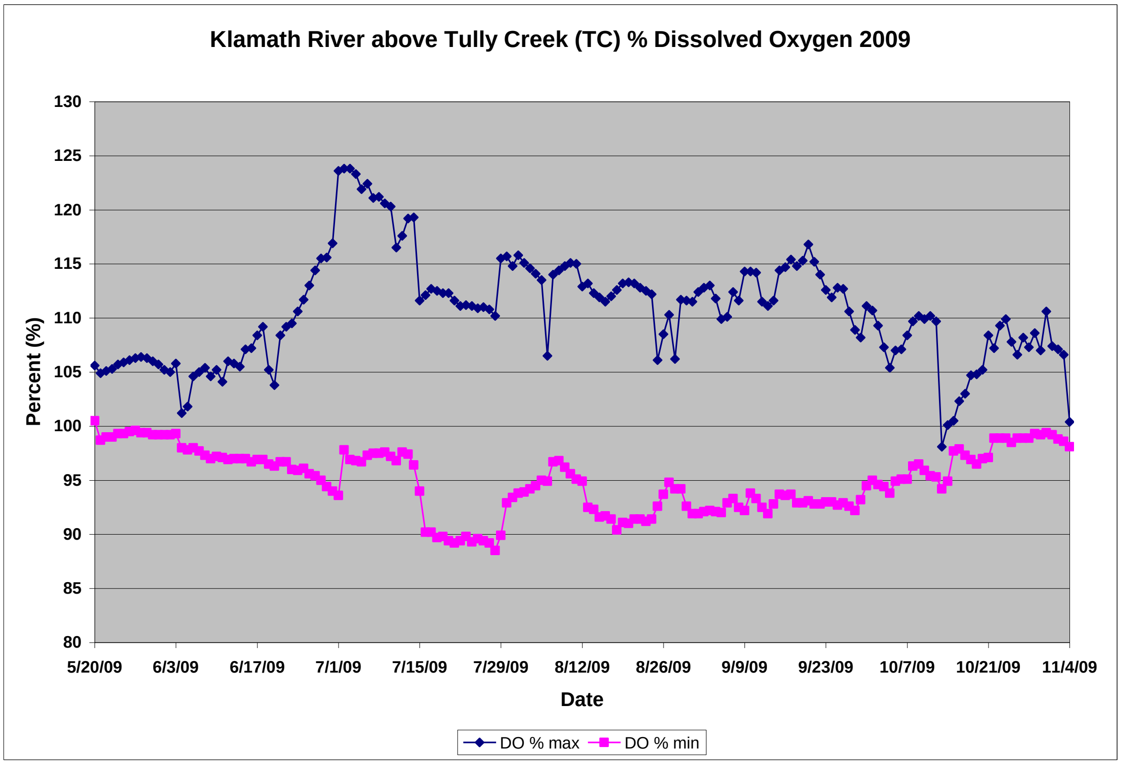

Figure 6-16. TC Percent Dissolved Oxygen: 2009

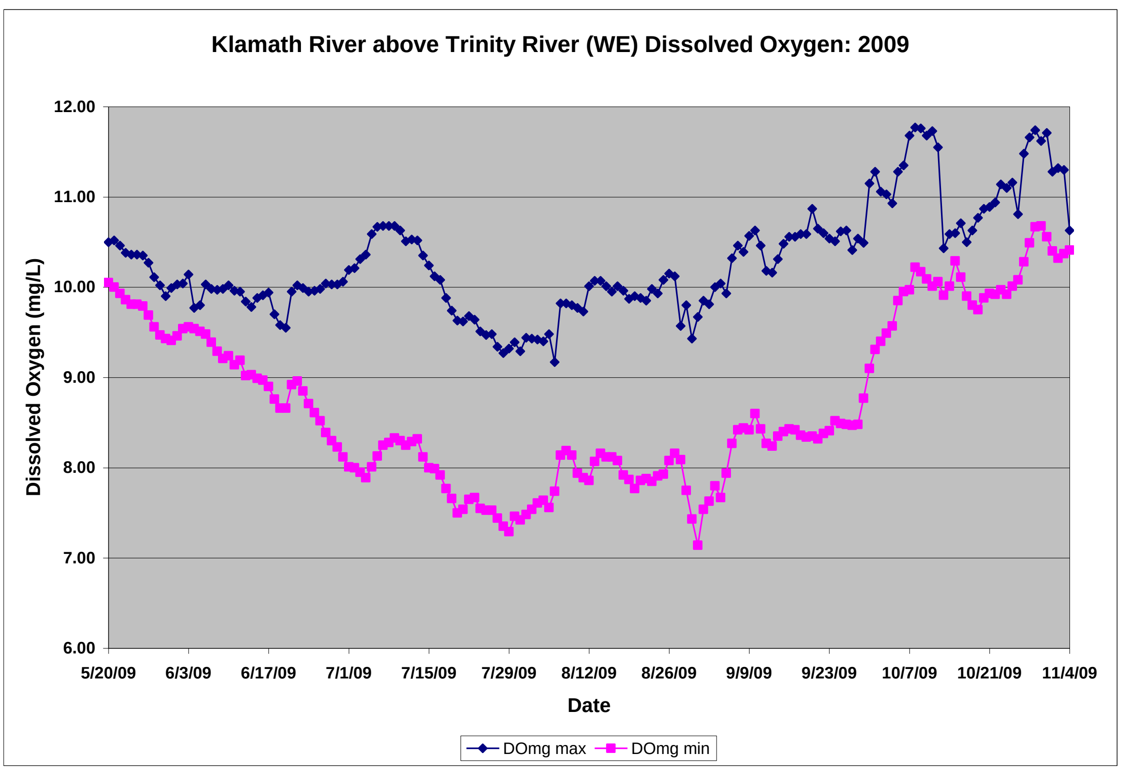

Figure 6-17. WE Dissolved Oxygen: 2009

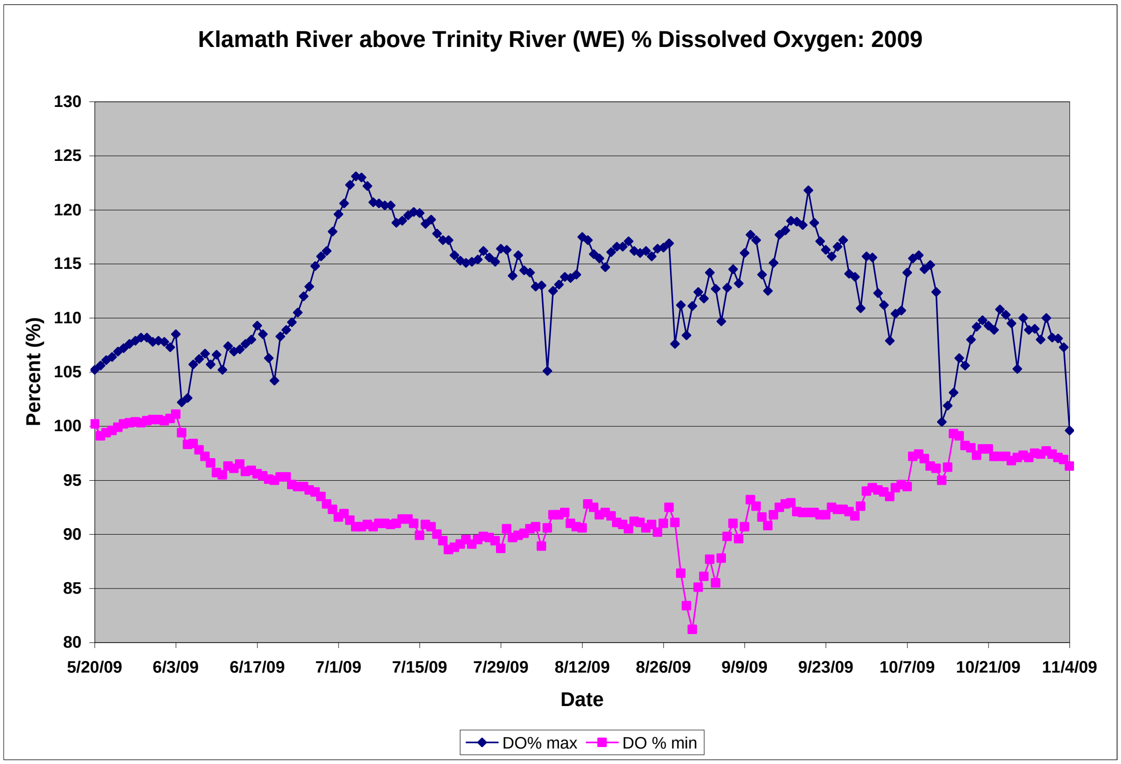

Figure 6-18. WE Percent Dissolved Oxygen: 2009

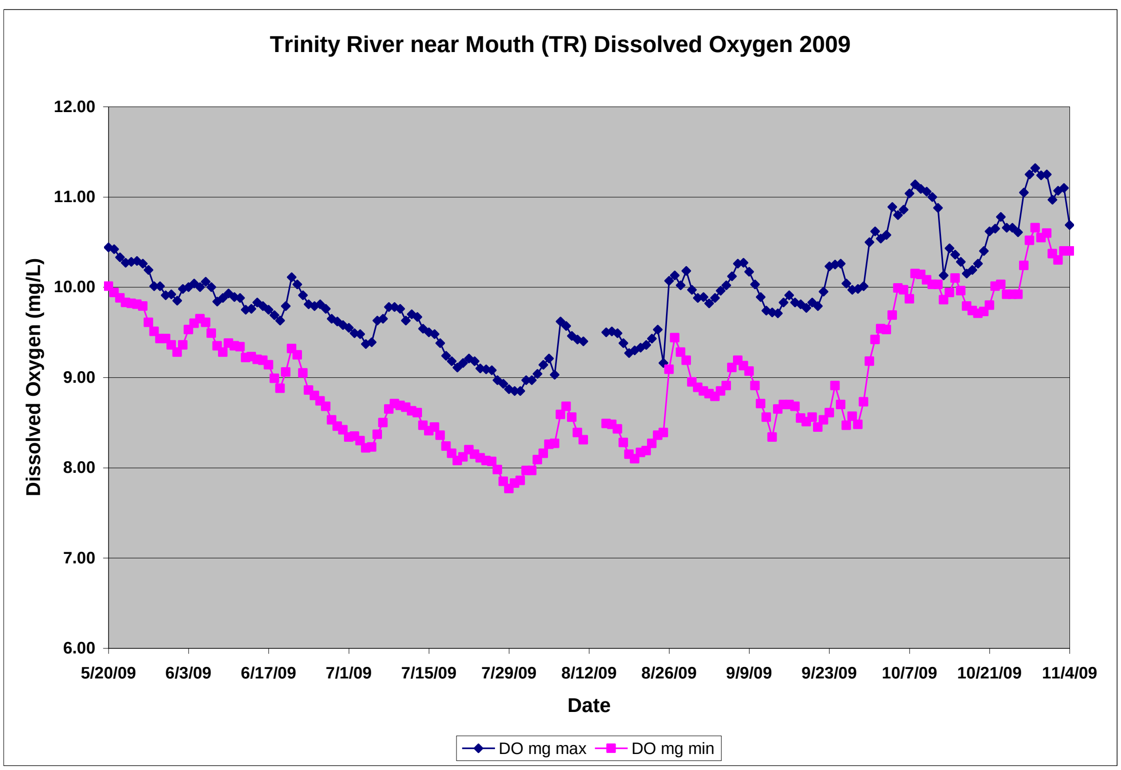

Figure 6-19. TR Dissolved Oxygen: 2009

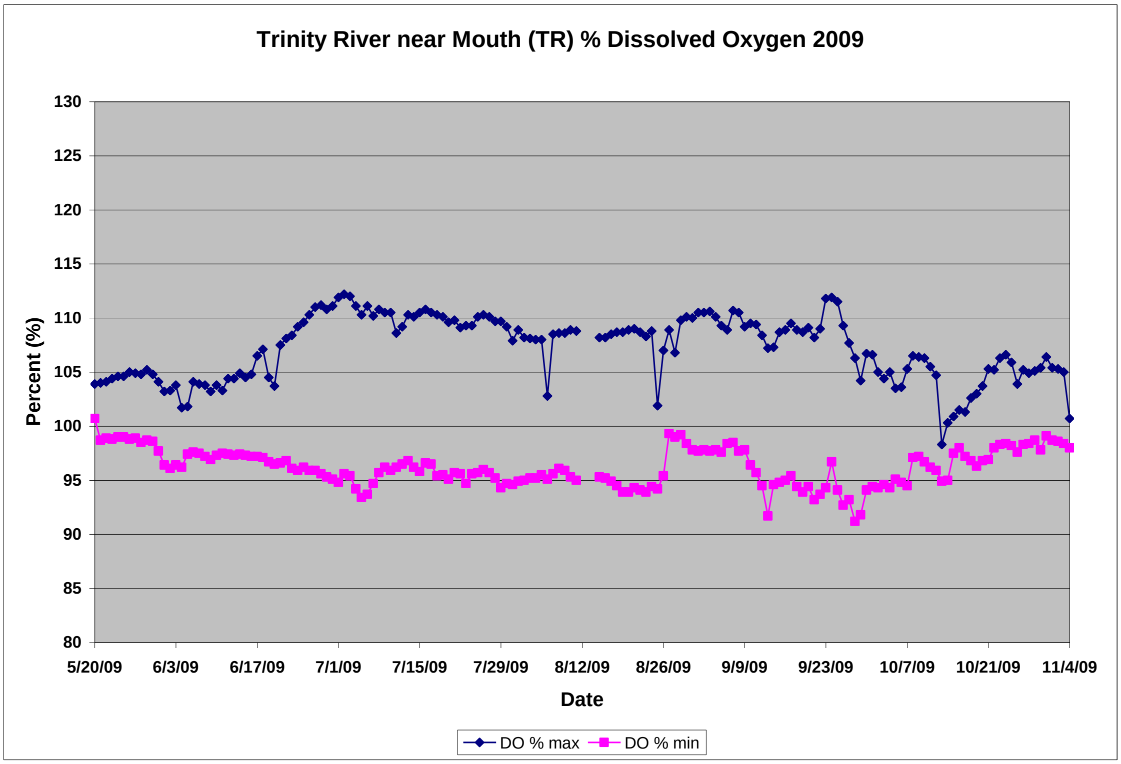

Figure 6-20. TR Percent Dissolved Oxygen: 2009

pH

All Riverine Sites

pH values on the lower Klamath and Trinity River varied greatly throughout the monitoring season. The lowest recorded pH was 7.85 at KAT on October 16, while the highest recorded pH was 9.02 at WE on July 7.

Due to its implications for fish health, maximum pH is focused on in this summary. The Yurok Tribe has set a standard of 8.5 for pH on the lower Klamath and Trinity Rivers. pH values above this standard can cause chronic stress and exhaustion to salmonids. Values above 9.6 are often lethal. The combined affects of high pH and high water temperature increases unionized ammonia, which can be highly toxic to salmon and steelhead. For results of nutrient samples collected on the Lower Klamath and Trinity River, see the Yurok Tribe's 2009 Klamath River Nutrient Summary Report at: http://www.yuroktribe.org/departments/ytep/documents/FINAL2009NutrientReport040610.pdf.

Daily maxima and minima were disregarded when more than five measurements were missing from a 24-hour period and when the daily maximum or minimum was expected to occur during the gap. Gaps in data may occur during service or due to instrument malfunction or vandalism. Continuous pH data from the Lower Klamath and Trinity River is available from the Yurok Tribe Environmental Program upon request.

Klamath River above Turwar (KAT)

Maximum pH at KAT increased from mid-June to early July, then decreased until mid-July (Figure 6-21). pH then held study at around 8.5 until early August, after which it increased until late August. After late August there was a gradual overall decline in pH until early October, with small dips in late August and mid-September, followed by an increase in pH until mid-October. In mid-October there was a large, sudden decrease in pH that lasted several days, followed by a steady increase until the end of the monitoring season.

The lowest pH recorded at KAT was 7.85 on October 16, while the highest recorded pH was 8.88 on July 2 (Figure 6-21). Daily maximum pH values remained above the standard of 8.5 a majority of the monitoring season (109 out of 144 days).

Klamath River above Tully Creek (TC)

Maximum pH at TC generally increased from late May until early July, with small dips in early and late June, subsequently falling until late July (Figure 6-22). In late July there was a small increase in pH, which then generally slightly declined/held steady until late August. Maximum pH then held steady until mid-October with small peaks in early September and early October. In mid-October there was a large, sudden decrease in pH that lasted several days, followed by a steady increase until late October. Maximum pH values were dropping when sampling was suspended in early November.

The lowest recorded pH at TC was 7.87 on October 17, while the highest was 8.82 on July 7 (Figure 6-22). Daily maximum pH values remained above the standard of 8.5 for a large portion of the monitoring season (98 out of 169 days).

Klamath River above Trinity River (WE)

Maximum pH at WE generally increased from late May until early July, with a small dip in early June, then gradually decreased until early August (Figure 6-23). pH values then gradually increased from early August to early September, with steady values with minor fluctuations from early September until mid-October. In mid-October there was a large, sudden decrease in pH that lasted several days, followed by a sharp increase. Maximum pH values then held steady with minor fluctuations until late October. Maximum pH values were dropping when sampling was suspended in early November.

The lowest recorded pH at WE was 8.02 on August 6, while the highest was 9.02 on July 7 (Figure 6-23). Daily maximum pH values remained above the standard of 8.5 for most of the monitoring season (136 out of 169).

Trinity River near Mouth (TR)

Maximum pH values at TR increased slightly from May to early June (Figure 6-24). In early June there was a small decrease in pH followed by gradually increasing pH values until mid-July. In mid-July there was a decrease in pH, followed by increasing pH values until early August. Maximum pH then slightly decreased into late August, with a small peak in mid-August. In late August there was a large, sharp decrease in pH over the course of several days followed by gradually increasing pH values in early October with a small peak in mid-September. Maximum pH then fell gradually until mid-October, at which time there was a large, sudden reduction in values, followed by a rapid increase in values. Maximum pH values then held steady until sampling was suspended in early November.

The lowest recorded pH at TR was 8.02 on August 27, while the highest pH was 8.78 on August 2 (Figure 6-24). Daily maximum pH values remained above the standard of 8.5 for a majority of the monitoring season (115 out of 166 days).

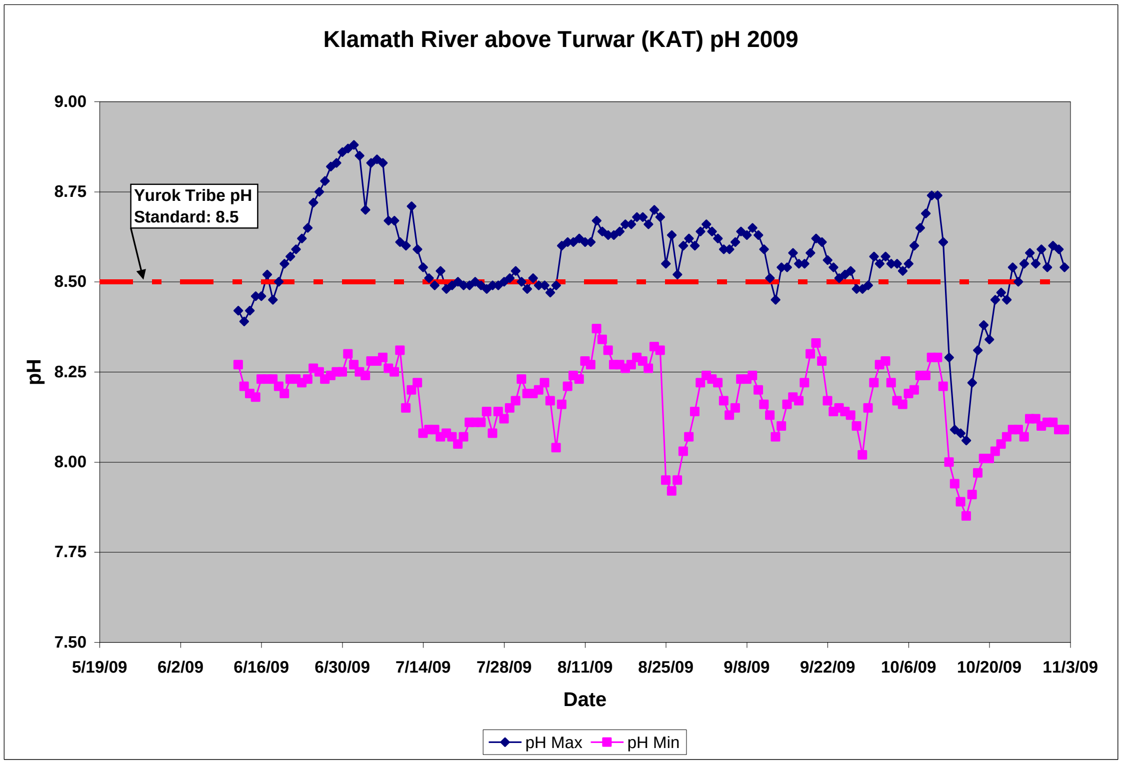

Figure 6-21. KAT Maximum/minimum pH: 2009

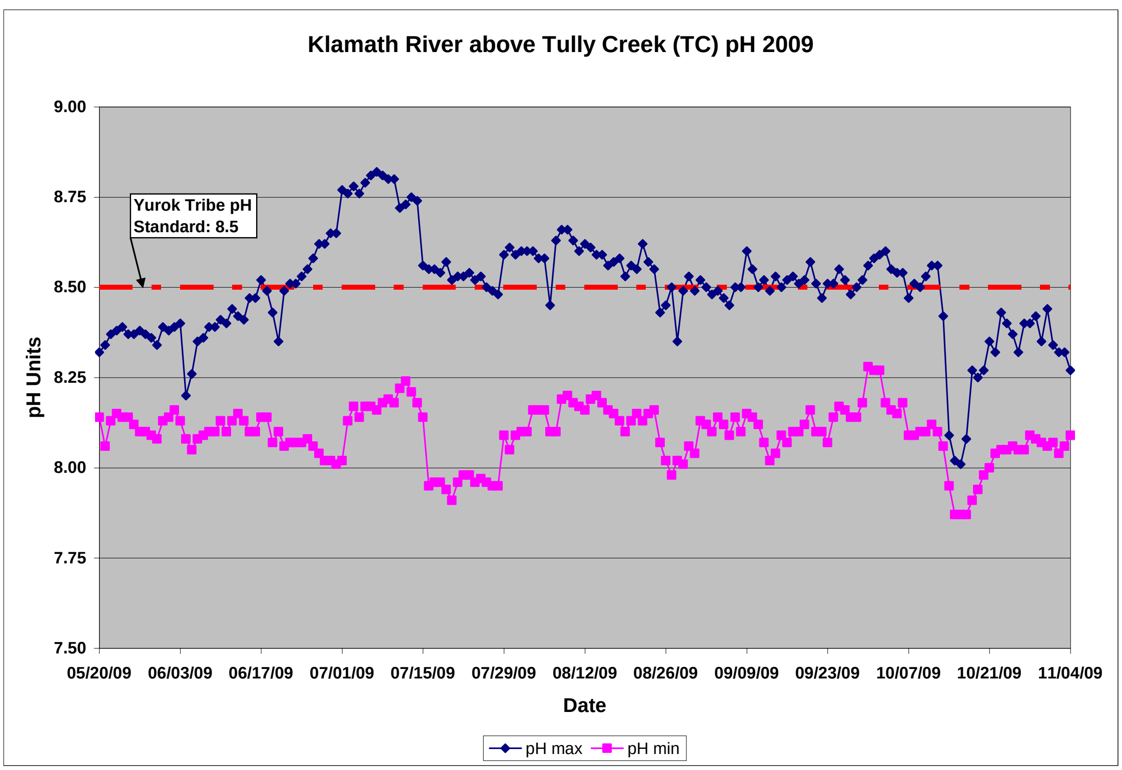

Figure 6-22. TC Maximum/minimum pH: 2009

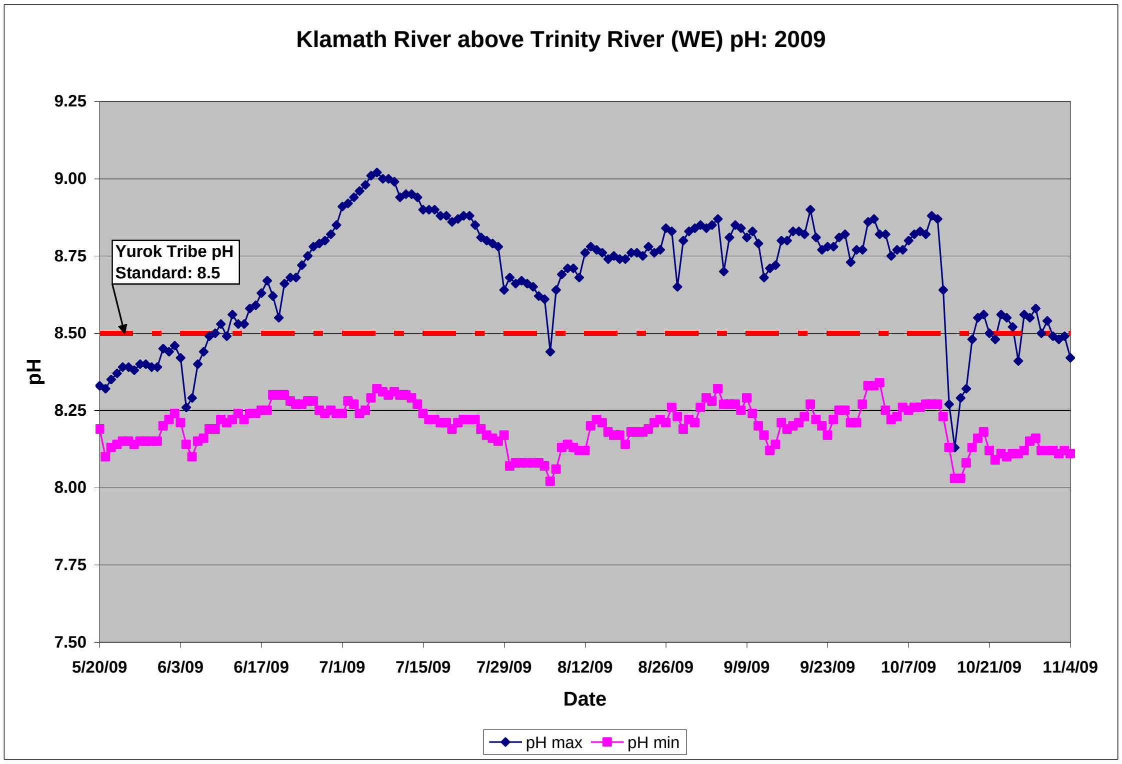

Figure 6-23. WE Maximum/minimum pH: 2009

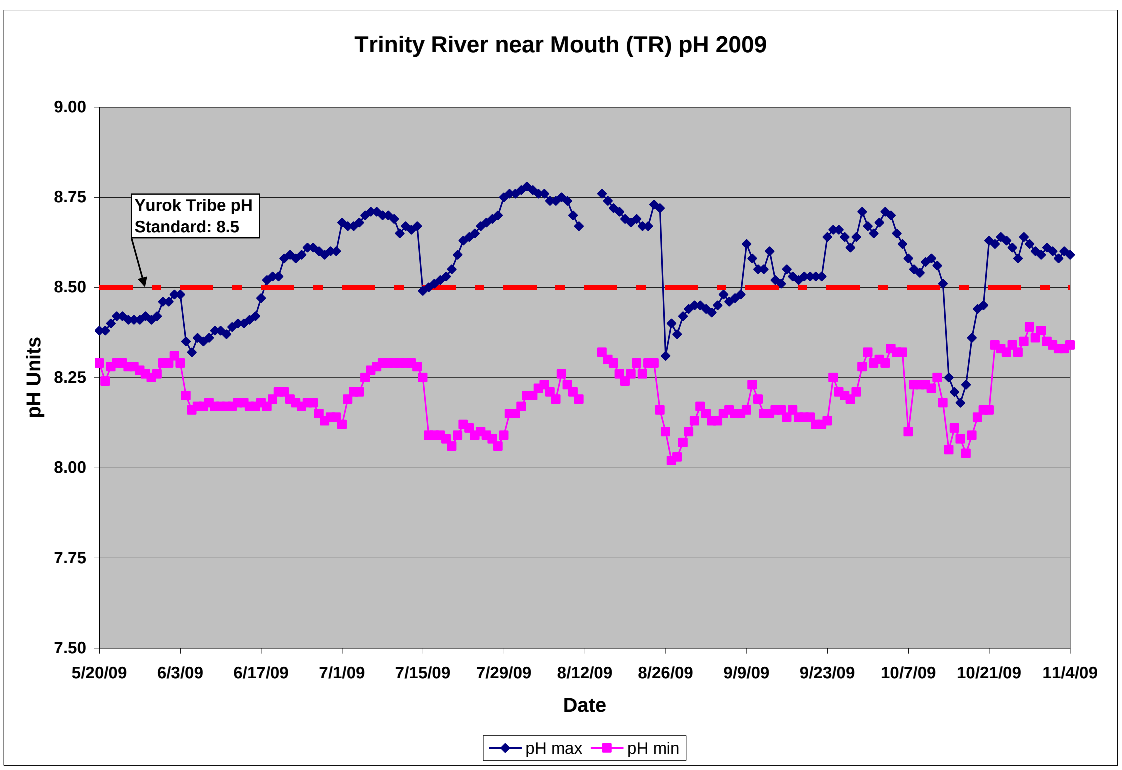

Figure 6-24. TR Maximum/minimum pH: 2009

Specific Conductivity

All Riverine Sites

Specific conductivity measures how well an aqueous solution can pass an electric current, which increases with the quantity of dissolved ionic substances in the water column, thus another method to determine the level of dissolved substances present. Specific conductivity is measured in microsiemens per centimeter.

Specific conductivity varied greatly at all sites during the 2009 monitoring season. The highest specific conductivity recorded was 193 µS/cm at WE on October 5, while the lowest specific conductivity recorded was 106 µS/cm at KAT on May 19. At no time did specific conductivity levels exceed the Yurok Tribe's specific conductivity standard, which states that levels shall have a 90% upper limit of 300 µS/cm at 25 °C, and a 50% upper limit of 200 µS/cm at 25°C.

Daily maxima and minima were disregarded when more than five measurements were missing from a 24-hour period and when the daily maximum or minimum was expected to occur during the gap. Gaps in data may occur during service or due to instrument malfunction or vandalism. Continuous specific conductivity data from the lower Klamath and Trinity River is available from the Yurok Tribe Environmental Program upon request.

Klamath River above Turwar (KAT)

Specific conductivity at KAT increased steadily from May until mid-July, then remained steady until late August (Figure 6-25). In late August there was a sudden decrease in specific conductivity for several days, then a return to readings similar to those before the sudden decrease. Specific conductivity values then remained steady until early October. In early October, there was a slight increase in values, followed by steady readings until mid-October. In mid-October there was a large, sudden decrease in values over there course of several days, then a return to readings similar to those before the dramatic decrease in values. This was followed by a steady increase in specific conductivity values until sampling was suspended in early November.

The lowest recorded specific conductivity reading at KAT was 106 µS/cm on May 19, while the highest recorded specific conductivity reading was 187 µS/cm on November 11 (Figure 6-25).

Klamath River above Tully Creek (TC)

Specific conductivity at TC increased gradually from May until mid-June, at which time there was a large, sudden increase in values (Figure 6-26). After this large increase, values steadily increased until late June, and then gradually dropped until late August, with one small peak in mid-August. In late August there was a sudden decrease in specific conductivity for several days, then a return to readings similar to those before the sudden decrease. Specific conductivity values then remained steady until early October. In early October, there was a slight increase in values, followed by steady readings until mid-October. In mid-October there was a large, sudden decrease in values over there course of several days, then a return to readings similar to those before the dramatic decrease in values. This was followed by stable specific conductivity values until sampling was suspended in early November.

The lowest specific conductivity reading at TC was 110 µS/cm on May 20, while the highest recorded reading was 184 µS/cm on October 24 (Figure 6-26).

Klamath River above Trinity River (WE)

Specific conductivity at WE steadily increased from May until late July (Figure 6-27). In late July values decreased slightly, then remained steady until early October, except for a small dip in mid-September. In early October specific conductivity values increased slightly, then remained steady until mid-October. In mid-October there was a large, sudden decrease in values over there course of several days, then a return to readings similar to those before the dramatic decrease in values. This was followed by steady specific conductivity values until sampling was suspended in early November.

The lowest recorded specific conductivity reading at WE was 107 µS/cm on May 20, while the highest recorded reading was 193 µS/cm on October 5 (Figure 6-27).

Trinity River near Mouth (TR)

Specific conductivity at TR generally increased from May until late July, with small dips in early and mid-July (Figure 6-28). After late July, values gradually dropped until mid-October, except for a large, sudden decrease in values, over the course of several days in late August. In mid-October, values sharply increased until late October, at which time they remained stable until sampling was suspended in early November.

The lowest recorded specific conductivity reading at TR was 119 µS/cm on May 20, while the highest recorded specific conductivity was 182 µS/cm on November 3 (Figure 6-28).

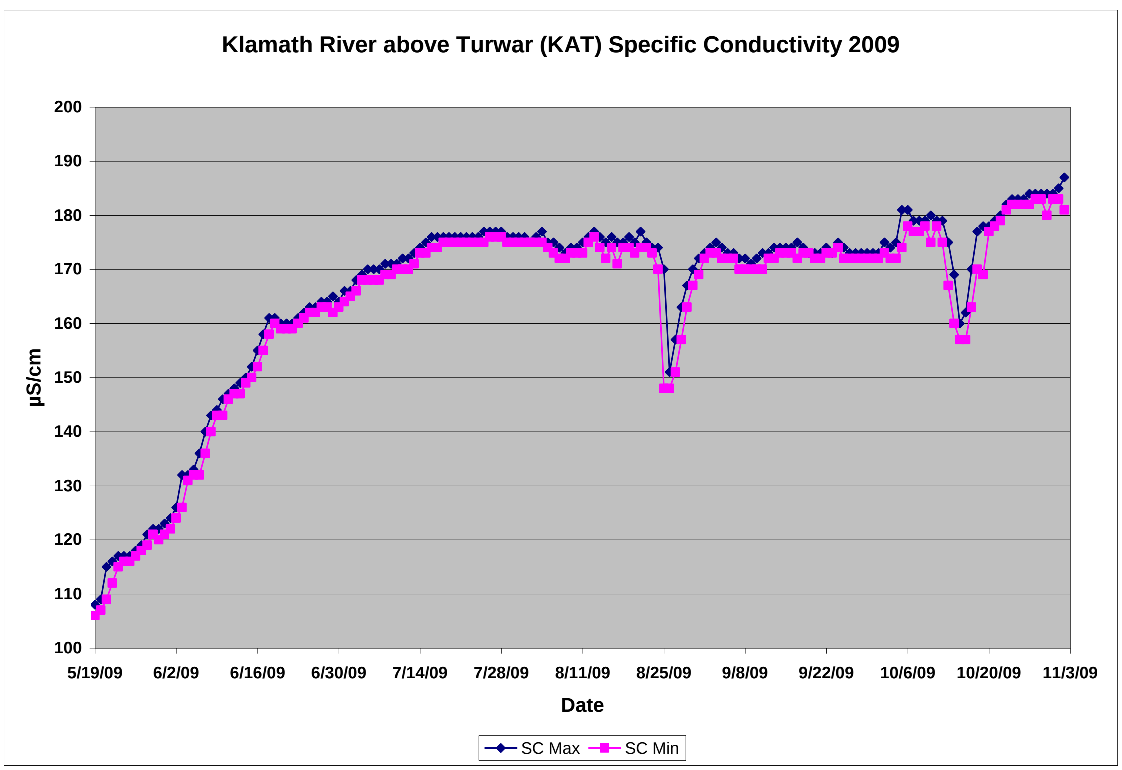

Figure 6-25. KAT Maximum/minimum Specific Conductivity: 2009

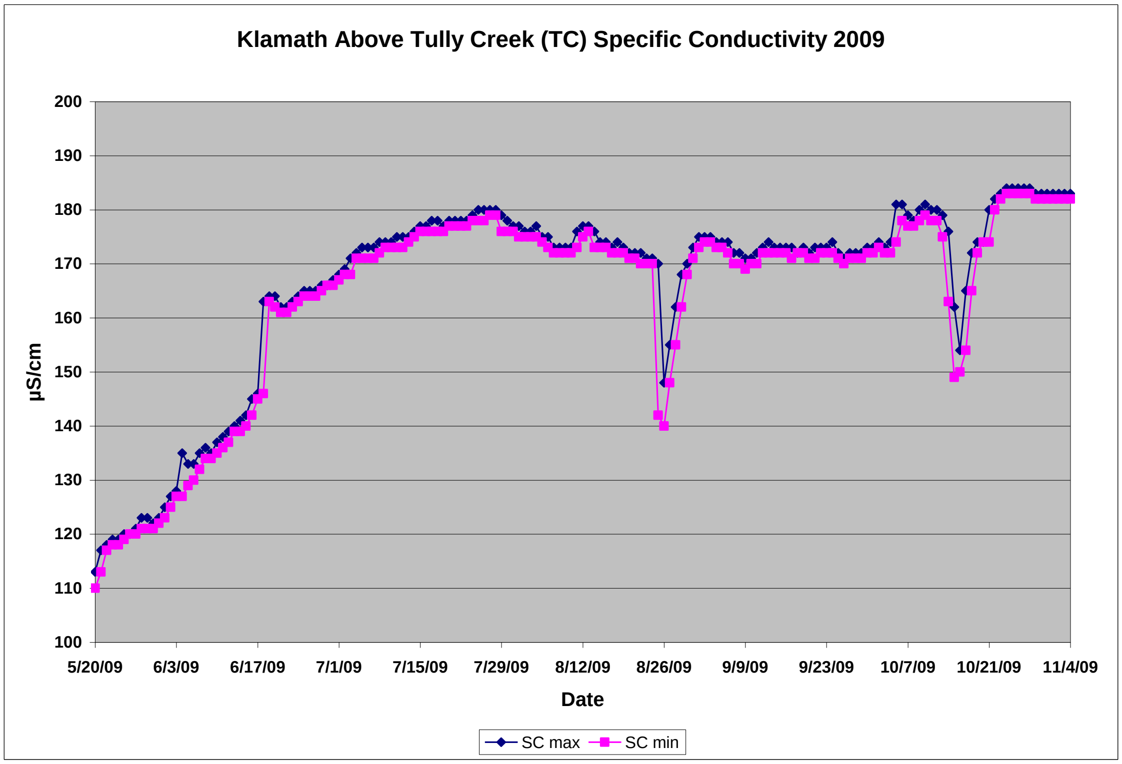

Figure 6-26. TC Maximum/minimum Specific Conductivity: 2009

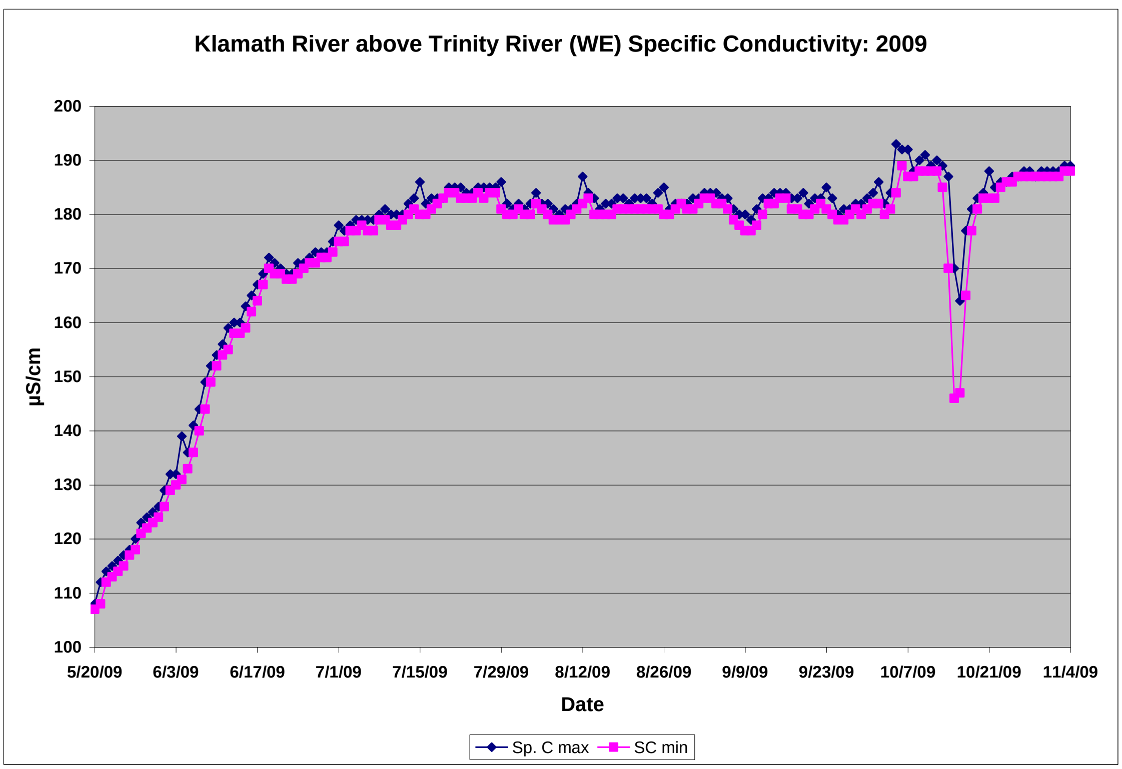

Figure 6-27. WE Maximum/minimum Specific Conductivity: 2009

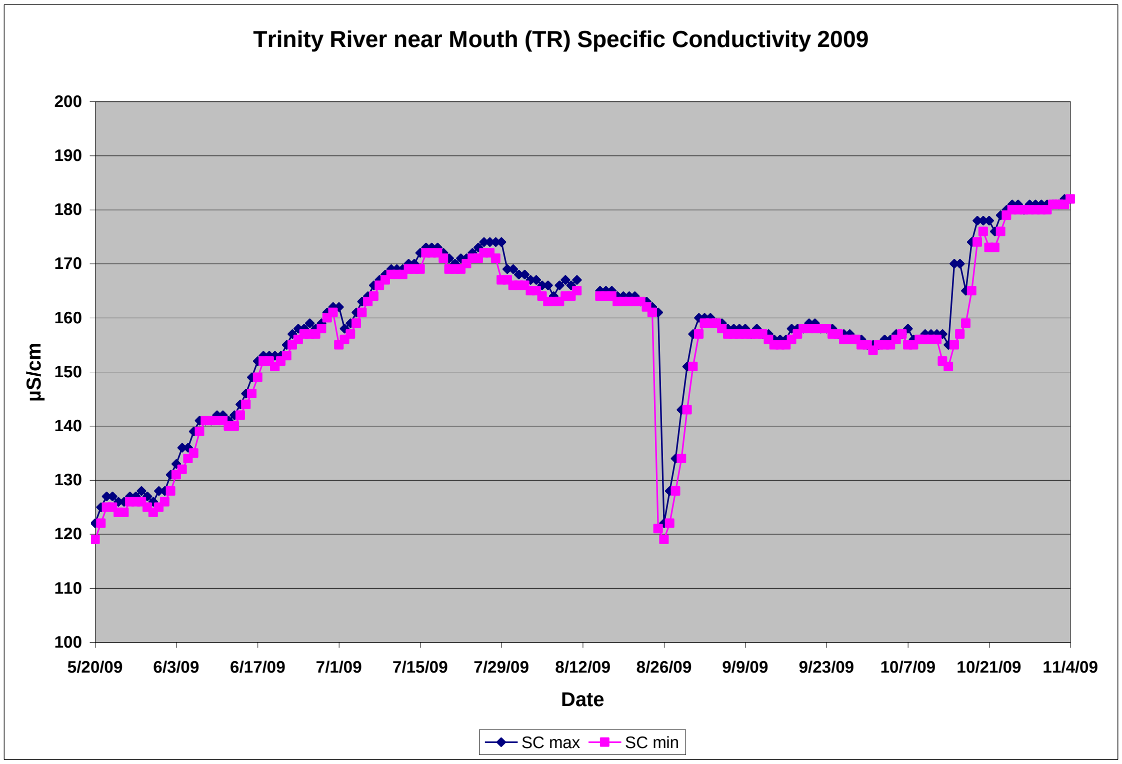

Figure 6-28. TR Maximum/minimum Specific Conductivity: 2009

VII. Discussion

Temperature

All Riverine Sites

In general the warmest maximum daily water temperatures were recorded at WE until early October, at which time KAT generally returned the warmest readings (Figure 7-1). Before early October, KAT tended to return the lowest maximum water temperatures. TR recorded the largest drop in water temperature in late August, temporarily giving it the lowest maximum water temperatures. Throughout most of the monitoring season the upriver sites generally recorded the highest maximum water temperatures, with daily maxima decreasing as the site moved downriver.

Additional graphs have been generated to illustrate how water temperatures may have been affected by volume of water present in the river at that time. Flow discharge data used to generate these graphs was downloaded from the USGS website. These graphs provide additional information when trying to determine the impact flow has on water temperature.

Klamath River above Turwar (KAT)

The pulse flow from the Lewiston Dam in late August appears to have briefly influenced the maximum water temperature at KAT (Figure 7-2). The peak of this pulse flow arrived at KAT from August 25-29. While maximum water temperature had been slowly decreasing prior to the pulse, on August 26 maximum water temperature at KAT was 20.97 °C, a decrease of 1.07 °C from August 25. Maximum water temperature then held steady until early September, at which time it started decreasing again.

The first rain event of the season on October 13-14 seems to have increased water temperature at KAT for a short period of time (Figure 7-2). On October 15, maximum water temperature was 15.66 °C, an increase of 1.31 °C from October 12. Water temperature continued to increase for several days, subsequently continuing on its downward trend.

Klamath River above Tully Creek (TC)

The pulse flow from the Lewiston Dam in late August appears to have briefly influenced the maximum water temperature at TC for a short period of time (Figure 7-3). The peak of this pulse flow arrived at TC from August 25-29. On August 26 maximum water temperature at TC was 20.22 °C, a decrease of 1.9 °C from August 25. Maximum water temperature then rose to 21.63 °C on August 30, an increase of 0.75 °C from the day before.

The first rain event of the season on October 13-14 seems to have slightly increased water temperature at TC for a short period of time (Figure 7-3). On October 15, maximum water temperature was 14.44 °C, an increase of 0.25 °C from October 12. Water temperature continued to increase for several days, subsequently continuing on its downward trend.

Klamath River above Trinity River (WE)

The first rain event of the season on October 13-14 seems to have affected water temperature at WE for a short period of time (Figure 7-4). Maximum water temperature did not change much between October 12 and October 15, but water temperature rose until October 18, then decreased to temperatures less than those recorded leading up to the rain even.

Trinity River near Mouth (TR)

The pulse flow from the Lewiston Dam in late August appears to have briefly influenced the maximum water temperature at TR (Figure 7-5). The peak of this flow arrived at TR from August 25-29. On August 26 maximum water temperature at TR was 20.22 °C, a decrease of 3.66 °C from August 25. Maximum water temperature then rose to 21.34 °C on August 30, an increase of 0.95 °C from the day before.

The first rain event of the season on October 13-14 seems to have increased water temperature at TR for a short period of time (Figure 7-6). On October 15, maximum water temperature was 14.62 °C, an increase of 0.35 °C from October 12. Water temperature continued to increase for several days, subsequently continuing on its downward trend.

Impacts of the Trinity River on Water Temperature in the Klamath River

The Trinity River tended to have a cooling affect on the Klamath River, with maximum daily temperature at TC usually lower than at WE (Figure 7-6). This cooling affect, however, was less than 0.5 °C for most of the monitoring season. The Trinity River had its largest cooling affect on the Klamath River during the pulse flow from the Lewiston Dam in late August, when maximum water temperatures on the Klamath River below the confluence with the Trinity (monitoring site TC) were 0.85 to 2.29 °C cooler than temperatures above the confluence (monitoring site WE).

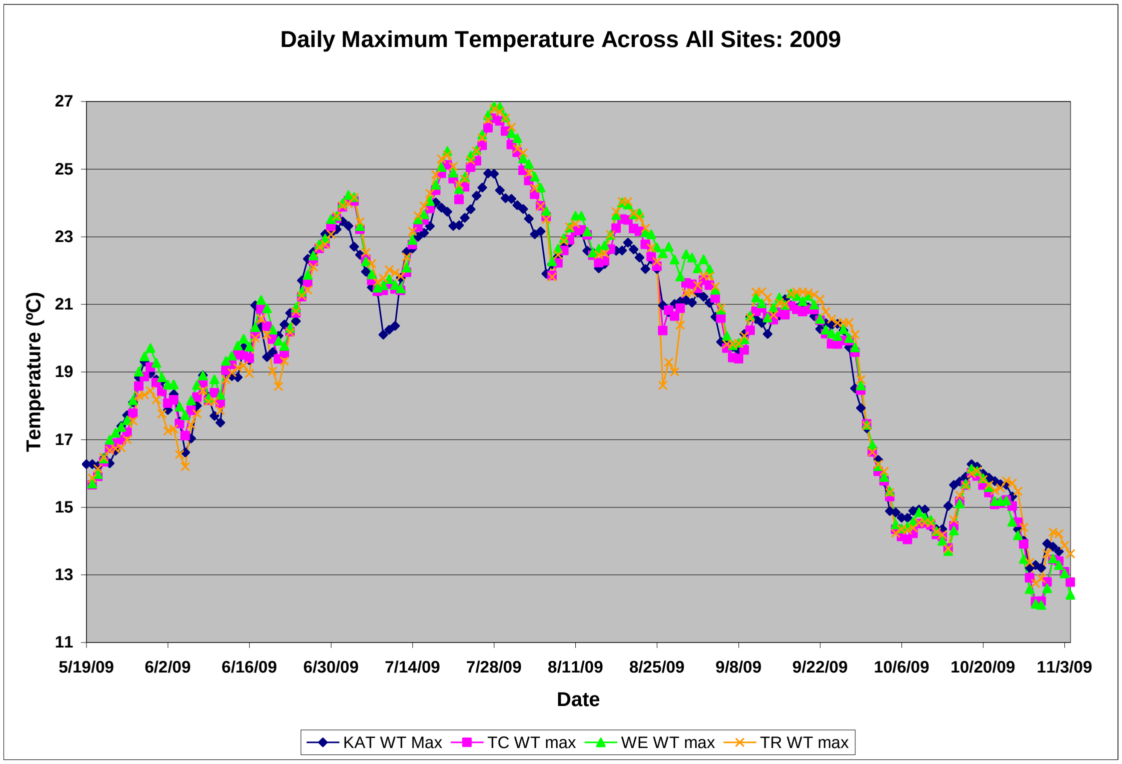

Figure 7-1. Daily Maximum Temperature Across All Sites: 2009

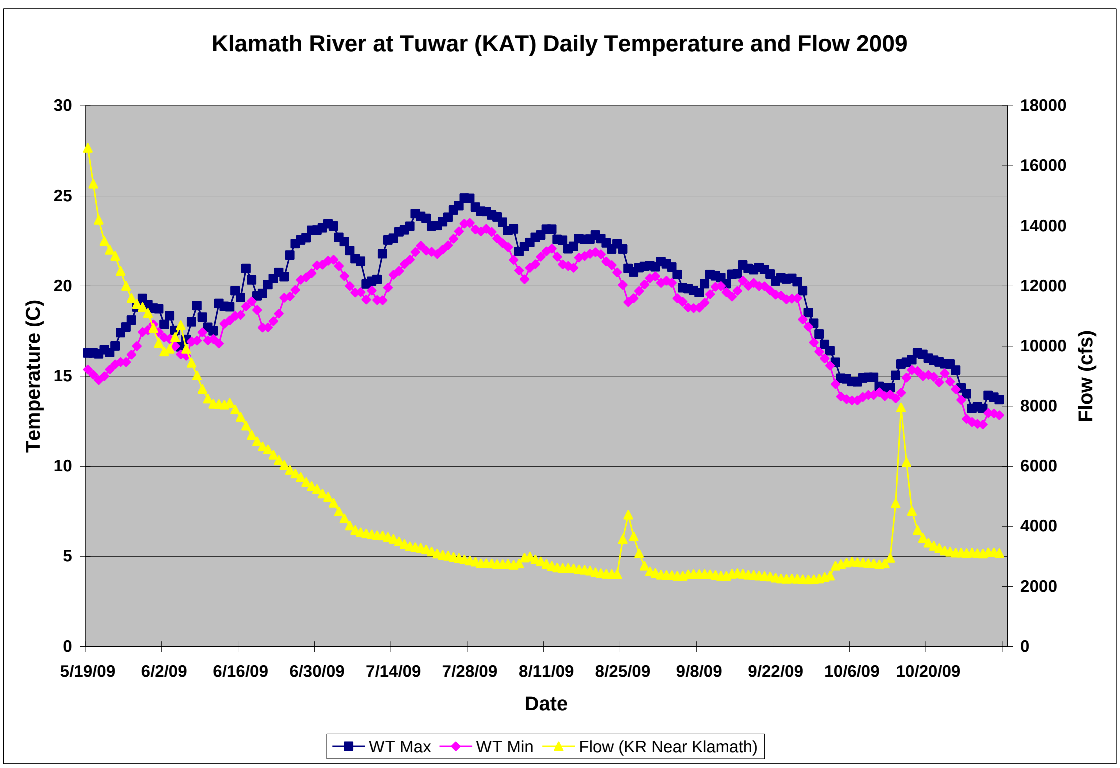

Figure 7-2. KAT Daily Water Temperature and Flow: 2009

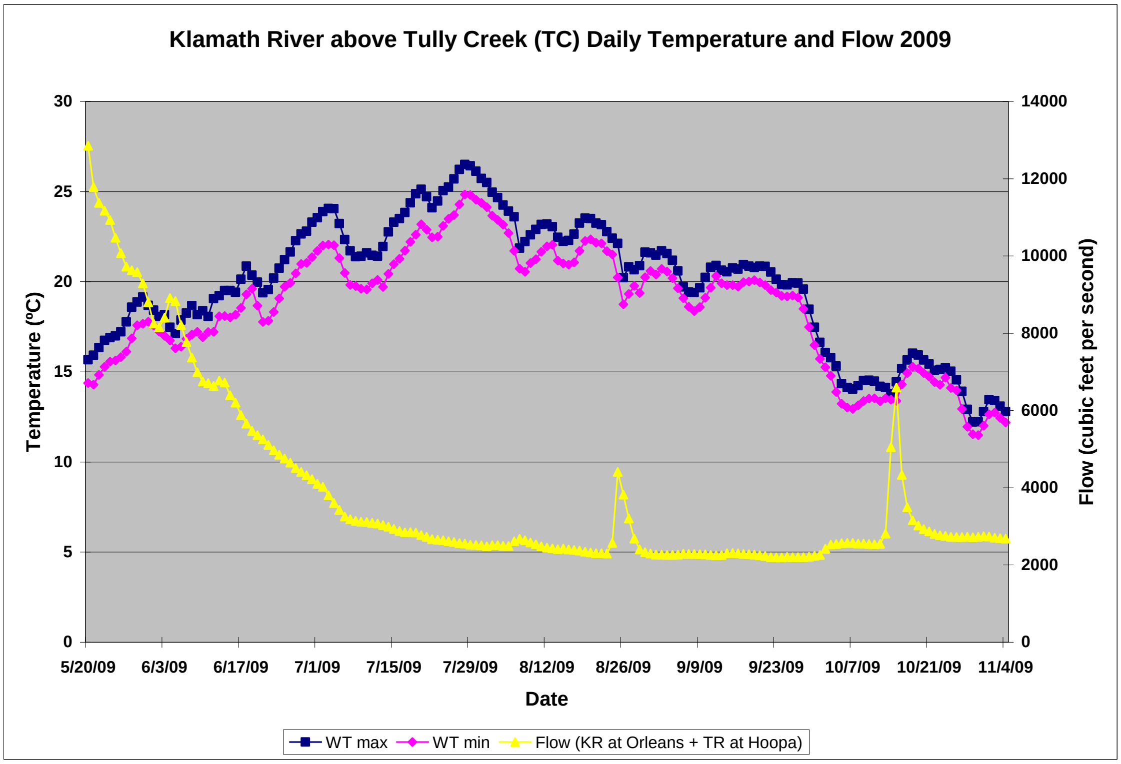

Figure 7-3. TC Daily Water Temperature and Flow: 2009

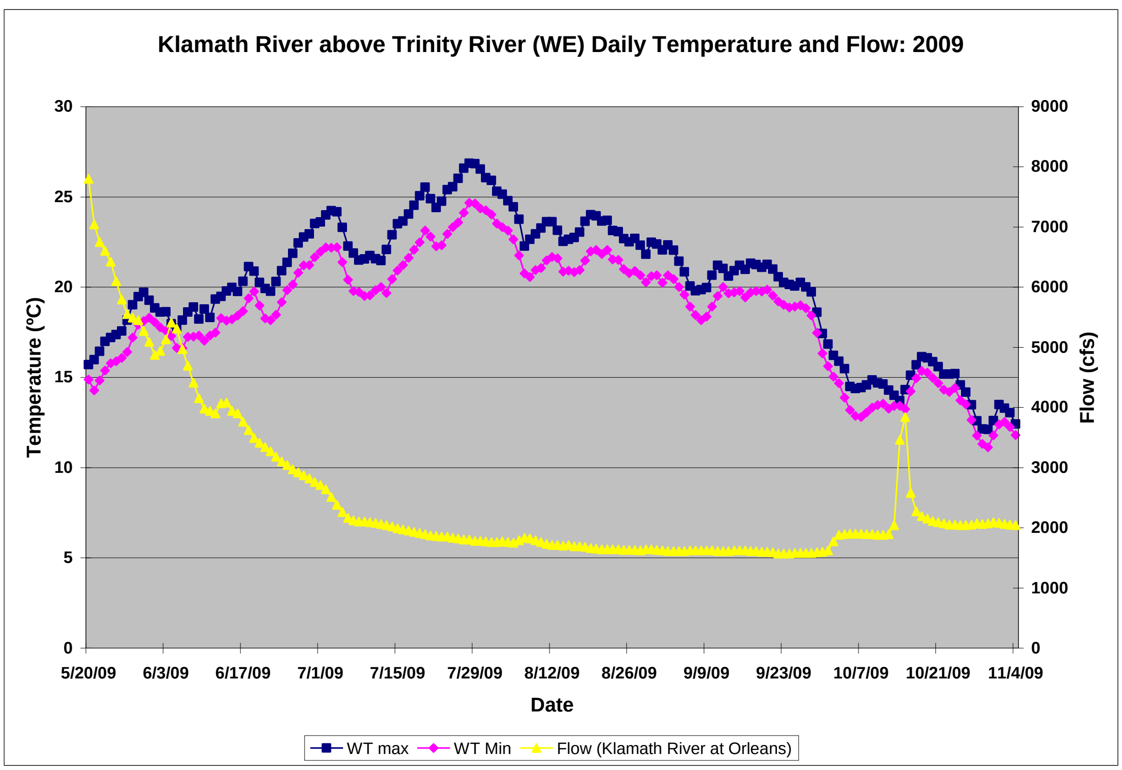

Figure 7-4. WE Daily Water Temperature and Flow: 2009

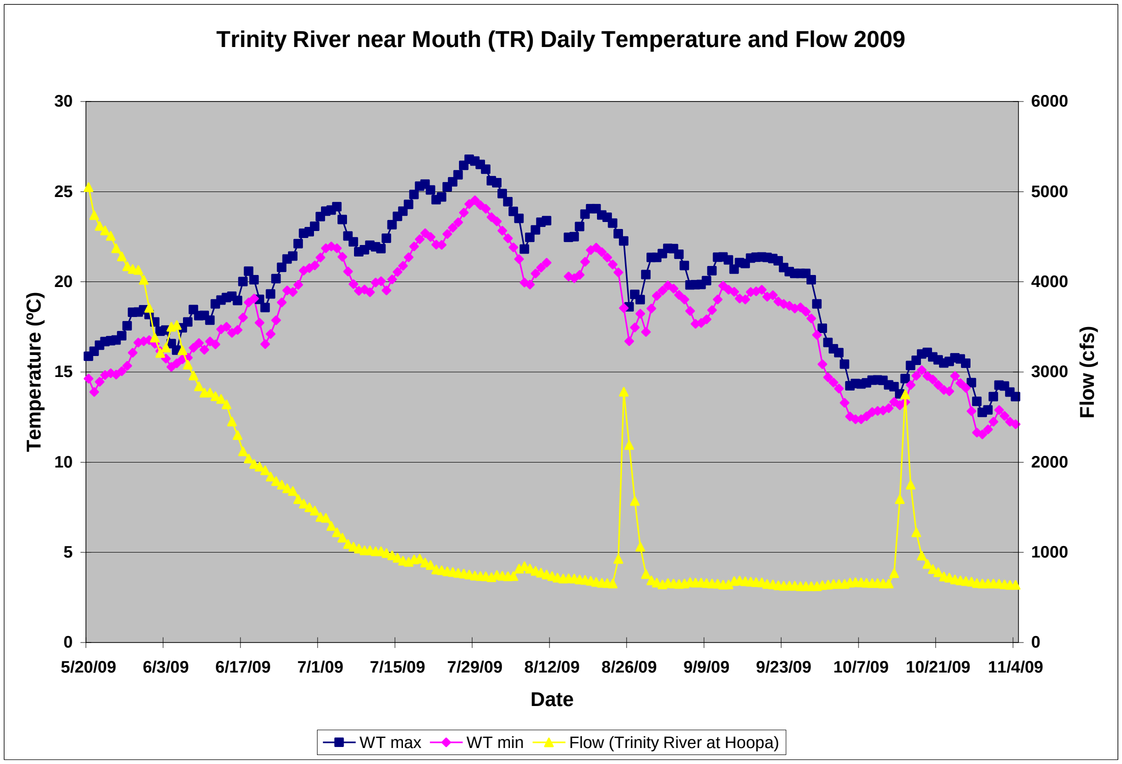

Figure 7-5. TR Daily Water Temperature and Flow: 2009

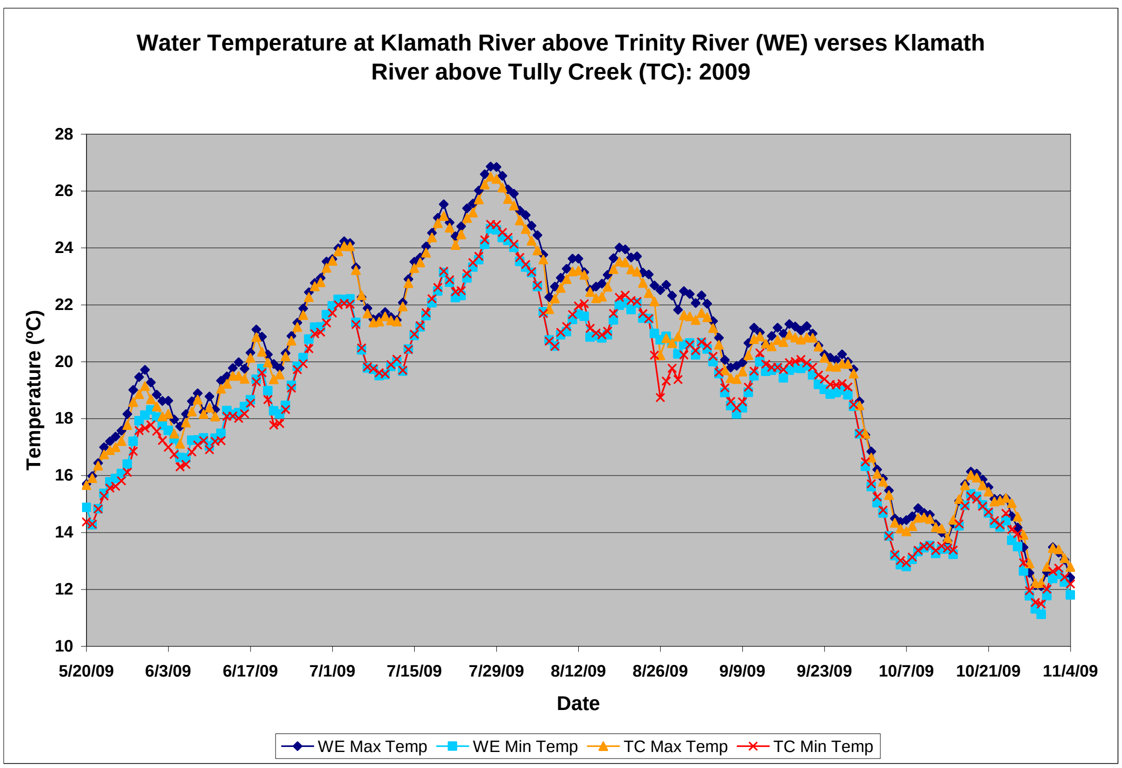

Figure 7-6. WE vs. TC Water Temperature: 2009

Dissolved Oxygen

All Riverine Sites

In general the highest daily minimum dissolved oxygen concentrations were recorded at TR, while the lowest daily minimum DO concentrations were recorded at KAT (Figure 7-7). TR experienced the greatest increase in minimum DO concentrations during the pulse flow from Lewiston Dam.

Additional graphs have been generated to illustrate how dissolved oxygen concentrations may have been affected by volume of water present in the river at that time. Flow discharge data used to generate these graphs was downloaded from the USGS website. These graphs provide additional information when trying to determine the impact flow has on dissolved oxygen concentrations.

Klamath River above Turwar (KAT)

The pulse flow from the Lewiston Dam in late August appears to have slightly influenced the DO concentrations at KAT (Figure 7-8). The peak of this pulse flow arrived at KAT from August 25-29. On August 26 minimum DO at KAT was 8.20 mg/L, an increase of 0.26 mg/L from August 25. Minimum DO concentrations then slowly returned to values similar to those before the pulse event.

The first rain event of the season on October 13-14 seems to have slightly increased minimum DO concentrations for a short period of time (Figure 7-8). During the week leading up to the rain event, DO concentrations were steadily falling. On October 14, however, minimum dissolved oxygen was 9.74 mg/L, an increase of 0.22 mg/L from October 12. Minimum DO concentrations returned to values similar to those before the event by October 17.

Klamath River above Tully Creek (TC)

The pulse flow from the Lewiston Dam in late August appears to have briefly influenced minimum DO concentrations at TC (Figure 7-9). The peak of this pulse flow arrived at TC from August 25-29. On August 26 minimum DO at TC was 8.63 mg/L, an increase of 0.42 mg/L from August 25. Minimum DO then fell to 8.32 mg/L on August 30, a decrease of 0.31 mg/L from the day before.

The first rain event of the season on October 13-14 appears to have temporarily increased minimum DO concentrations at TC (Figure 7-9). During the week leading up to the rain event, DO concentrations were steadily falling. On October 15, however, minimum dissolved oxygen was 10.12 mg/L, an increase of 0.19 mg/L from October 12. Minimum DO concentrations returned to values similar to those before the event by October 16.

Klamath River above Trinity River (WE)

The first rain event of the season on October 13-14 appears to have increased minimum DO concentrations for a short period of time (Figure 7-10). During the week leading up to the rain event, DO concentrations were steadily falling. On October 15, however, minimum dissolved oxygen was 10.29 mg/L, an increase of 0.23 mg/L from October 12. Minimum DO concentrations returned to values similar to those before the event by October 16.

Trinity River near Mouth (TR)

The pulse flow from the Lewiston Dam in late August appears to have briefly influenced minimum dissolved oxygen concentrations at TR (Figure 7-11). The peak of this pulse flow arrived at TR from August 25-29. On August 26 minimum DO at TR was 9.09 mg/L, an increase of 0.70 mg/L from August 25. Minimum DO then fell 8.95 mg/L on August 30, a decrease of 0.24 mg/L from the day before.

The first rain event of the season on October 13-14 appears to have increased minimum DO concentrations for a short period of time (Figure 7-11). During the week leading up to the rain event, DO concentrations were steadily falling. On October 15, however, minimum dissolved oxygen was 10.10 mg/L, an increase of 0.24 mg/L from October 13. Minimum DO concentrations quickly returned to values similar to those before the event.

Impacts of the Trinity River on Dissolved Oxygen in the Klamath River

The Trinity River tended to increase minimum dissolved oxygen concentrations in the Klamath River, with higher daily minimum DO concentrations at TC than WE (Figure 7-12). The Trinity River seems to have had its greatest affect DO on concentrations in the Klamath River during the pulse flow from the Lewiston Dam in late August, when minimum daily DO concentrations at TC were 0.44 to 1.01 mg/L higher than minimum daily DO concentrations at WE.

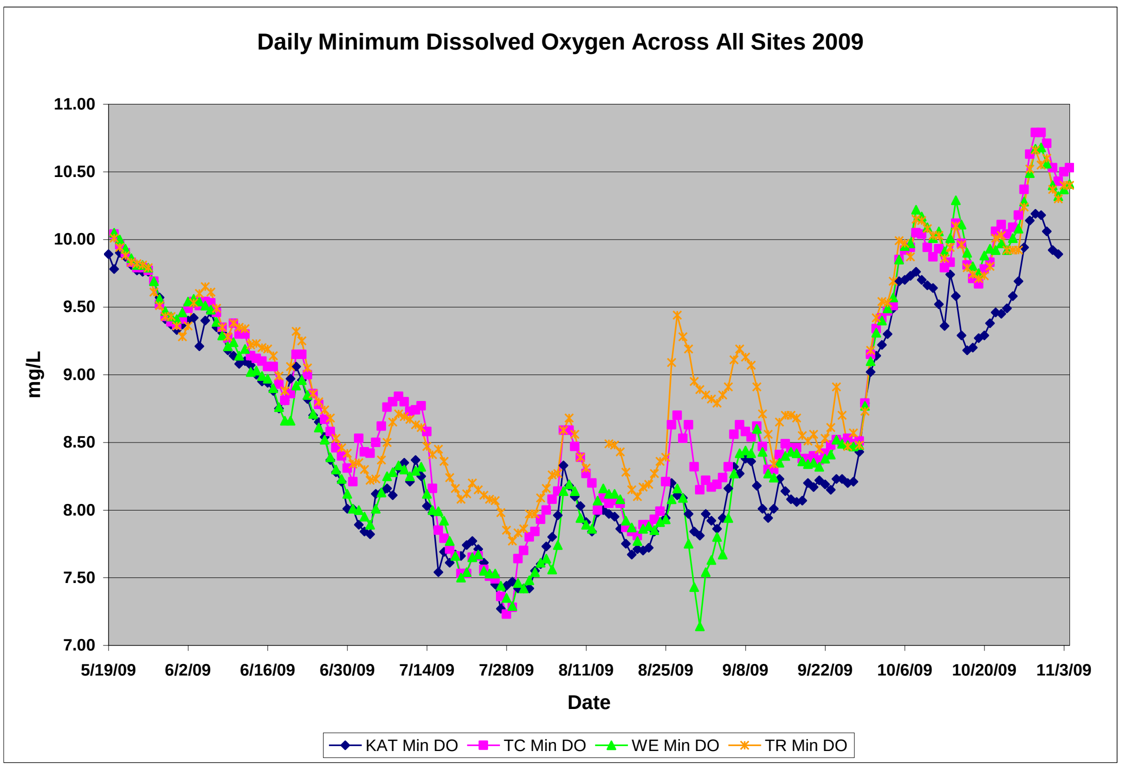

Figure 7-7. Daily Minimum Dissolved Oxygen Across All Sites: 2009

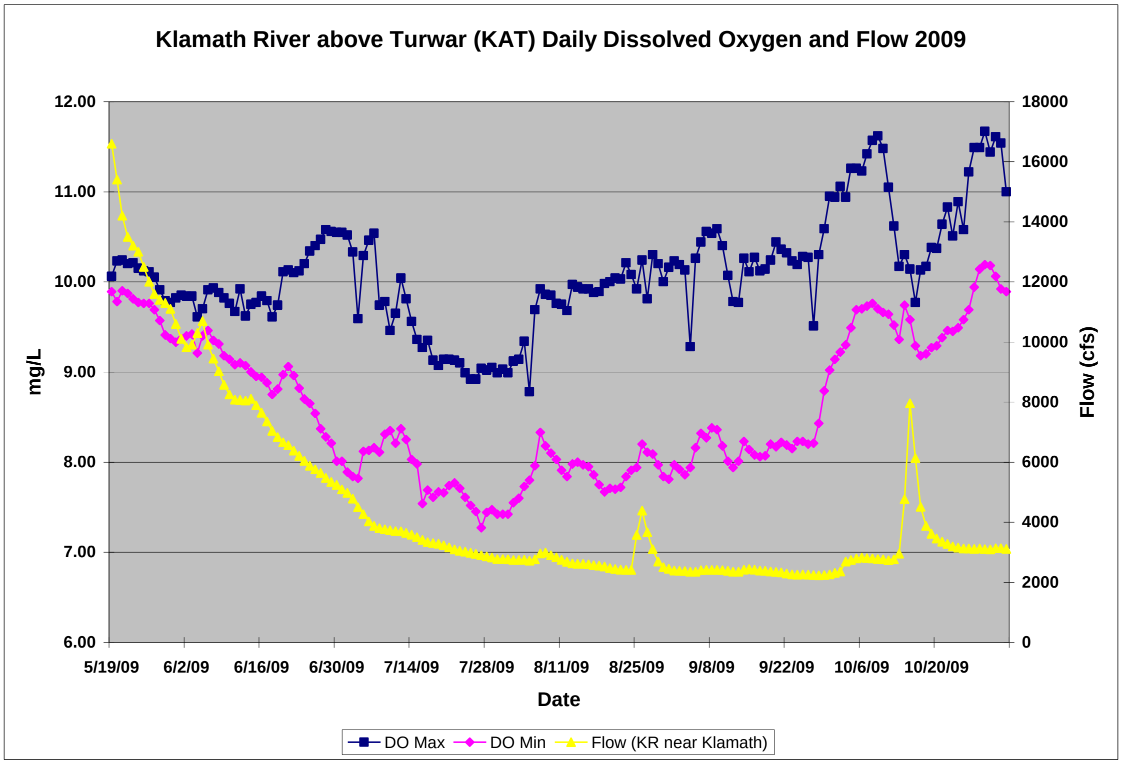

Figure 7-8. KAT Dissolved Oxygen and Flow: 2009

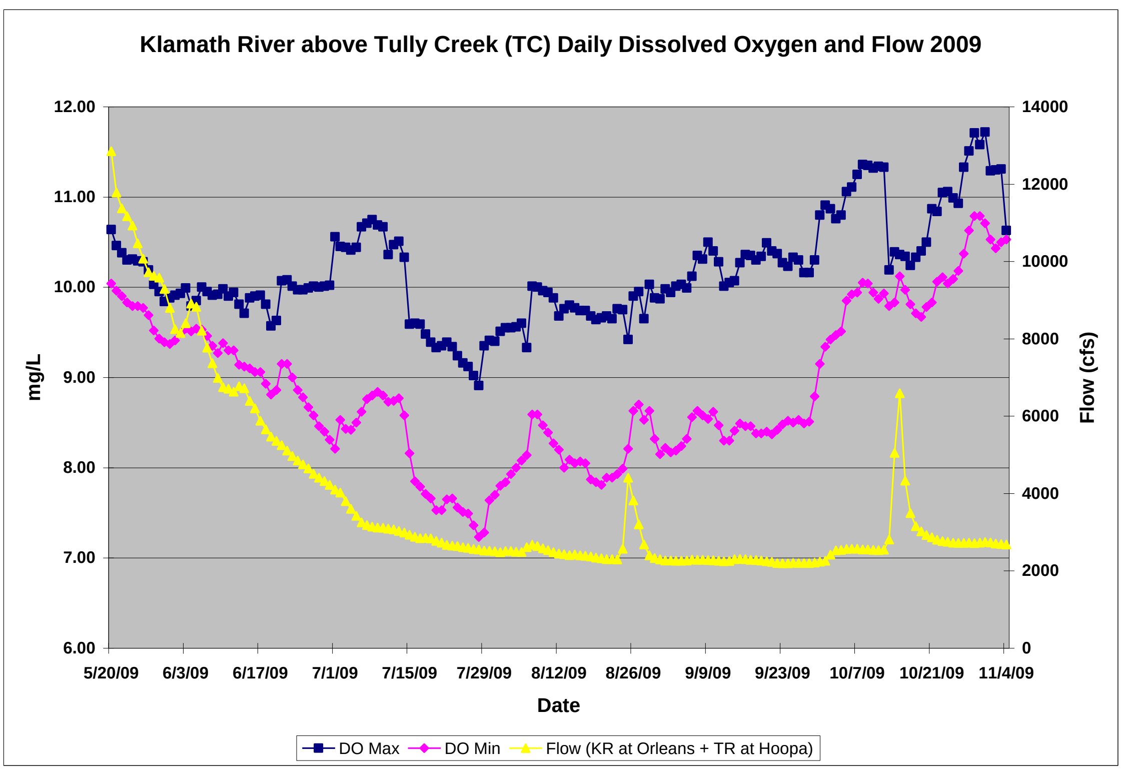

Figure 7-9. TC Dissolved Oxygen and Flow: 2009

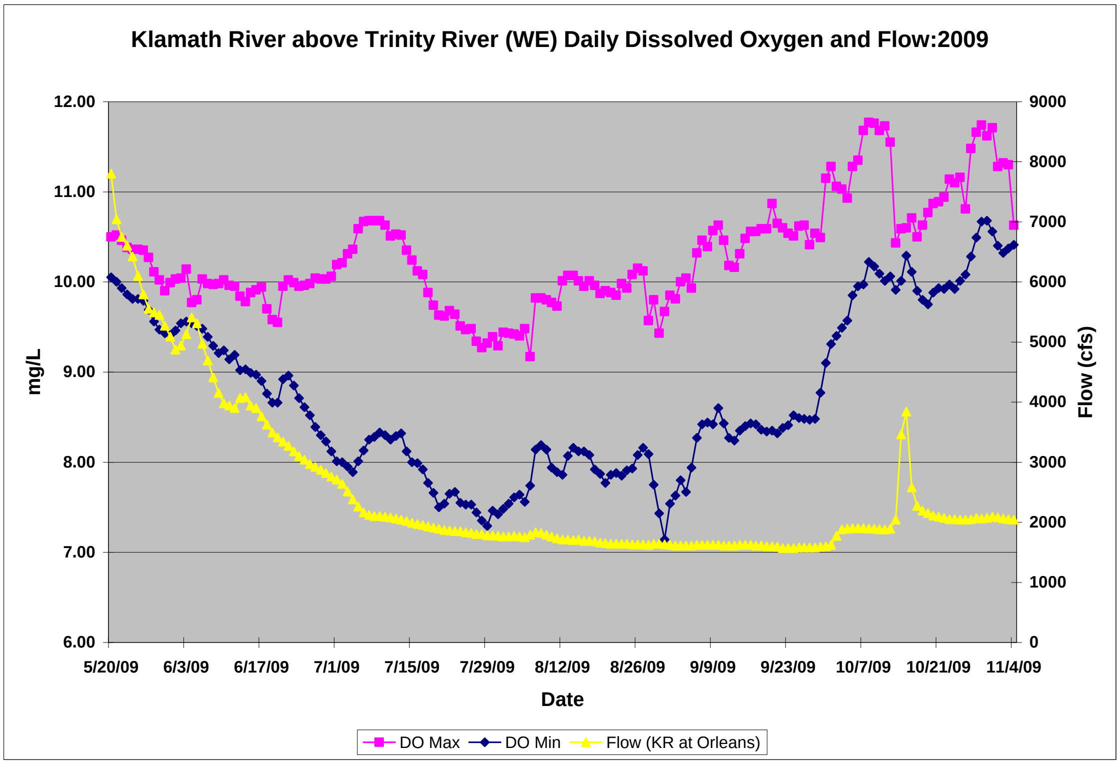

Figure 7-10. WE Dissolved Oxygen and Flow: 2009

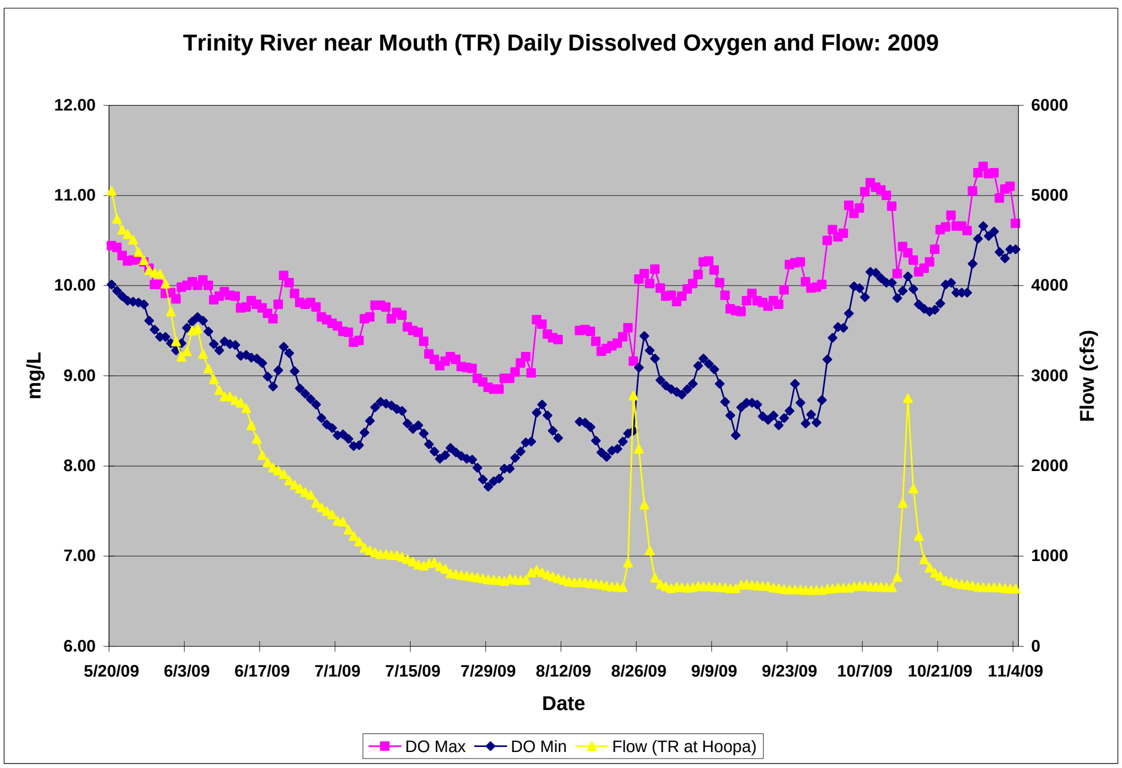

Figure 7-11. TR Dissolved Oxygen and Flow: 2009

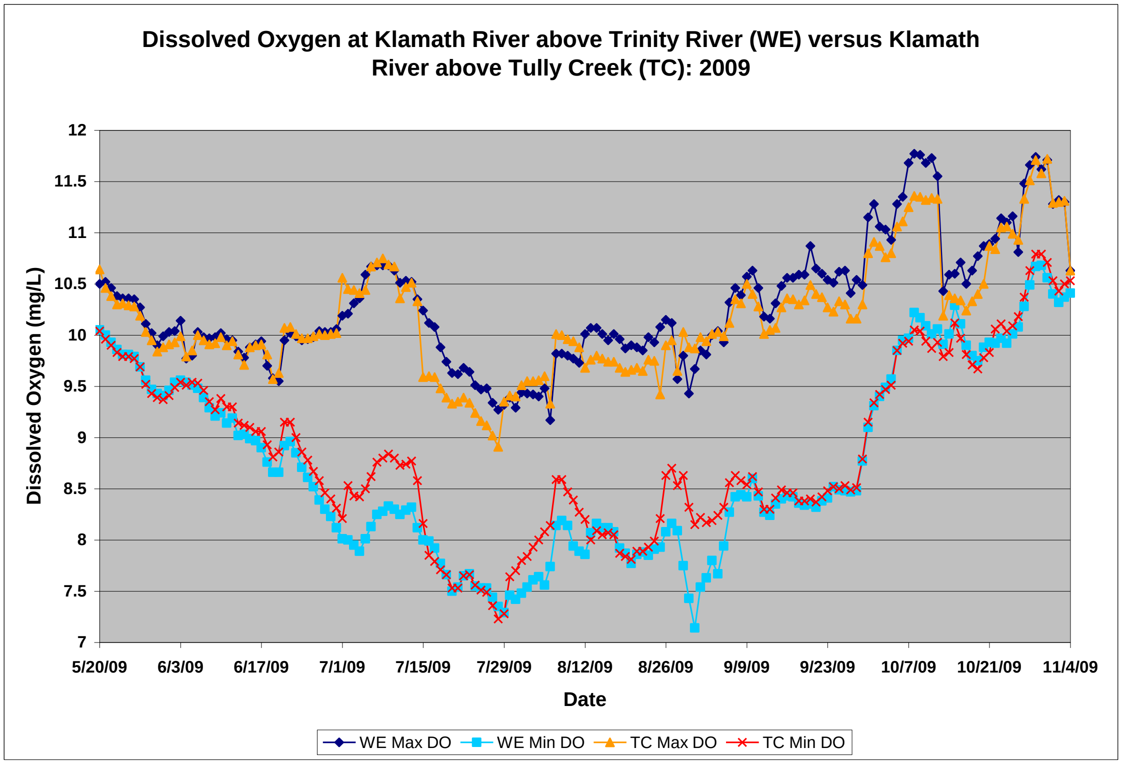

Figure 7-12. WE vs. TC Dissolved Oxygen: 2009

pH

All Riverine Sites

In general the highest maximum daily pH values were recorded at WE, while the lowest maximum daily pH values tended to be recorded at TC (Figure 7-13). TR experienced the greatest decrease in maximum daily values during the pulse flow from Lewiston Dam in late August.

Additional graphs have been generated to illustrate how pH values may have been affected by volume of water present in the river at that time. Flow discharge data used to generate these graphs was downloaded from the USGS website. These graphs provide additional information when trying to determine the impact flow has on pH.

Klamath River above Turwar (KAT)

The pulse flow from the Lewiston Dam appears to have had a negligible influence on maximum daily pH at KAT (Figure 7-14). It did, however, greatly influence minimum daily pH for a brief period of time, reducing minimum pH from 8.31 on August 24 to 7.95 on August 25.

The first rain event of the season on October 13-14 appears to have greatly decreased maximum daily pH for a short period of time (Figure 7-14). During the week leading up to the rain event, pH was rising. On October 15, however, maximum pH was 8.08, a decrease of 0.53 from October 12, dropping pH values to less than the standard of 8.5. After this first rain event, pH values slowly increased, surpassing the standard of 8.5 again after 10 days.

Klamath River above Tully Creek (TC)

The pulse flow from the Lewiston Dam appears to have had only a slight influence on maximum daily pH at TC (Figure 7-15). The first rain event of the season on October 13-14, however, appears to have greatly decreased maximum daily pH at TC for a short period of time (Figure 7-15). During the week leading up to the rain event, pH was rising. On October 15, however, maximum pH was 8.02, a decrease of 0.54 from October 12. This influx of water dropped pH values below the standard of 8.5 for the rest of the monitoring season. After this first rain event, pH values increased, but did not reach the values observed leading up to the event for the rest of the monitoring season.

Klamath River above Trinity River (WE)

The first rain event of the season on October 13-14 appears to have greatly decreased maximum daily pH at WE for a short period of time (Figure 7-16). During the week leading up to the rain event, pH was rising. On October 15, however, maximum pH was 8.13, a decrease of 0.74 from October 12, dropping it below the standard of 8.5 for 6 days. After this first rain event, pH values increased, but did not reach the values observed leading up to the event for the rest of the monitoring season.

Trinity River near Mouth (TR)

It appears that the pulse flow from the Lewiston Dam in late August influenced daily maximum pH at TR (Figure 7-17). The peak of this flow arrived at TR from August 25-28. On August 26 maximum pH at TR was 8.31, a decrease of 0.41 from

August 25. Maximum pH then rose gradually until early October. This pulse dropped maximum pH values to below the standard of 8.5 for 14 days.

The first rain event of the season on October 13-14 seems to have decreased maximum daily pH at TR for a short period of time (Figure 7-17). On October 15 maximum pH was 8.21, a decrease of 0.35 from October 12, dropping it below the standard of 8.5 for 7 days. After this first rain event, pH values quickly returned to values near those that were recorded before the rain event.

Impacts of the Trinity River on pH in the Klamath River

The Trinity River tended to decrease daily maximum pH in the Klamath River, with lower daily maximum pH values at TC than WE (Figure 7-18). The Trinity River seems to have had its greatest affect on pH values in the Klamath River during the pulse flow from the Lewiston Dam on August 25 until the day before the first rain event of the season (October 12). During this time maximum daily pH values at TC were lower by an average of 0.29 with a largest difference of 0.39 and a smallest difference of 0.16.

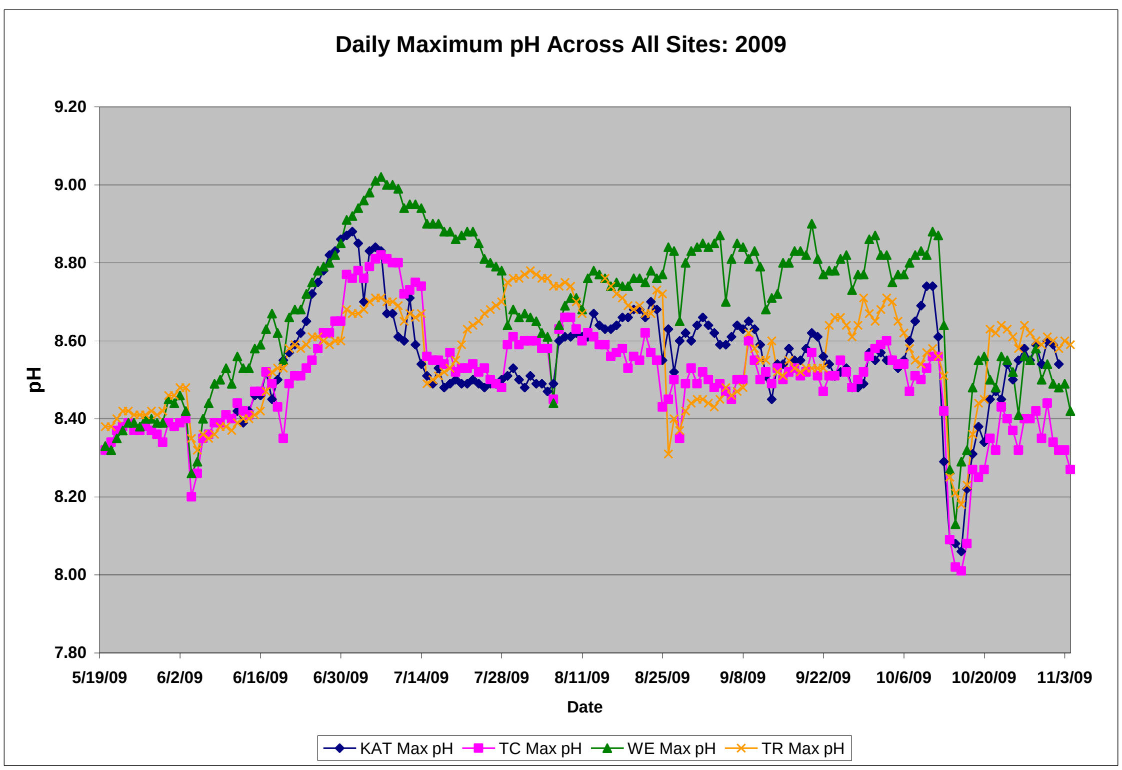

Figure 7-13. Daily Maximum pH Across All Sites: 2009

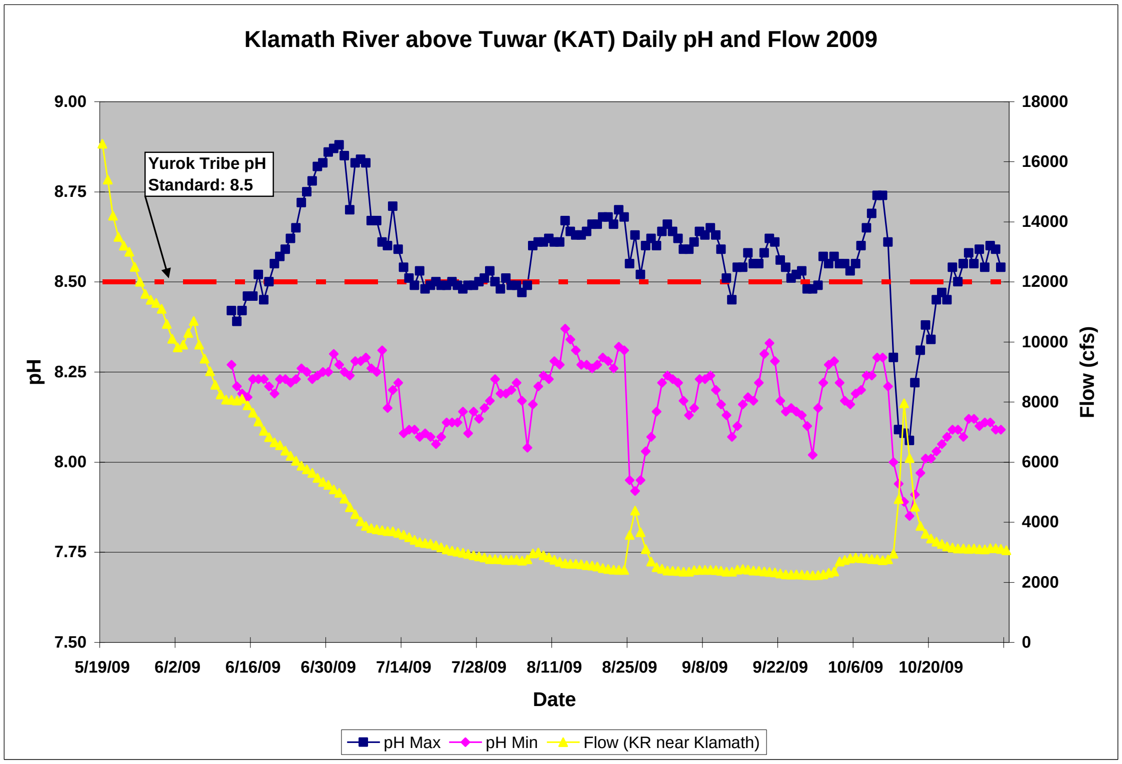

Figure 7-14. KAT pH and Flow: 2009

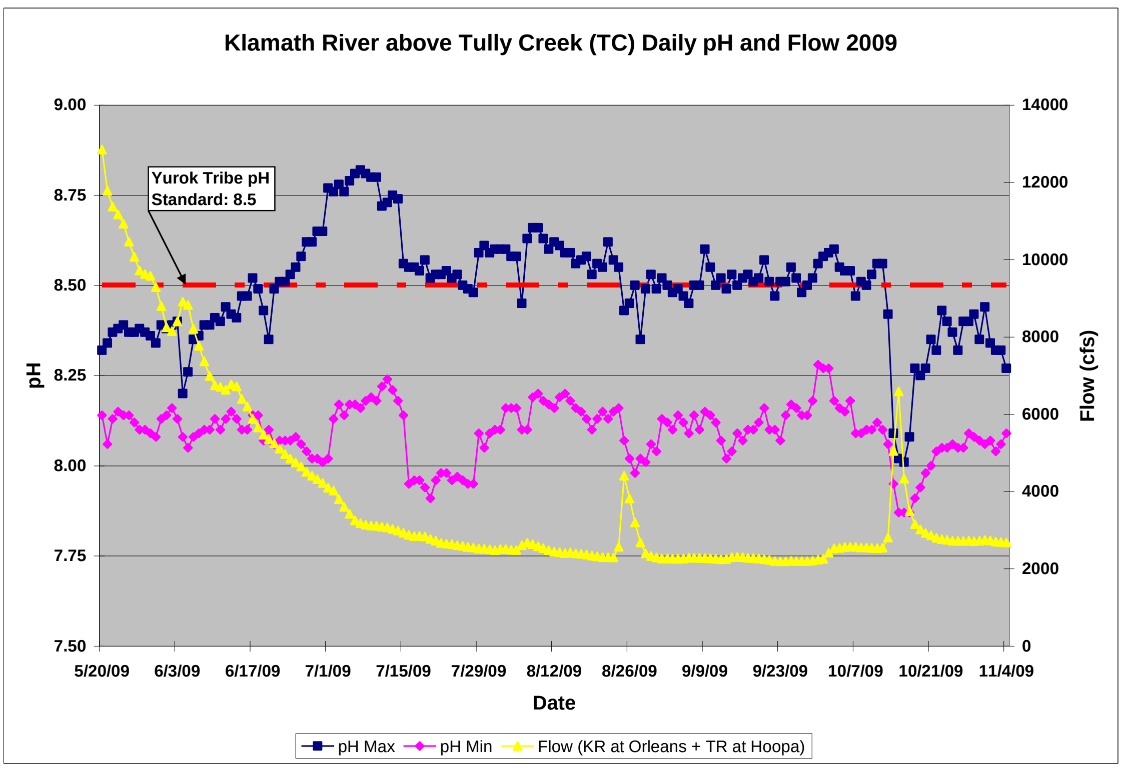

Figure 7-15. TC pH and Flow: 2009

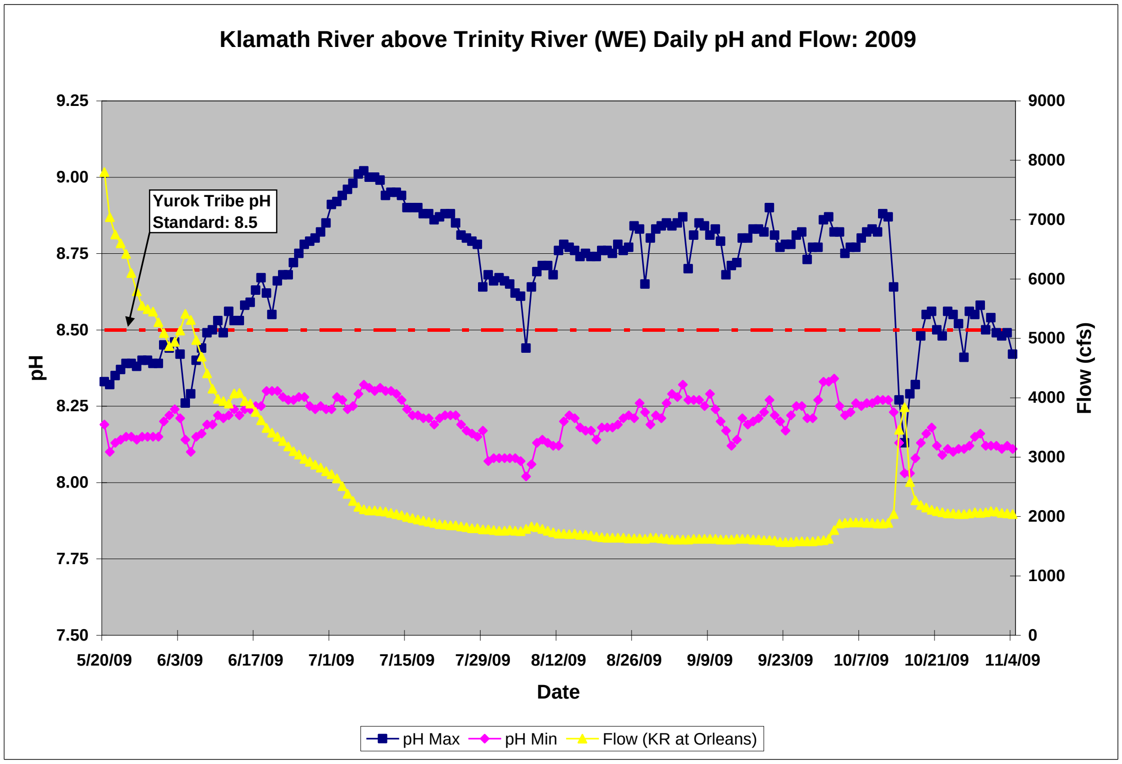

Figure 7-16. WE pH and Flow: 2009

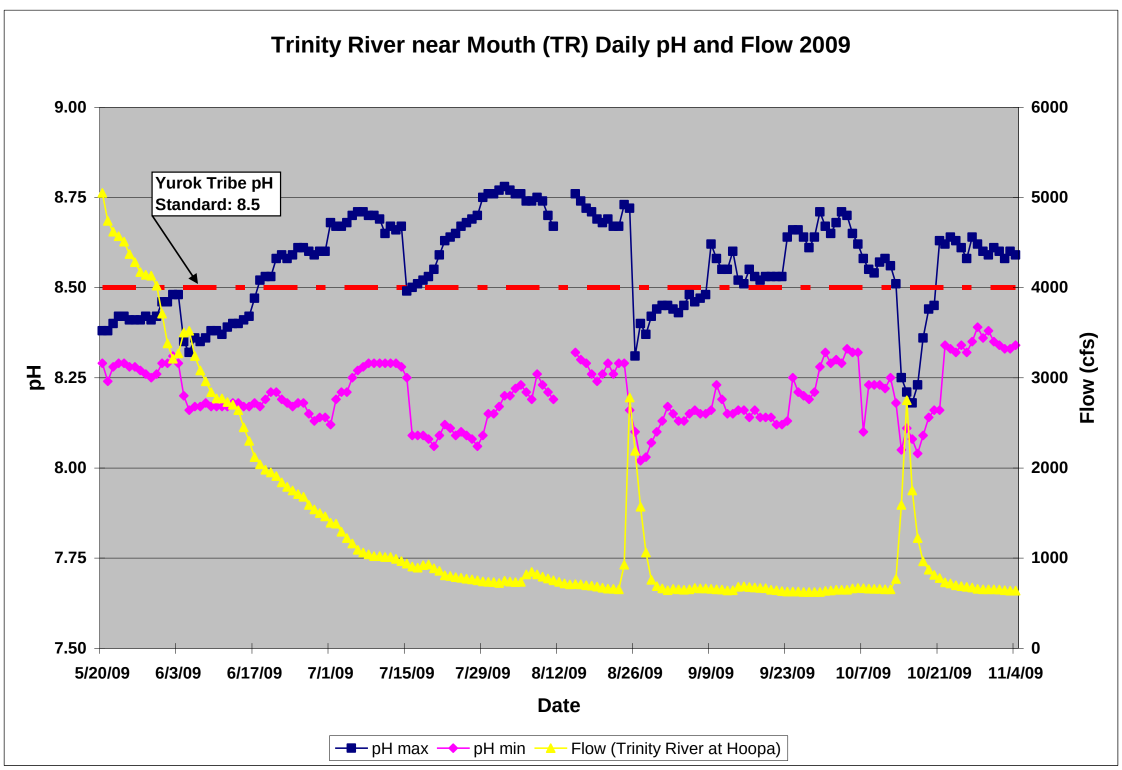

Figure 7-17. TR pH and Flow: 2009

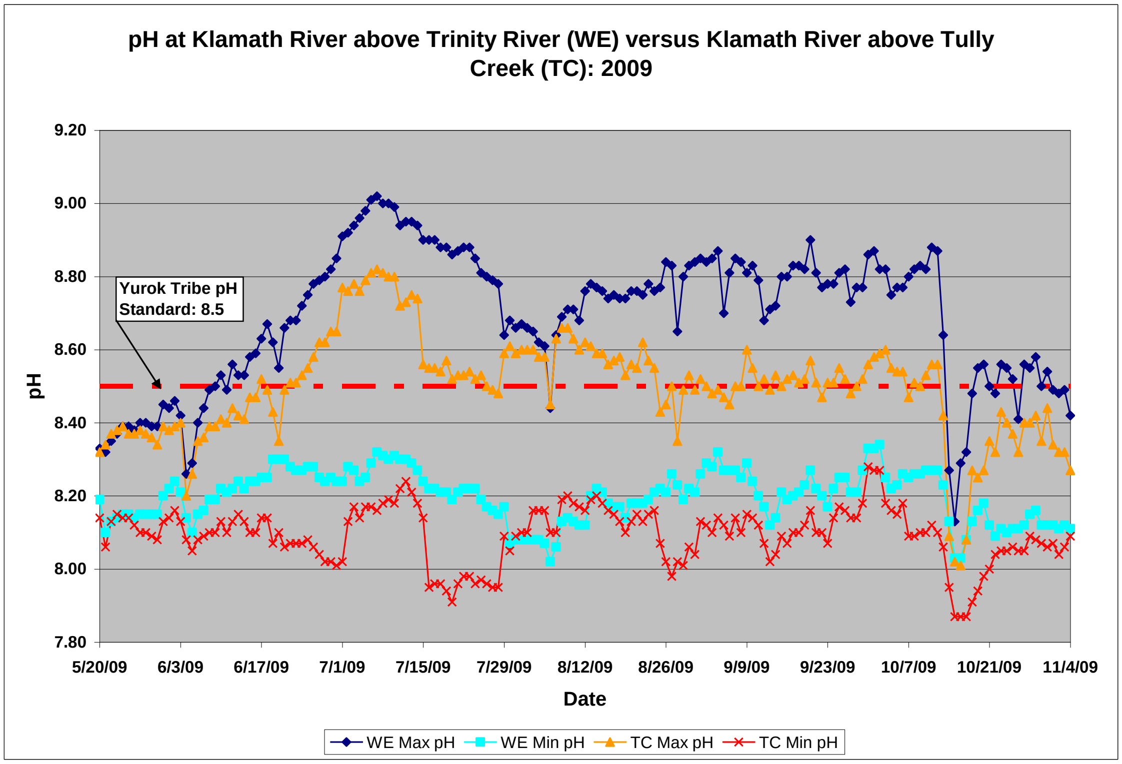

Figure 7-18. WE vs. TC pH: 2009

Specific Conductivity

All Riverine Sites

In general highest maximum daily specific conductivity was recorded at WE, while lowest maximum daily specific conductivity tended to be recorded at TR (Figure 7-19). Other than the beginning of the monitoring season, upriver sites usually recorded higher specific conductivity readings than downriver sites. TR experienced the greatest decrease in maximum daily values during the pulse flow from Lewiston Dam in late August.

Additional graphs have been generated to illustrate how specific conductivity may have been affected by volume of water present in the river at that time. Flow discharge data used to generate these graphs was downloaded from the USGS website. These graphs provide additional information when trying to determine the impact flow has on specific conductivity.

Klamath River above Turwar (KAT)

It appears that the pulse flow from the Lewiston Dam in late August temporarily influenced daily maximum specific conductivity at KAT (Figure 7-20). The peak of this flow arrived at KAT from August 25-28. On August 26 maximum specific conductivity at KAT was 151 µS/cm, a decrease of 23 µS/cm from August 24. After the pulse flow maximum specific conductivity quickly rose to values similar to those before the pulse flow and stayed stable until October.

The first rain event of the season on October 13-14 seems to have decreased maximum daily specific conductivity at KAT for a short period of time (Figure 7-20). On October 15 maximum specific conductivity was 160 µS/cm, a decrease of 19 µS/cm from October 12. After this first rain event, specific conductivity values quickly returned to values near those that were recorded before the rain event and continued to increase until the end of the monitoring season.

Klamath River above Tully Creek (TC)

It seems that the pulse flow from the Lewiston Dam in late August briefly influenced daily maximum specific conductivity at TC (Figure 7-21). The peak of this flow arrived at TC from August 25-28. On August 26 maximum specific conductivity at TC was 140 µS/cm, a decrease of 30 µS/cm from August 24. After the pulse flow maximum specific conductivity quickly rose to values similar to those before the pulse flow and stayed stable until October.

The first rain event of the season on October 13-14 also seems to have decreased maximum daily specific conductivity at TC for a short period of time (Figure 7-21). On October 15 maximum specific conductivity was 149 µS/cm, a decrease of 29 µS/cm from October 12. After this first rain event, specific conductivity values quickly increased to values higher than those that were recorded before the rain event and continued to increase until the end of the monitoring season.

Klamath River above Trinity River (WE)

The first rain event of the season on October 13-14 also appears to have decreased maximum daily specific conductivity at WE for a short period of time (Figure 7-22). On

October 15 maximum specific conductivity was 170 µS/cm, a decrease of 20 µS/cm from October 12. After this first rain event, specific conductivity values quickly increased to values similar to those that were recorded before the rain event and then remained stable until the end of the monitoring season.

Trinity River near Mouth (TR)

It seems that the pulse flow from the Lewiston Dam in late August influenced daily maximum specific conductivity at TR for a short period of time (Figure 7-23). The peak of this flow arrived at TR from August 25-28. On August 26 maximum specific conductivity at TR was 122 µS/cm, a decrease of 40 µS/cm from August 24. After the pulse flow maximum specific conductivity quickly rose to values similar to those before the pulse flow and then continued to decrease gradually until October.

The first rain event of the season on October 13-14 appears to have increased maximum daily specific conductivity at TR (Figure 7-23). On October 15 maximum specific conductivity was 170 µS/cm, an increase of 13 µS/cm from October 12. After this first rain event, specific conductivity values continued to increase until late October, then remained stable until the end of the monitoring season.

Impacts of the Trinity River on Specific Conductivity in the Klamath River

The Trinity River tended to decrease daily maximum specific conductivity in the Klamath River, with lower daily maximum specific conductivity values at TC than WE (Figure 7-24). In fact, daily maximum specific conductivity at TC was almost always lower than daily minimum specific conductivity at WE. The Trinity River seems to have had its greatest affect on specific conductivity in the Klamath River during the pulse flow from the Lewiston Dam in late August when daily maximum specific conductivity at TC was 14-37 µS/cm lower than daily maximum specific conductivity at WE.

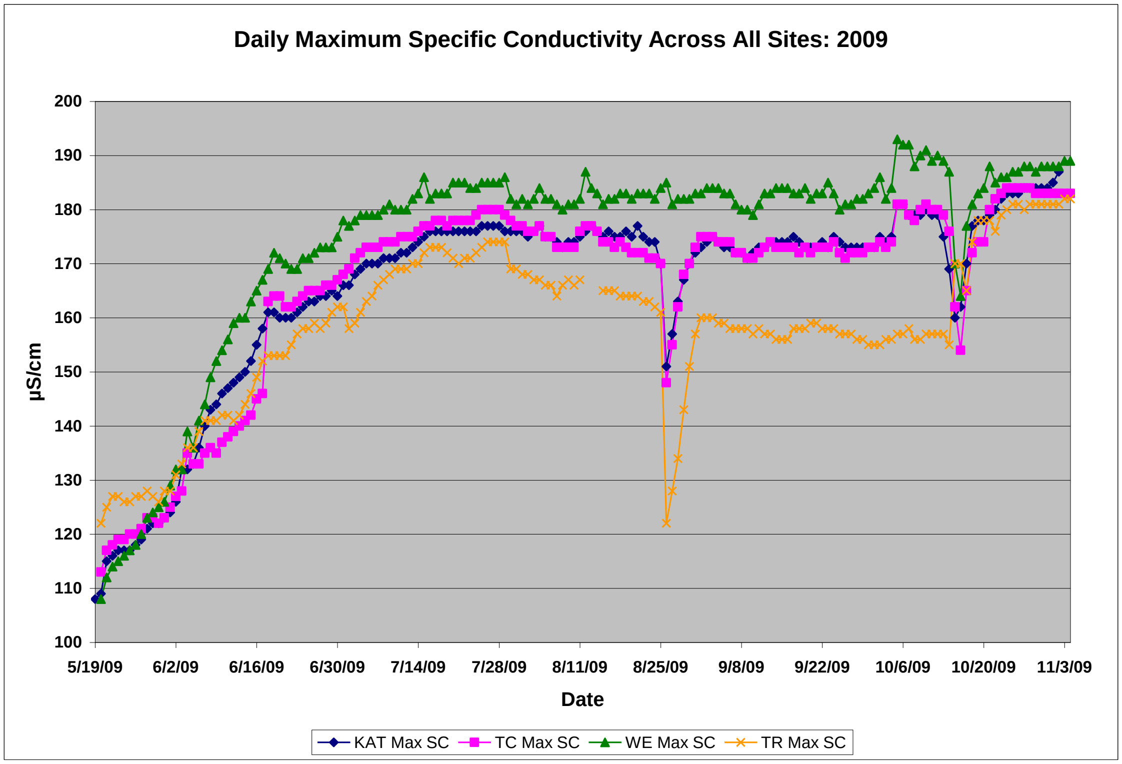

Figure 7-19. Daily Maximum Specific Conductivity Across All Site: 2009

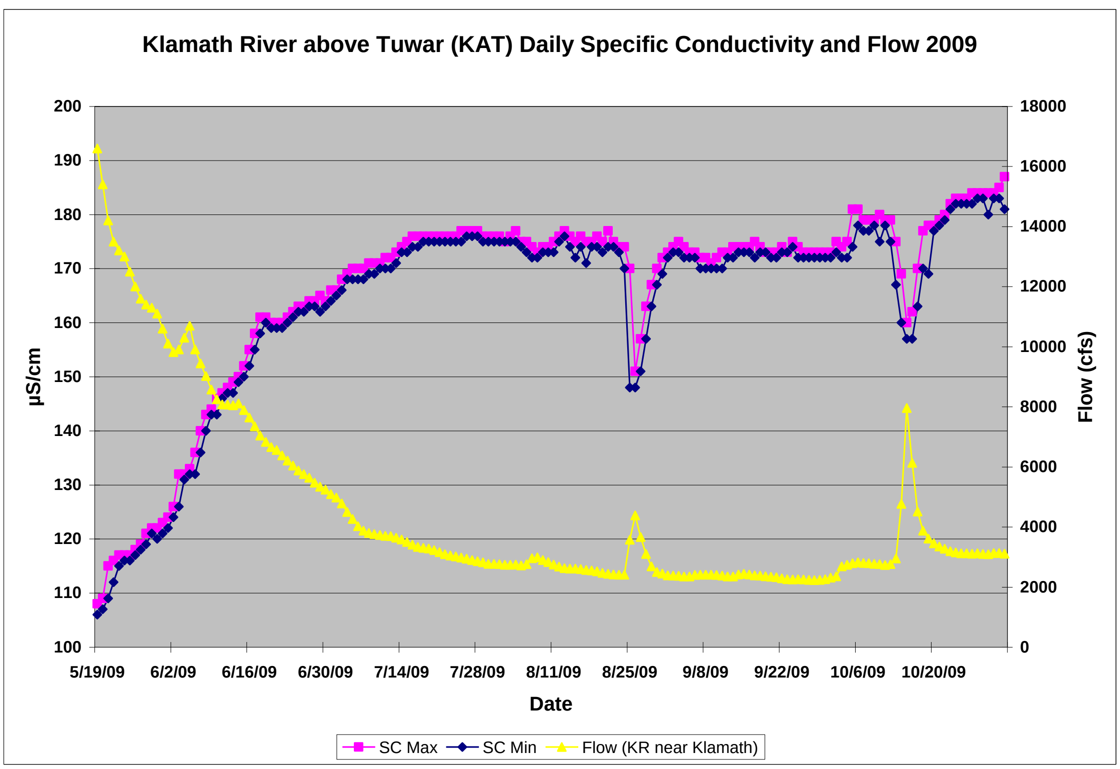

Figure 7-20. KAT Specific Conductivity and Flow: 2009

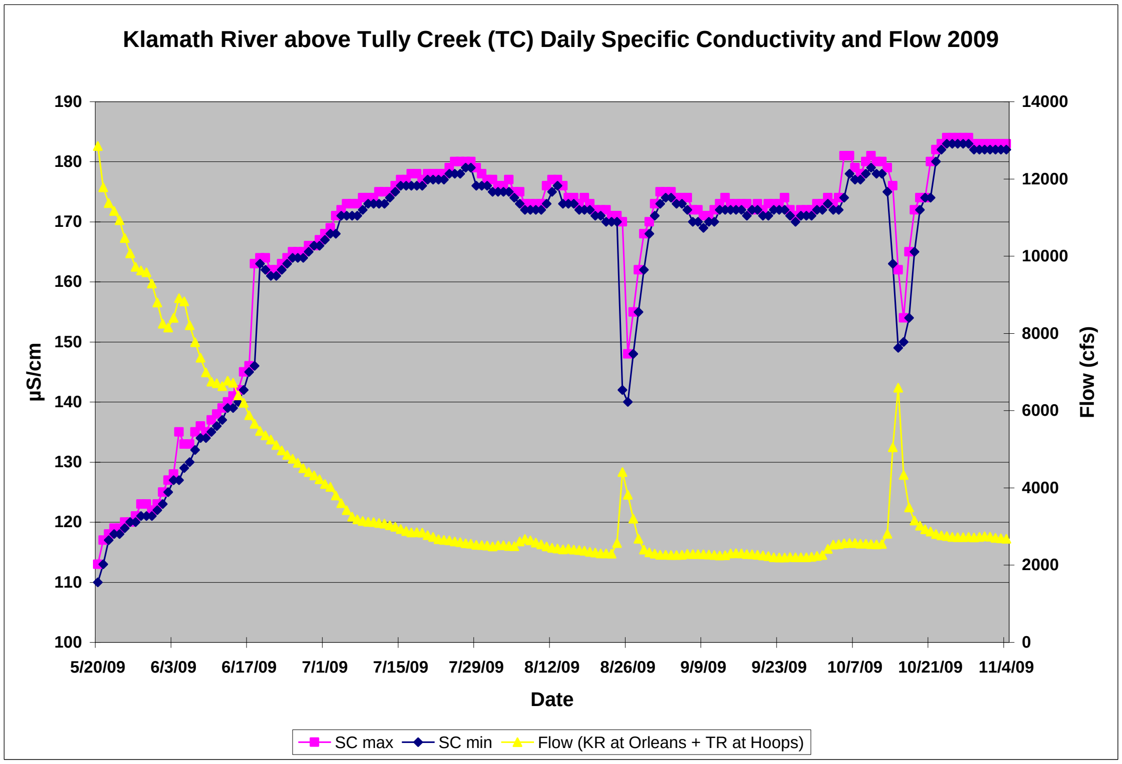

Figure 7-21. TC Specific Conductivity and Flow: 2009

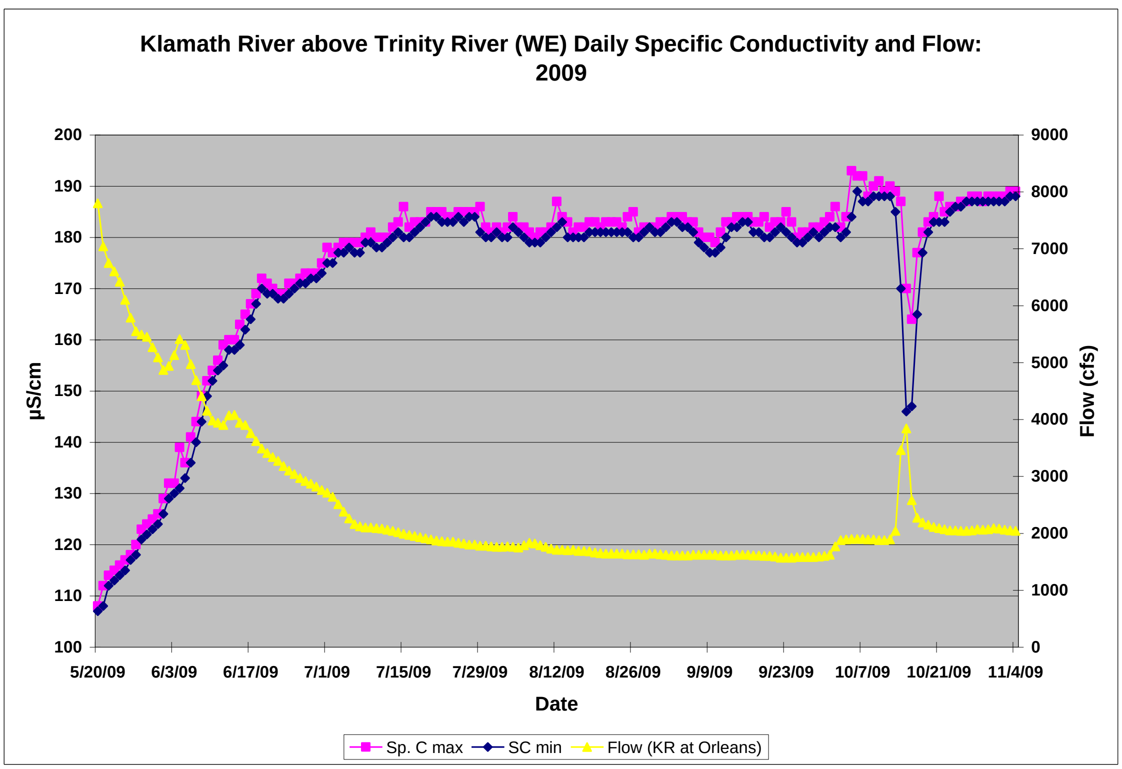

Figure 7- 22. WE Specific Conductivity and Flow: 2009

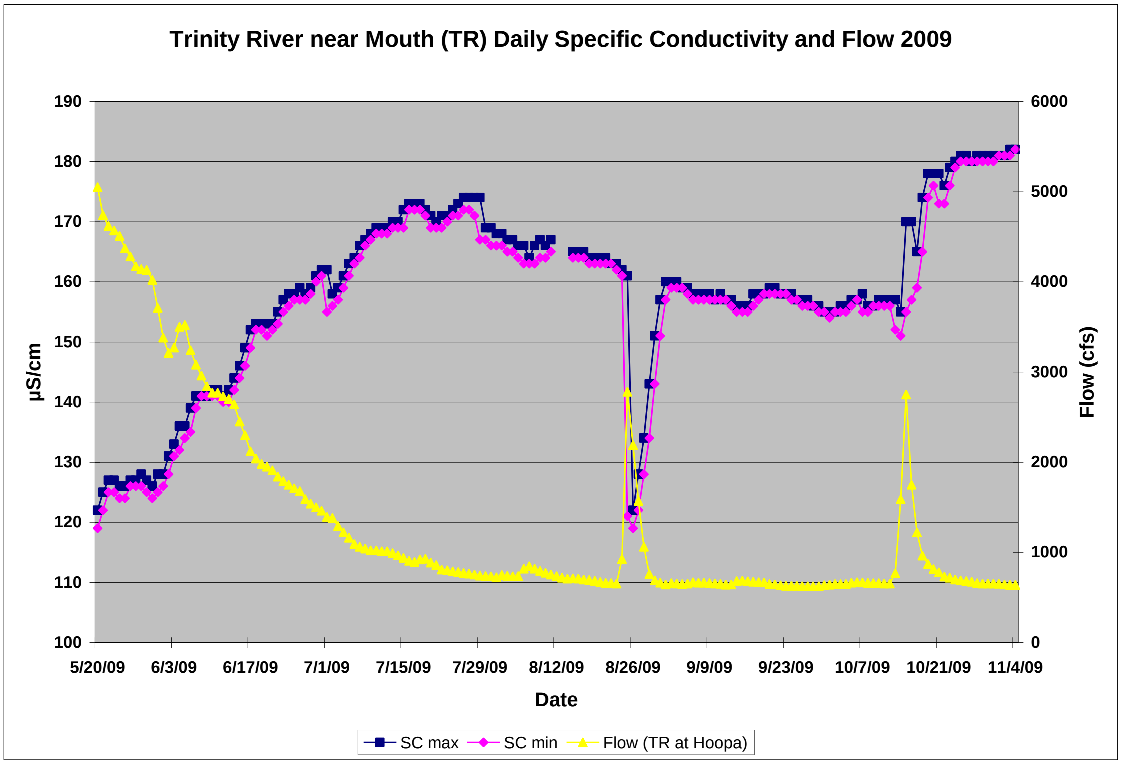

Figure 7-23. TR Specific Conductivity and Flow: 2009

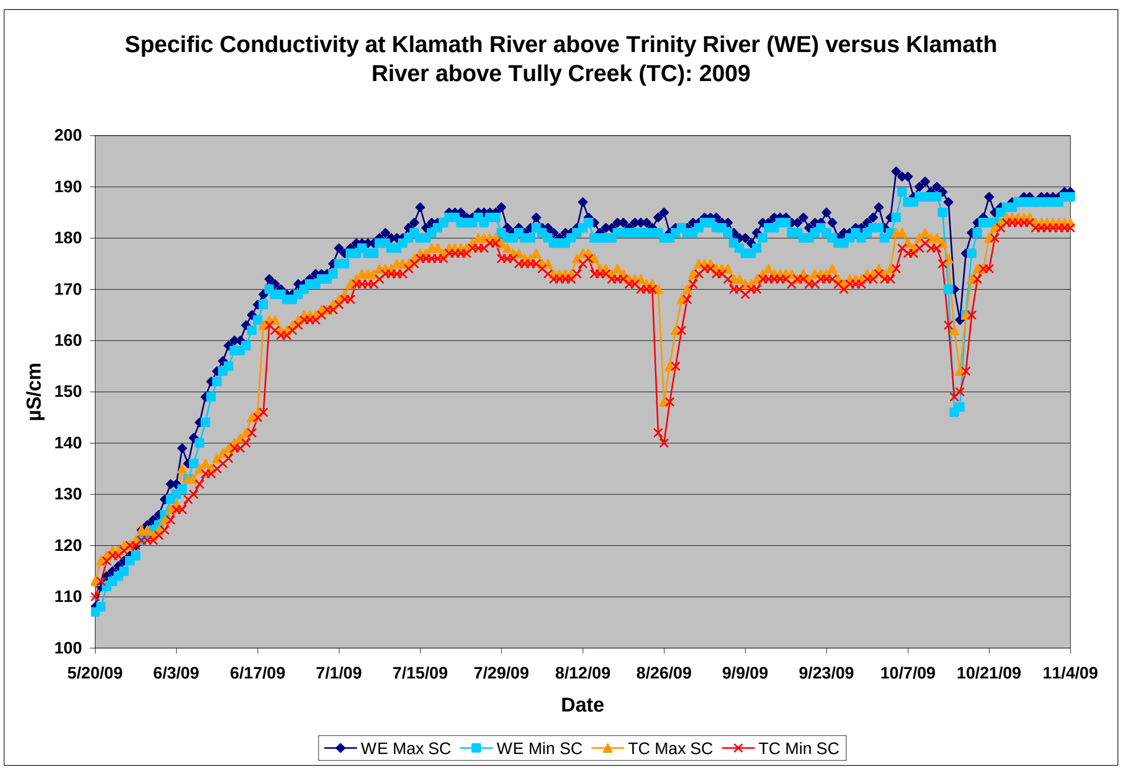

Figure 7- 24. WE vs. TC Specific Conductivity: 2009

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Appendix A: YSI Calibration SOP

Upon arrival at each monitoring site, numerous tasks must be performed to successfully meet the QA/QC protocol and service the Sonde. Properly filling out the calibration sheet is critical to collecting all the data that is needed for the evaluation of the sonde file. Here is an overview of a typical field tour consisting of extracting the sonde, performing scheduled maintenance and redeploying.

- Arrive on site: Record current barometric pressure and temperature using DeltaCal barometer at the site. Also record other environmental conditions, such as: weather, changing water levels, color of water, water clarity, etc on the datasheet. If at KAT or TC calibrate dissolved oxygen of reference sonde to current barometric pressure onsite.

- Audit the site sonde (datasonde that is dedicated to the site) by placing the reference sonde as close as possible to the lock box that contains the site sonde. As close to the half hour or top of the hour as possible (+/- 2 minutes), record the reference sonde water quality parameters on the datasheet. Remove the lock box containing the site sonde from the water no earlier than 2 minutes after the 30 minute or top of the hour reading. Carefully remove the site sonde from the housing trying not to disturb any fouling on the probes. Inspect the probes and determine if the wiper was properly wiping al of the sondors and make any notes such as extreme biofouling was present or the probes were extremely silted in by sand.

- Fill insulated water jug with river water.

- Connect site sonde to hand held and put in run mode by going to the sonde menu, highlight **Run** and press ENTER, highlight **Discrete Sample** and press ENTER, highlight **Start Sampling** and press ENTER.

- Place the site sonde, reference sonde, and NIST thermistor in the water jug and record pre-cleaning readings after WQ parameters have stabilized (Temp, SpCond, DO %, DO mg/L, pH, BGA) of site sonde in addition to readings of reference sonde and NIST thermistor in bucket.

- Turn off the site sonde. Remove site sonde and thoroughly clean.

- Cleaning site sonde: **Note: only site sonde is cleaned during cleaning process**

- YSI Sonde cleaning Procedure is as follows:
    - Remove sonde gaurd
    - Use an Alan head wrench to remove the wiper brush and the wiper on the BGA probe.
    - Clean conductance probe with wire brush.

- To clean the probes carefully loosen any built up sediment or algae by brushing sides (**NOT MEMBRANE SURFACES**) with toothbrush. When completed, use squirt bottle with DI water to rinse surfaces of probes.
- Swipe the sides of the probes with a Q-tip moistened with alcohol. **DO NOT APPLY TO MEMBRANE SURFACES**
- Swipe membrane surfaces with Q-tip moistened with DI water.
- Rinse all surfaces once more with squirt bottle of DI water.
- Install wiper brush and wiper (with new wiper pads) back onto probes with the proper gap (width of Rite-In-The-Rain paper).
- Put sonde guard back on.

WHILE SOMEONE IS CLEANING THE SONDE THE OTHER CAN:

- Take the big brush and thoroughly clean the inside and outside of the sonde lock box and outside of conduit.

- Get new wiper brush from cleaning kit and apply new wiper pad. Apply new wiper pad to wiper.

- Clean the site sonde sensor guard with a toothbrush and Q-tips.

- Take a Q-tip and clean out the data line connection on the data line ensuring it is free of water and sand.

- Download data from logger.
    - **If you are at the KAT site you do not download data until USGS is present**

    - **If you are at the Weitchpec or Trinity River site then follow the attached SOP to download data off of the H-350 XL data logger using the compact flash card.**

    - **If you are at the TC site then follow the other SOP to swap linear flash cards from the H-350 datalogger.**

After site sonde has been cleaned:

- Replace site sonde, reference sonde, and NIST thermistor in bucket and record post-clean readings of YSI site sonde and reference sonde in bucket after WQ parameters have stabilized.

- **Post calibrate site sonde DO probe:** Remove any water from the optical DO probe with Q-tip or Kim wipe **(careful not to push too hard on membrane)**. Wrap the wet towel over the sensor guard and entire datasonde to provide insulation. Place the entire sonde with wet towel into the DO calibration chamber (red jug with lid on) and make sure the sonde will not fall over.

- Go to the sonde main menu, highlight calibrate and press enter. Select **ODOsat %** and then **1-Point** to access the DO calibration procedure. Enter the current barometric pressure in **mm of Hg.** Press **Enter** and the current values of all enabled sensors will appear on the screen and change with time as they stabilize. Observe the readings under ODO mg/L. **After the DO stabilizes = shows no significant change for approximately 30 seconds,** Record the temp and the initial in DO mg/L and press **ENTER** to calibrate. The screen will indicate that the calibration has been accepted , record the Final DO in mg/L

- **Next: post calibrate the Specific Conductivity Probe**
- Rinse probes two times with DI water.
- Rinse probes two times with specific conductivity standard.
- Fill calibration cup with fresh specific conductivity standard.
- Under the main menu highlight calibrate and hit enter
- Highlight **Conductivity** and hit ENTER
- Highlight **SpCond** and hit ENTER
- Enter the value of calibration standard (for 1,000 µS/cm, enter 1.0) and press ENTER.
- Wait at least 30 seconds until specific conductivity stabilizes and record the temperature and initial specific conductivity value onto data sheet.
- Press ENTER to calibrate the sonde
- Never accept an "Out of Range" message – if this occurs ensure there are no bubbles in the hole where the Sp Cond probe is located and that the standard covers the hole completely
- Record the final value of specific conductivity onto data sheet.
- Press ESCAPE several times to go to the Main Menu and highlight **Advanced** and hit ENTER
- Highlight **Cal constants** and hit ENTER
- Record conductivity cell constant onto data sheet and verify the number ranges between 4.5 to 5.5
- Dump conductivity standard into rinse jar.

- **Next: post calibrate the pH probe**
- Rinse two times with DI water
- Rinse two times with pH 7.0_ standard.
- Fill calibration cup with fresh pH 7.0_ standard ensuring that the temp probe is covered with calibration standard
- Press ESCAPE twice to the main menu and highlight **RUN** and hit ENTER
- Highlight **Discrete Sample** and hit ENTER
- Highlight **Start Sampling** and hit ENTER
- Wait until temp stabilizes and record the temperature of the pH 7.0_ standard and the temperature compensated value for the pH standard, this is done to determine the temperature compensation for the pH standard, for example if the temp is 18 degrees C then determine the value of the pH 7 standard at 20 degrees C on the

look up table on the datasheet and fill it out in the pH standard line on the datasheet

- Press ESCAPE 3 times to go to the Main Menu
- Highlight **Calibrate** and hit ENTER
- Highlight **ISE1 pH** and press ENTER
- Highlight **2 point** and press ENTER
- Enter the temperature compensated value for the pH 7._ calibration standard for the first calibration point and hit ENTER.
- Wait at least 30 seconds until pH stabilizes and record the initial pH 7._ value onto the data sheet.
- Press ENTER to calibrate the sonde
- **DO NOT press enter or escape!**
- Record the final value of pH onto data sheet.
- Record pH mv onto data sheet and verify that the value ranges between -50 and +50
- Dump pH standard into rinse jar.
- Rinse two times with DI water.
- Rinse two times with pH 10._ standard.
- Fill calibration cup with fresh pH 10._ standard., ensuring that the pH probe is completely submerged
- Record the temperature of the pH 10.0_ standard and the temperature compensated value for the pH standard onto the datasheet
- Press ENTER once and enter the temperature compensated pH 10.0_ value as the second point and hit ENTER.
- Wait until pH stabilizes and record the initial pH 10 value onto data sheet
- Press ENTER to calibrate the sonde
- Record the final value of pH onto data sheet
- Record pH mv onto data sheet and verify that the value ranges between -130 and -230
- calculate the pH slope onto data sheet by subtracting the difference between the two numbers (using absolute value of the two numbers) and enter the value onto the datasheet, ensure the value ranges between 165 and 180
- Dump pH 10.0_ standard into rinse jar
- Rinse with two times with DI water

- **Next: IF YOU ARE AT THE WE, KAT or TC SITES THEN YOU NEED TO DO A 0 CHECK OF THE OPTICAL BGA PROBE.**
- Fill calibration cup ¾ of the way with DI water so that the BGA and temp probe are fully immersed.
- Be sure to engage only one thread on the calibration cup during this procedure to avoid a small interference from the cup bottom
- Highlight **Run** in the main menu and press ENTER, highlight **Discrete Sample** and press ENTER, highlight **Interval** and change it from 0.5 to 4 and highlight **Start Sampling** and press ENTER.

- On the 650 activate the wiper to clean the optics to remove any bubbles that may be present
- **After BGA has stabilized.** Record initial temperature and BGA on data sheet. Do not calibrate

- **Once BGA is present in the Klamath River do a rhodamine dye check for the BGA probes.**
- Rinse two times with DI water
- Rinse two times with rhodamine dye standard that was prepared in the lab.
- Fill calibration cup with fresh rhodamine dye standard ensuring that the temp probe is covered with calibration standard
- Press ESCAPE twice to the main menu and highlight **Run** and hit ENTER
- Highlight **Discrete Sample** and hit ENTER
- Highlight **Start Sampling** and hit ENTER
- Wait until temp stabilizes and record the temperature of the rhodamine dye standard and the temperature compensated value for the rhodamine dye standard, this is done to determine the temperature compensation for the rhodamine dye standard, for example if the temp is 18 degrees C then determine the value of the rhodamine dye standard at 18 degrees C on the look up table on the datasheet and fill it out in the rhodamine dye standard line on the datasheet
- After BGA has stabilized record the BGA number on the datasheet, if BGA number does not stabilize on any one number record the range after you watch it carefully for a couple of minutes
- Dump the rhodamine dye standard into the waste jug and rinse two times with distilled water

- Disconnect the sonde and 650.
- Connect sonde to site datacable, attach carabiner, and insert into aluminum sonde box. Deploy sonde at least 5 minutes before it is set to take a measurement. Record the time of deployment
- Place the reference sonde next to the datasonde at least 5 minutes before it is set to take a measurement and record WQ parameters as close as possible to the half hour or top of the hour (+/- 2 minutes).
- Check logger to ensure that sonde is communicating with logger and logger is recording data.

H350 XL Datalogger Instructions

Klamath River at Weitchpec(WE) and Trinity River at Weitchpec (TR)

To Download Data

- Insert 256 MB Compact Flash Card with PC Card Adapter into Datalogger
- Scroll Down to ‘Data Options’
- Press Arrow →
- Scroll Down to ‘Copy .NEW to Card?’
- Press Enter
- Wait Until Datalogger reads ‘Done, Press Enter to Erase .NEW’
- Press Esc/Cancel to Main Menu
- Remove Data Card by pushing eject button next to card slot

H350 data download for the TC site

Data Download (Linear Flash card swap out)

1. Open Gaging Station by unlocking metal box.
2. Disconnect the two metal rings holding lid on display board.
3. Press **ON**.
4. Scroll Down to <**CHANGE DATA CARD>** and hit **ENTER**.
5. Hit **ENTER** for **YES**.
6. Pull card and hit **ENTER**.
7. Install new blank card (from office) and press **ENTER**.
8. Hit **ENTER** for **YES** to format card.
9. On the data logger, scroll down to **<FLASH MEMORY CARD>**, hit **ENTER**.
10. Scroll down to **<VIEW DATA FILE>**, hit **ENTER**. (If the data headings are there, it is accepting data.) Hit **ESCAPE**.
11. Scroll up to **<LOGGING PARAMETER>**, hit **ENTER.** (Screen should say **<LOGGING [ON]>**, if it doesn’t, it needs to be turned on.)
12. Close lid on data logger.
13. Lock door on Gaging Station.

Method to remove and install a probe

- First carefully unscrew the stainless steel probe nut with the provided tool. Carefully dry the base of the probe with a kim wipe. Tilt the probes to be pointing towards the ground. Firmly grasp the probe at its base and pull in a slow downward motion until the o-rings on the probe have cleared the probe port. Blow out the probe port with compressed air to dry it thoroughly.
- Prepare the new probe by lightly greasing the o-rings on the probe. Insert the probe into the correct port and gently rotate the probe until you feel the connector engage. Now push the probe in towards the bulkhead until you feel the o-ring seat in its bore. You will experience some resistance as you push the probe inward. Once you feel the o-ring seat, gently rotate the stainless steel probe nut clockwise with your fingers while you are holding the probe in place.
- **DO NOT USE THE TOOL! The nut must be seated by hand, if the nut is difficult to turn STOP back off and attempt again to prevent cross threading the threads on the sonde. The nut will seat flat against the bulkhead and rotate easily when the parts are properly aligned. Use the tool to snug up the nut so it cannot come loose. DO NOT OVER TIGHTEN!!!!!!**
- If you are removing probe from the spare sonde make sure to install a port plug in the same way you install a probe. (grease o-rings and hand screw in first then tighten with the tool)
- Document what you did on the data sheet

Sensor Settings for Datasonde that is used in mainstem monitoring activities
(does not matter if hooked up to a logger or not)

- **Time is on**
- **Temperature is on**
- **Sp. Conductivity is on**
- **ISE1 pH is on**
- **Dissolved Oxy is OFF**
- **Optic-T – Dissolved Oxy is ON**
- **Battery is OFF**
- **Pressure is OFF**
- **ISE-2 is off**
- **Optic C - BGA is ON (except for TR sonde that has turbidity probe keep it off)**

Report Settings for Datasonde that is Hooked up to a datalogger at WE,TC, KAT and TR:

- **Date and Time is OFF**
- **Temperature is on: °C**
- **Specific Conductivity is on: microsiemens μ**
- **pH is on**
- **pH mv is on**
- **ODO Sat % and mg/L is on**
- **Turbidity is OFF**
- **BGA is ON (at KR sites only)**

Report Settings for Datasonde that is **NOT** Hooked up to a datalogger:

- **Same as above but Date and Time is turned on**

To download data and create files on sondes that are not hooked up to a datalogger

Before postcalibrating DO follow the below instructions to download data off of the internal datasonde memory.

- **If the sonde is not hooked up to the datalogger then this is a good time to download the data off of the sonde.**

- Turn the logging off by selecting run, unattended sample, and stop logging
- Download the data (page 55 in the 650 manual) by selecting the sonde menu in the 650 Main Menu
- Highlight File and hit enter
- Highlight Quick Upload and hit enter
- Select PC6000 for the File Type and hit enter
- Do the same process again for the same file but download it as a different data file, a ASCII Text file this time

- Create a file after you do your final calibration of pH or the BGA check

- Create a new file in the Sonde Run Menu unattended sample menu. Make sure the start time is two minutes before the half hour or top of the hour (i.e, 10:28 or 10:58). The interval is 30 minutes. The parameters to log should be date and time, temperature, conductivity, pH, pH mv, and battery voltage, ODO mg/L, ODO % Saturation (and BGA for KR sites). Set the stop time to run for 21 days. Set the file name to site id and start date, example-(TR061606). Scroll down to the bottom of the screen and start logging. To verify that logging is activated go to file status and it will say logging active.