Umpqua Basin Watershed Council

# South Umpqua Watershed Temperature Study 1999

*Procedure, results and preliminary analysis*

*February 2000*

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The writer takes full responsibility for all errors and omissions.

Kent Smith
Consultant, InSight Consultants


# Disclaimer

The Roseburg BLM requested that the following disclaimer be included in the final document:

> "No warranty is made by the Bureau of Land Management as to the accuracy, reliability or completeness of these data for individual use or aggregate use with other data." In addition these data are provisional and subject to revision."

# South Umpqua Watershed Temperature Study - Summer of 1999


## *Executive Summary*

Temperature data from 119 continuously sampling data loggers was obtained from monitoring sites throughout the South Umpqua watershed during the summer of 1999. The seasonal maximums from the various sites ranged between 90.24 and 52.51 °F with an average of 70.55 °F. The 7-day maximums lagged the seasonal maximums by an average of 1.39 degrees with a maximum difference of 5.24 °F. The maximum $\Delta T$ (difference between daily maximum and minimum values) value ranged from 3.64 to 21.5 °F with an average of 9.9 °F.

Analysis of the data with respect to the location in the watershed indicated that the tributary streams tended to be in the order of 10 °F cooler than the larger South Umpqua River. Charting the data with respect to the distance from the ridge of each stream indicated that the maximum temperature of the coldest streams tended to increase about .58°F per downstream mile. The data cluster above this line suggests that many of the similarly sized tributary streams have the potential to be at cooler temperatures.


## Objective and scope of the study:

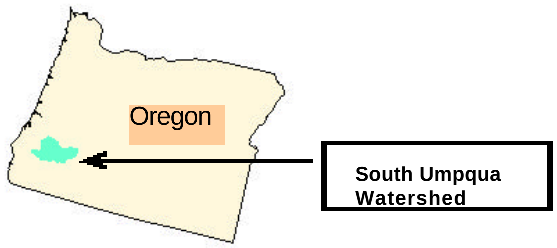
This study was sponsored by the Umpqua Basin Watershed Council (UBWC) in partnership with the Umpqua National Forest, Roseburg BLM, and Roseburg DEQ. The study is part of an ongoing project to characterize the summer stream temperature regime in the interior watersheds of the Umpqua River Basin with an emphasis on the seasonal maximum temperatures. This particular study is directed at stream temperatures within the South Umpqua watershed. A synoptic approach was taken by collecting data for the 1999 season from a large number of sites through the South Umpqua Watershed. This approach provides the opportunity to compare data between the various sites without introducing between-year variability.

A preliminary analysis using statistics from the data was completed to examine the range of variability in the data as well as the spatial distribution of the temperature patterns and the effect of stream size on stream temperature. It is expected that this data and analysis will provide a basis for addressing site specific temperature related issues, aquatic habitat evaluation, a Temperature Management Plan for the watershed and further study.

## Study Area:

### Geographical Characteristics

The South Umpqua River Watershed comprises most of southern Douglas County, extending south from its mouth near Roseburg for about 1820 square miles. The elevation at the mouth is 350 feet and the elevation of the defining ridges ranges from 3000 feet to over 5000 feet at the Rouge-Umpqua Divide located at the east end of the watershed.




## Description of the study:

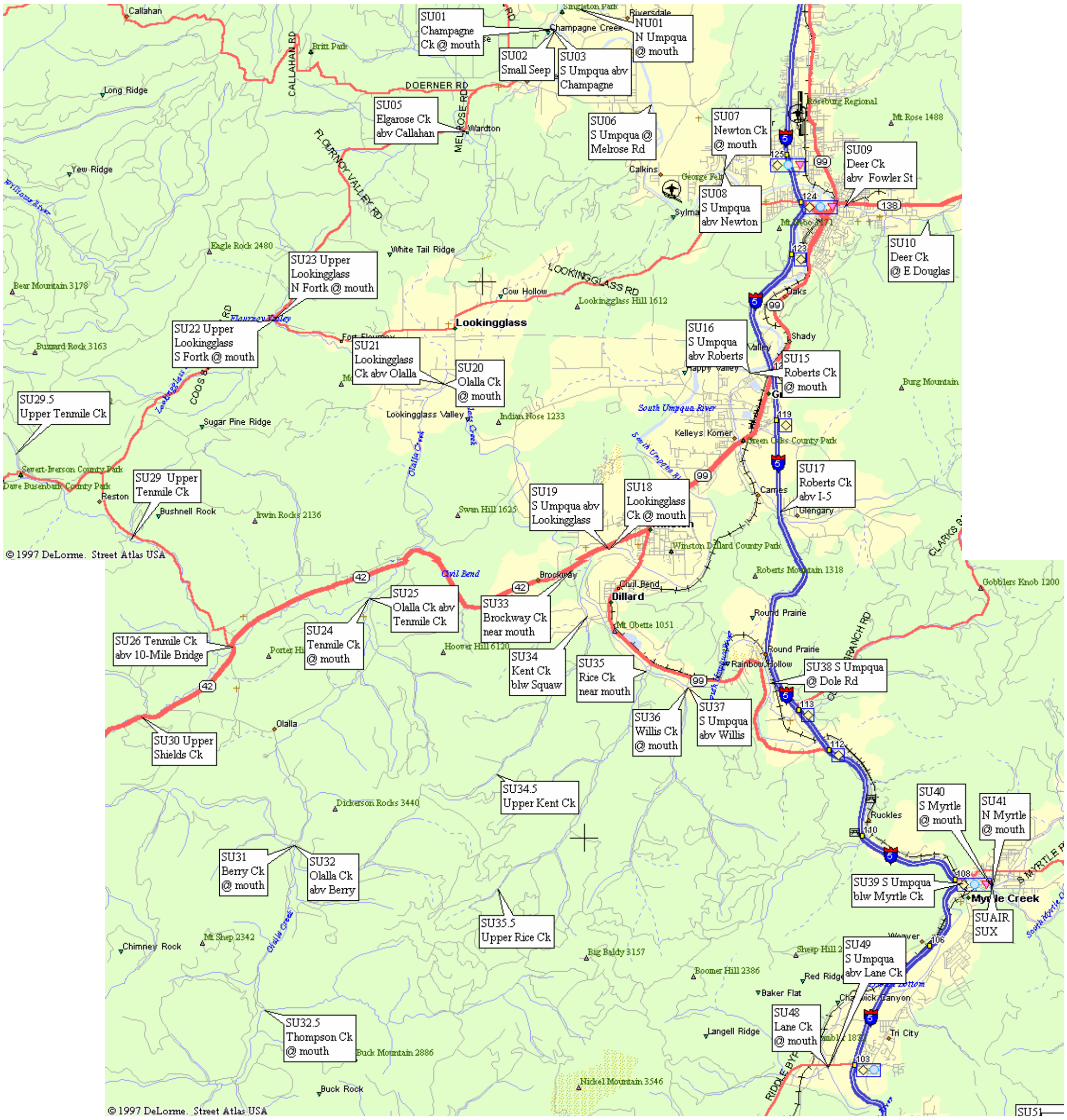
### Site Selection:

Seventy UBWC site locations were chosen to obtain a representative sample of the various types of streams throughout the watershed. Data were also obtained from twelve DEQ, twenty-four BLM, and thirteen Forest Service monitoring stations for a total of 119 stations within the watershed.

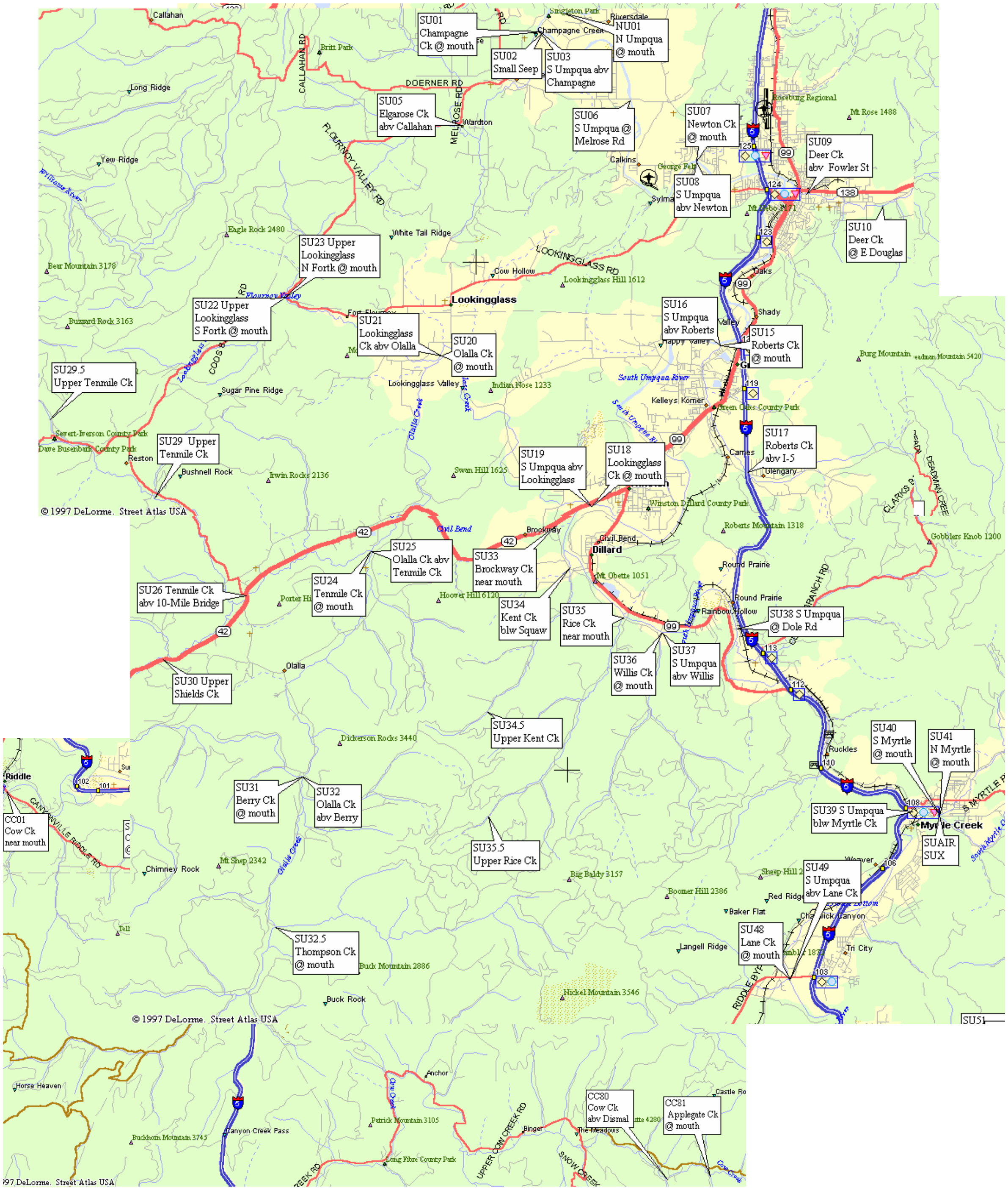
The UBWC sites were selected to provide a broad, representative sample of streams in the watershed. An emphasis was placed on monitoring the smaller streams to better understand their temperature characteristics and how they affect the larger streams. Sites on the main streams were often paired with a site at the mouth of a contributing tributary.

At site SU41, North Myrtle Creek @ the mouth, an additional sensor was deployed to measure air temperature. The unit was placed in a shaded location about 10 feet above the water. This site is representative of the central portion of the watershed and it is suggested that it be used in the future as a temperature baseline station for the watershed. At site SU41 a logger was also deployed in a water-filled bucket to provide a comparison of the thermal response of a relatively simple system with that of the more complex stream system. This data may be useful for calibrating stream temperature computer models.

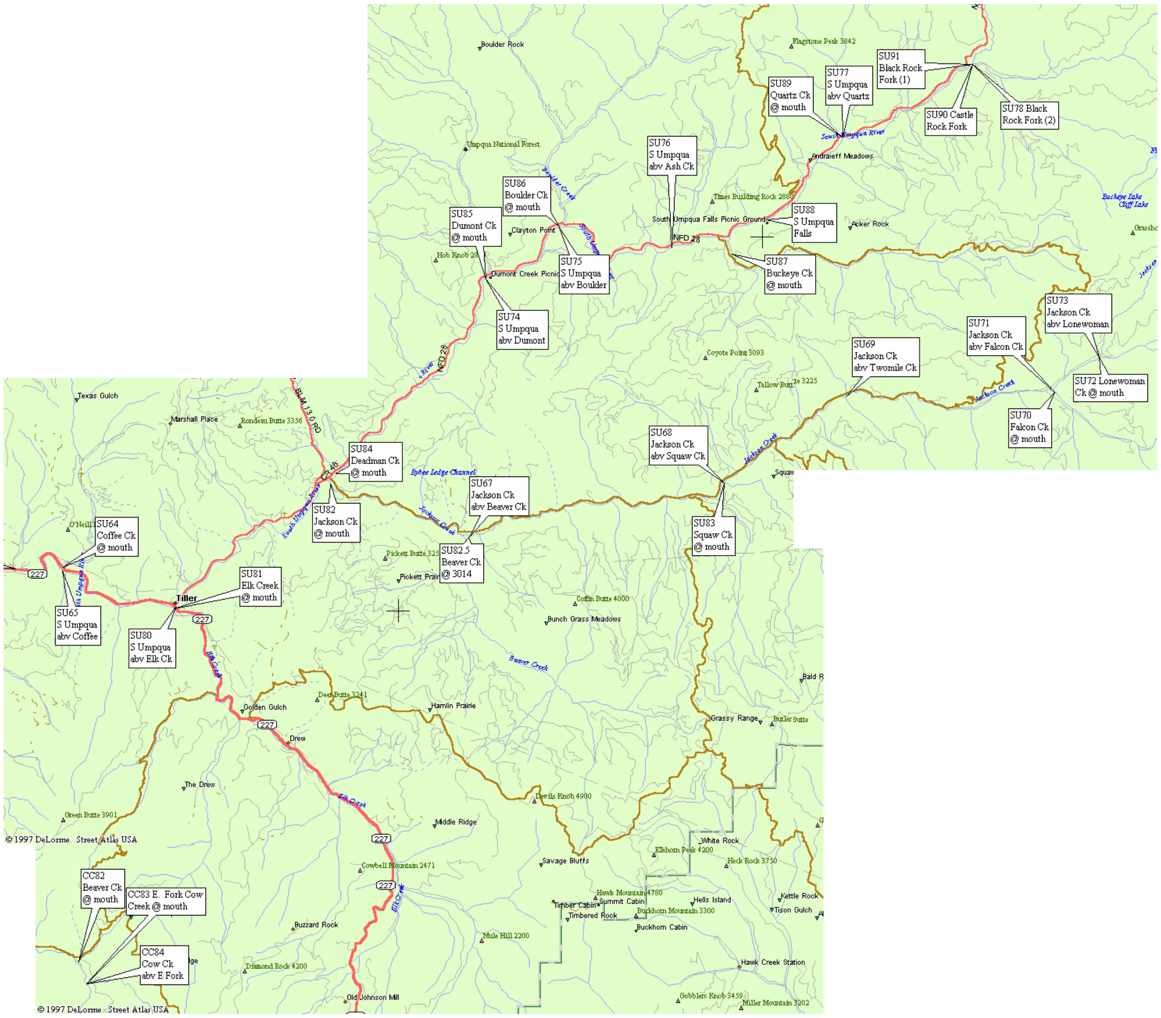
The locations of the monitoring sites are shown on Maps 1-3. Detailed information for each site is included on Site Data Sheets in Appendix A. Digital picture computer files are also available for each site that show the upstream and downstream condition as well as the data logger site location.




*Map 1 Temperature Monitoring Sites in the Western Portion of the South Umpqua River Watershed*

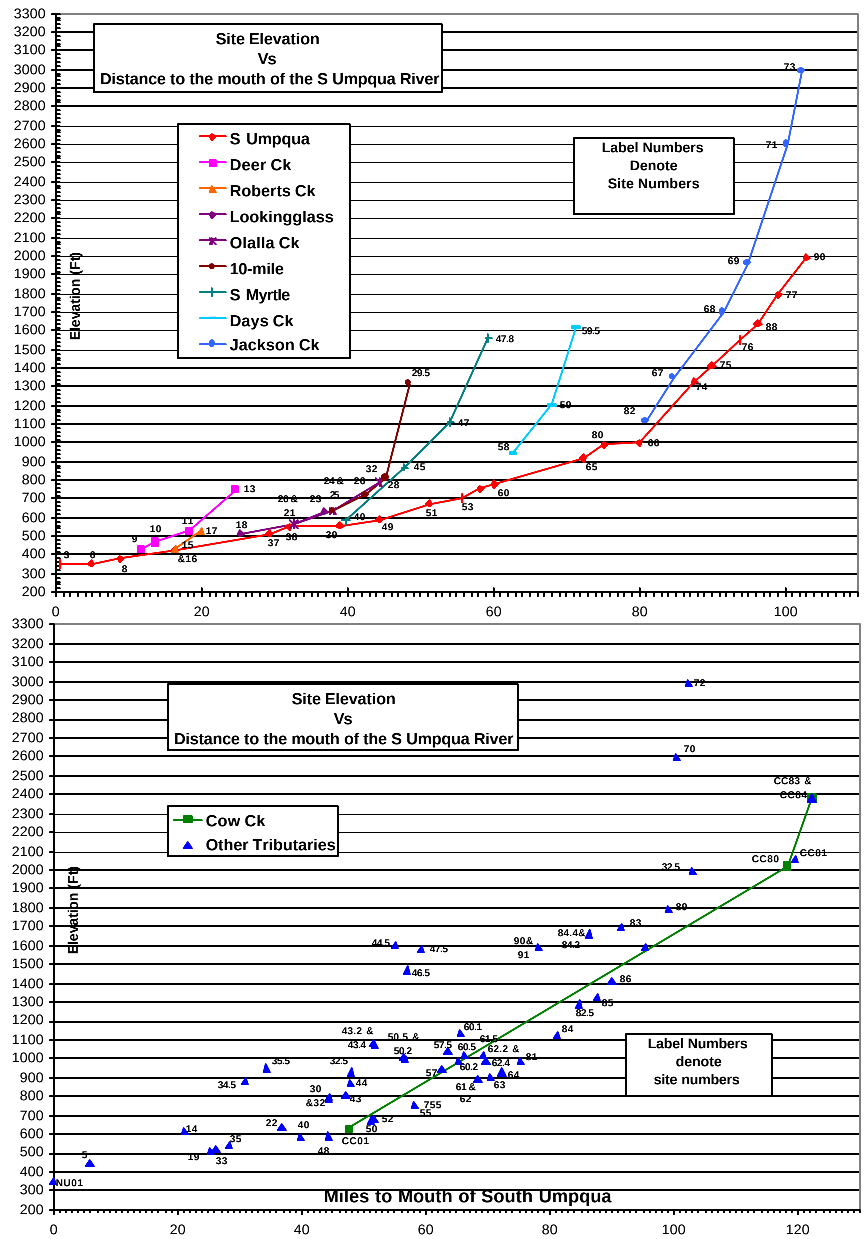



*Map 2 Temperature Monitoring Sites in the Central Portion of the South Umpqua River Watershed*




*Map 3 Temperature Monitoring Sites in the Eastern Portion of the South Umpqua River Watershed*

Elevation and the associated channel gradients are important parameters that affect the energy of the stream as well as the local weather regime. To help provide a three-dimensional perspective, Charts 1 and 2 shows the relative elevation of the sites plotted against the stream miles measured from the mouth of the South Umpqua. The point labels denote the monitoring site number. The data was put on two charts to improve readability.




Charts 1 & 2  Site elevation with respect to river mile.

### Deployment and Collection:

The 70 UBWC "StowAway® Tidbit®" data logger units were deployed in the South Umpqua watershed between June 24 and June 30 and collected between September 9 and September 15. The exact date of deployment and collection for the BLM and DEQ units is not available but the dates of the data record are shown on the Site Data Sheets in appendix A.

The units were set to record the temperature at 30-minute intervals. Typically, over 4,000 temperature measurements were taken at each site. Permission was obtained from landowners to access sites located on private property. An attempt was made to place the temperature logger device to assure it was measuring a representative sample of the active steam at the site. However, on large streams it was often difficult to secure a unit directly in the central portion of the channel at a point where it would remain submerged as the flow recedes. In the small streams the challenge was to select sites with good circulation and enough water volume to keep the unit submerged. In spite of best efforts, several logger units were exposed by receding flows and some units ended up measuring the temperature of an isolated pool. The sites that experienced these conditions are identified in Table 1.

Units that were found to be in dry channels during the field audit were redeployed at other locations. Since the data record from the second site did not contain the whole summer season, seasonal statistics were not developed. However, the data was used for other analysis and is included in the database.

### Field Documentation:

A camcorder was used to document the exact sensor location and general characteristics of each UBWC deployment site. Digital picture files for each site were produced that show the downstream and upstream views as well as the sensor location. Copies of these files are available through the watershed council.

A VHS recording entitled "South Umpqua River Temperat ure 1999– Field Notes" is also available for viewing or copying. The emphasis of this video was to document the location of each sensor unit. However, it also provides information about the general characteristics of each site.

Data sheets for each UBWC site were also developed that describe some of the site characteristics. Elevation data and the distances to mouth and ridge were obtained from mapping software. Local distance measurements at the site were estimated visually. Depth of unit at time of removal was measured with a tape measure to provide an indication of the final state of the unit. In some cases flow estimates were made using the streamflow nomograph in Appendix C. A chart of the temperature data is also included on each sheet. that charts all of the temperature data used to produce the summary statistics.

### Accuracy Checks:

To assure that the logger units were operating properly, accuracy checks were made on all of the UBWC instruments before deployment and after retrieval. A Tr aceable© reference thermometer was used to check each sensor at two different temperatures. Several readings were taken over a period of time to trace the response of the unit to an abrupt change in temperature. Chart 2 shows the results from a typical accuracy test. Note that the temperature time response of the units in stirred water is about six minutes. Tables 1 and 2 in Appendix B (Data Accuracy Information) shows the results of these tests. All of the units were within +0.3° and –0.1°C of the reference thermometer after thermal equilibrium was reached.

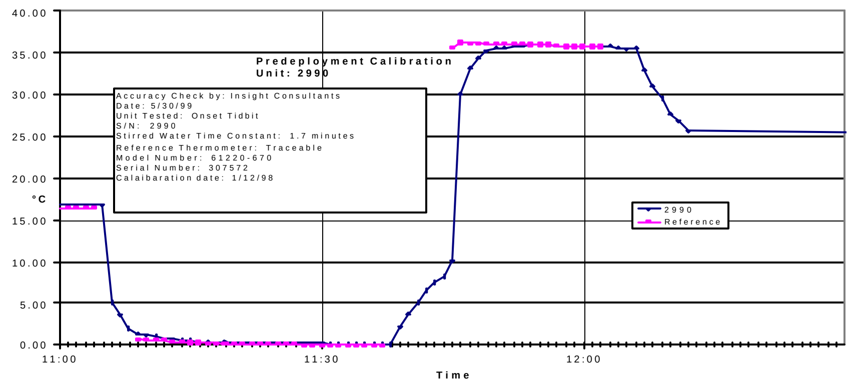



***Chart 3 Typical accuracy check for a Tidbit® unit.***

A field audit was also conducted on all of the UBWC sites using a Traceable reference thermometer to measure the water temperature at the site. The recorded value was later compared with the corresponding data logger value. This method is not as accurate as the direct calibration method since the water temperature was, in some cases, changing rapidly and the logger units do not respond to the changes as rapidly as the reference thermometer. Nevertheless, most of the field audit temperatures matched the Logger temperatures within +/ 1°F. (See Table 3 Appendix B). The reference thermometer was damaged during this portion of the project and the deviation at a few sites exceeded 1°F. Since the accuracy of the sensors under controlled conditions was consistently better than +/- 0.2 °F, both before and after the field deployment, it is reasonable to assume that the larger deviations in the field audit data were the caused by other factors and should not be attributed to the data loggers.

## Data Logger Results:

Each logger unit produced over 4000 readings that were loaded into an Excel® file. As mentioned previously, some of the data was affected by receding streamflow that caused the logger units to either become exposed to air or to end up in an isolated pool with no direct surface flow. All air-exposure data was trimmed from each file and discarded. The water temperature data from the isolated pool sites was retained because the pool temperature information has value when evaluating aquatic habitat. Table 1 provides a summary of the status of the end-of-season condition for each site.

- **Condition A**: Unit remained submerged in a flowing stream for entire period between 6/11 and 9/8. Seas onal statistics represent active flow conditions.

- **Condition B**: The stream flow receded to an isolated pool condition. Seasonal statistics were developed for the entire period that include both flow and pool conditions.

- **Condition C**: The unit had an incomplete record due to exposure to air temperatures by receding stream flow, late deployment, vandalism, or other reasons. The data trim date is noted on the Site Data Sheets and seasonal statistics were not developed. However, the valid partial record was kept and used for other analysis when appropriate.

***Table 1 Site Data Record Condition***

| Site # | Site Name | Condition Category | Collecting Agency | File # |
|---|---|---|---|---|
| CC01 | Cow Ck near mouth | A | UBWC | 2959 |
| CC80 | Cow Ck abv Dismal | A | USFS | 20001 |
| CC81 | Applegate Ck @ mouth | A | USFS | 20006 |
| CC83 | E Fork Cow @ mouth | A | USFS | 20010 |
| CC84 | Cow Ck abv E Fork Cow | A | USFS | 20011 |
| NU01 | N Umpqua @ mouth | C | UBWC | 2924 |
| SU01 | Champagne Ck @ mouth | C | UBWC | 2930 |
| SU02 | Small seep near mouth of Champagne ck | C | UBWC | 2929 |
| SU03 | S Umpqua abv Champagne Ck | A | UBWC | 2931 |
| SU05 | Elgarose Ck abv Callahan | A | UBWC | 2926 |
| SU06 | S. Umpqua @ Melrose Rd | C | UBWC | 2938.1 |
| SU07 | Newton Ck @ mouth | C | UBWC | 2974 |
| SU08 | S Umpqua abv Newton Ck | A | UBWC | 2973 |
| SU09 | Deer Ck abv Fowler Bridge | A | UBWC | 2972 |
| SU10 | Deer Ck on E Douglas | A | UBWC | 2979 |
| SU11 | N Fork Deer Ck @ mouth | A | UBWC | 2975 |
| SU12 | S Fork Deer Ck @ mouth | C | UBWC | 2976 |
| SU13 | N Deer Ck @ Buckhorn Rd | A | UBWC | 2977 |
| SU14 | S Deer Ck @ Dixonville RD | A | UBWC | 2978 |
| SU15 | Roberts Ck @ mouth | A | UBWC | 2980 |
| SU16 | S Umpqua abv Roberts Ck | A | UBWC | 2981 |
| SU17 | Roberts Ck abv I-5 | A | UBWC | 2989 |
| SU18 | Lookingglass @ mouth | A | UBWC | 2935 |
| SU19 | S Ump abv Lookingglass | A | UBWC | 2936 |
| SU20 | Olalla @ mouth | A | UBWC | 2933 |
| SU21 | Lookingglass abv Olalla | A | UBWC | 2932 |

| Site # | Site Name | Condition Category | Collecting Agency | File # |
|---|---|---|---|---|
| SU22 | Upper Lookingglass south fork | B | UBWC | 2927 |
| SU23 | Upper Lookingglass north fork | A | UBWC | 2928 |
| SU24 | 10-Mile Ck @ mouth | A | UBWC | 2941 |
| SU25 | Olalla abv 10-Mile Ck | A | UBWC | 2942 |
| SU26 | 10-Mile Ck abv 10-Mile bridge | A | UBWC | 2943 |
| SU29 | Upper 10-Mile Ck | C | UBWC | 2929.1 |
| SU29.5 | Upper Tenmile Ck | A | BLM | 918 |
| SU30 | Shields Ck @ 1st Bridge | B | UBWC | 2984 |
| SU31 | Berry Ck @ mouth | A | UBWC | 2985 |
| SU32 | Olalla Ck abv Berry | A | UBWC | 2986 |
| SU32.5 | Thompson Ck @ mouth | A | BLM | 919 |
| SU33 | Brockway Ck near mouth | B | UBWC | 2937 |
| SU34 | Kent Ck blw Squaw Ck | C | UBWC | 2938 |
| SU34.5 | Upper Kent Ck | A | BLM | 907 |
| SU35 | Rice Ck @ mouth | A | UBWC | 2939 |
| SU35.5 | Upper Rice Ck | A | BLM | 912 |
| SU36 | Willis Ck @ mouth | C | UBWC | 2940 |
| SU37 | S. Umpqua abv Willis Ck | C | UBWC | 2940.1 |
| SU38 | S Umpqua @ Dole Rd | A | UBWC | 2987 |
| SU39 | S Umpqua blw Myrtle Ck | A | UBWC | 2969 |
| SU40 | S Myrtle @ mouth | A | UBWC | 2961 |
| SU41 | N Myrtle @ mouth | A | UBWC | 2960 |
| SU42 | Frozen Ck @ mouth | A | UBWC | 2971 |
| SU43 | N Myrtle abv Frozen Ck | A | UBWC | 2970 |
| SU43.2 | Slide Ck abv Riser Ck | A | BLM | 915 |
| SU43.4 | Riser Ck near mouth | A | BLM | 913 |
| SU43.6 | Upper N Myrtle Ck | A | BLM | 920 |
| SU44 | Louis Ck @ mouth | A | UBWC | 2964 |
| SU44.5 | Upper Louis Ck | A | BLM | 909 |
| SU45 | S Myrtle abv Louis Ck | A | UBWC | 2965 |
| SU46 | Weaver Ck @ mouth | C | UBWC | 2966 |
| SU46.5 | Upper Weaver Ck | A | BLM | 923 |
| SU47 | S Myrtle abv Weaver | A | UBWC | 2967 |
| SU47.5 | Johnson Ck @ mouth | A | BLM | 906 |
| SU47.8 | Upper S Myrtle Ck | A | BLM | 922 |
| SU48 | Lane Ck @ mouth | A | UBWC | 2962 |
| SU49 | S Umpqua abv Lane Ck | A | UBWC | 2963 |
| SU50 | Canyon Ck @ mouth | A | UBWC | 2956 |
| SU50.2 | W Fork Canyon Ck | A | BLM | 924 |
| SU50.5 | Upper Canyon Ck | A | BLM | 901 |

| Site # | Site Name | Condition Category | Collecting Agency | File # |
|---|---|---|---|---|
| SU51 | S Umpqua abv Canyon Ck | A | UBWC | 2957 |
| SU52 | O' Shea Ck @ mouth | A | UBWC | 2958 |
| SU53 | S Umpqua @ Packard Gulch | A | UBWC | 2955 |
| SU54 | Days Ck @ mouth | A | UBWC | 2952 |
| SU55 | S Ump Alcove abv Days Ck | A | UBWC | 2954 |
| SU56 | S Umpqua abv Days ck | A | UBWC | 2953 |
| SU57 | Fate Ck @ mouth | A | UBWC | 2950 |
| SU57.5 | Upper Fate Ck | A | BLM | 905 |
| SU58 | Days Ck abv Fate Ck | A | UBWC | 2951 |
| SU59 | Days Ck (upper) | A | UBWC | 2949 |
| SU59.5 | Upper Days Ck | A | BLM | 921 |
| SU60 | S Umpqua blw Beals Ck | A | UBWC | 2948 |
| SU60.1 | Upper Shively Ck | A | BLM | 914 |
| SU60.2 | Poole Ck near mouth | A | BLM | 911 |
| SU60.5 | Lavadoure Ck near mouth | A | BLM | 908 |
| SU61 | St. John Ck near mouth | A | UBWC | 2947 |
| SU61.5 | Upper St. John Ck | A | BLM | 916 |
| SU62 | Stouts Ck near mouth | A | UBWC | 2946 |
| SU62.2 | E Fork Stouts Ck | A | BLM | 904 |
| SU62.4 | Stouts Ck abv E Fork | A | BLM | 917 |
| SU63 | Corn Ck near mouth | A | UBWC | 2945 |
| SU64 | Coffee Ck near mouth | A | UBWC | 2934 |
| SU64.5 | Upper Coffee Ck | | BLM | 902 |
| SU65 | S Umpqua abv Coffee Ck | C | UBWC | 2944 |
| SU66 | S Umpqua u/s Smolt Trap | A | DEQ | 6198 |
| SU67 | Jackson Ck u/s Beaver Ck | A | DEQ | 7017 |
| SU68 | Jackson Ck u/s Squaw Ck | A | DEQ | 7016 |
| SU69 | Jackson Ck u/s Twomile Ck | A | DEQ | 7011 |
| SU70 | Falcon Ck @ mouth | A | DEQ | 7013 |
| SU71 | Jackson Ck u/s Falcon Ck | A | DEQ | 7012 |
| SU72 | Lonewoman Ck @ mouth | A | DEQ | 7015 |
| SU73 | Jackson Ck u/s Lonewoman | A | DEQ | 7014 |
| SU74 | S Umpqua u/s Dumont | A | DEQ | 7007 |
| SU75 | S Umpqua u/s Boulder Ck | A | DEQ | 7009 |
| SU76 | S Umpqua u/s Ash Ck | A | DEQ | 7018 |
| SU77 | S Umpqua u/s Quartz Ck | A | DEQ | 7008 |
| SU78 | Black Rock Fork @ mouth (2) | A | DEQ | 7010 |
| SU80 | S Umpqua abv Elk | C | USFS | 70001 |
| SU81 | Elk Ck @ Tiller | A | USFS | 40001 |
| SU82 | Jackson Ck @ mouth | A | USFS | 50002 |

| Site # | Site Name | Condition Category | Collecting Agency | File # |
|---|---|---|---|---|
| SU82.5 | Beaver Ck near mouth | A | USFS | 50003 |
| SU83 | Squaw Ck @ mouth | A | USFS | 50004 |
| SU84 | Deadman Ck @ mouth | A | USFS | 70008 |
| SU84.2 | W Fork Deadman Ck | A | BLM | 903 |
| SU84.4 | Middle Fork Deadman Ck | A | BLM | 910 |
| SU85 | Dumont Ck @ mouth | A | USFS | 70002 |
| SU86 | Boulder Ck @ mouth | A | USFS | 70003 |
| SU87 | Buckeye Ck @ mouth | A | USFS | 60004 |
| SU88 | S Umpqua @ S Umpqua Falls | A | USFS | 60005 |
| SU89 | Quartz Ck @ mouth | A | USFS | 60003 |
| SU90 | Castle Rock Fork @ mouth | A | USFS | 60001 |
| SU91 | Black Rock Fork @ mouth | A | USFS | 60002 |
| SUAIR | Air Temperature @ Mouth N Myrtle | A | UBWC | 2968 |
| SUX | Myrtle Ck Bucket Test | A | UBWC | 2988 |

## Preliminary Analysis

### Seasonal Patterns

Each year the summer weather patterns cause a unique characteristic temperature pattern that is generally apparent in all of the stream temperature data within a river basin. Chart 4 compares the 1998 and 1999 results at a site in the Elk Creek watershed. Notice that the maximum values for this site were over 5 degrees warmer in 1998 and that 1999 had a relatively flat temperature profile. The flat shape of the 1999 pattern resulted in more variability in the dates of the seasonal maximum temperatures for the various sites.

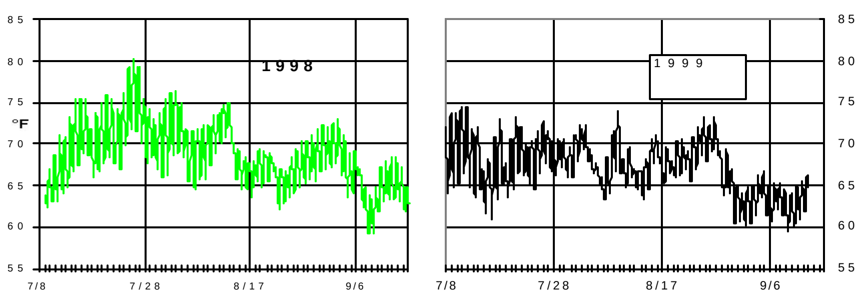



***Chart 4 Comparison of 1998 and 1999 seasonal patterns for central Douglas County. (Data from Pass Creek @ mouth /Elk Creek***

The difference in the seasonal maximums that is apparent in Chart 4 demonstrates the value of same-year synoptic studies. Any direct comparison of data from different years would need to account for this between-year variability.

Chart 5 shows typical patterns for the 1999 maximum temperature season for two sites in the South Umpqua River watershed. Notice the similarity of the data with the 1999 data in Chart 4 from the Elk Creek watershed.

Analysis of the similarities and differences of these data records can provide some insight to the processes and conditions that are influencing stream temperature. Some basic statistics are needed to summarize the data in a meaningful way.

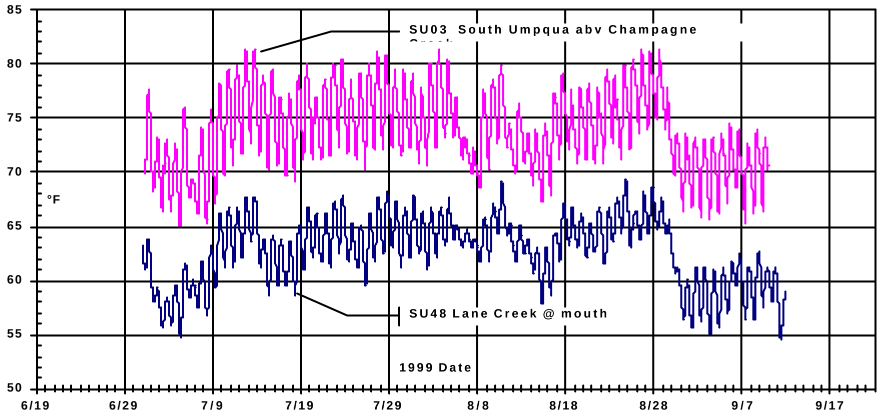



***Chart 5 Typical 1999 stream temperature data from the South Umpqua watershed.***

## Site Temperature Statistics

Table 2 lists the seasonal statistics generated by the DEQ Temperature Analysis Macro Version 1.1, which was applied to the sites with a complete seasonal record as identified in Table 1. Chart 6 provides a visual comparison of the seasonal maximum, 7-day maximum and ΔT statistics

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**Notes to Table 2 and Chart 6:**

- Statistics were developed only for the 109 sites that had a complete record between 7/15 and 8/30.
- The seasonal maximum value is the highest daily temperature measured at a site.
- The maximum ΔT (Delta T) represents the largest difference between the daily maximum and minimum for the site.
- The 7-day maximum is the seasonal maximum of the 7-day running average of the daily maximum values. This statistic blends a time duration factor with the maximum value and is part of the State criteria for stream temperatures.
- The "SUAir" entry is air temperature measured at site SU 41 (Mouth of North Myrtle Creek).
- The SUX is the temperature of water in a 10" dia. metal pail also located at site SU 41.
- The Seasonal maximums from the various sites (excluding SUAIR and SUX) ranged between 90.2 and 52.5 with an average of 70.6 °F.
- The 7-day maximums lagged the seasonal maximums by an average of 1.4 °F with a maximum difference of 5.2 °F.
- The maximum ΔT value ranged from 21.5 to 3.6 with an average of 9.9 °F.

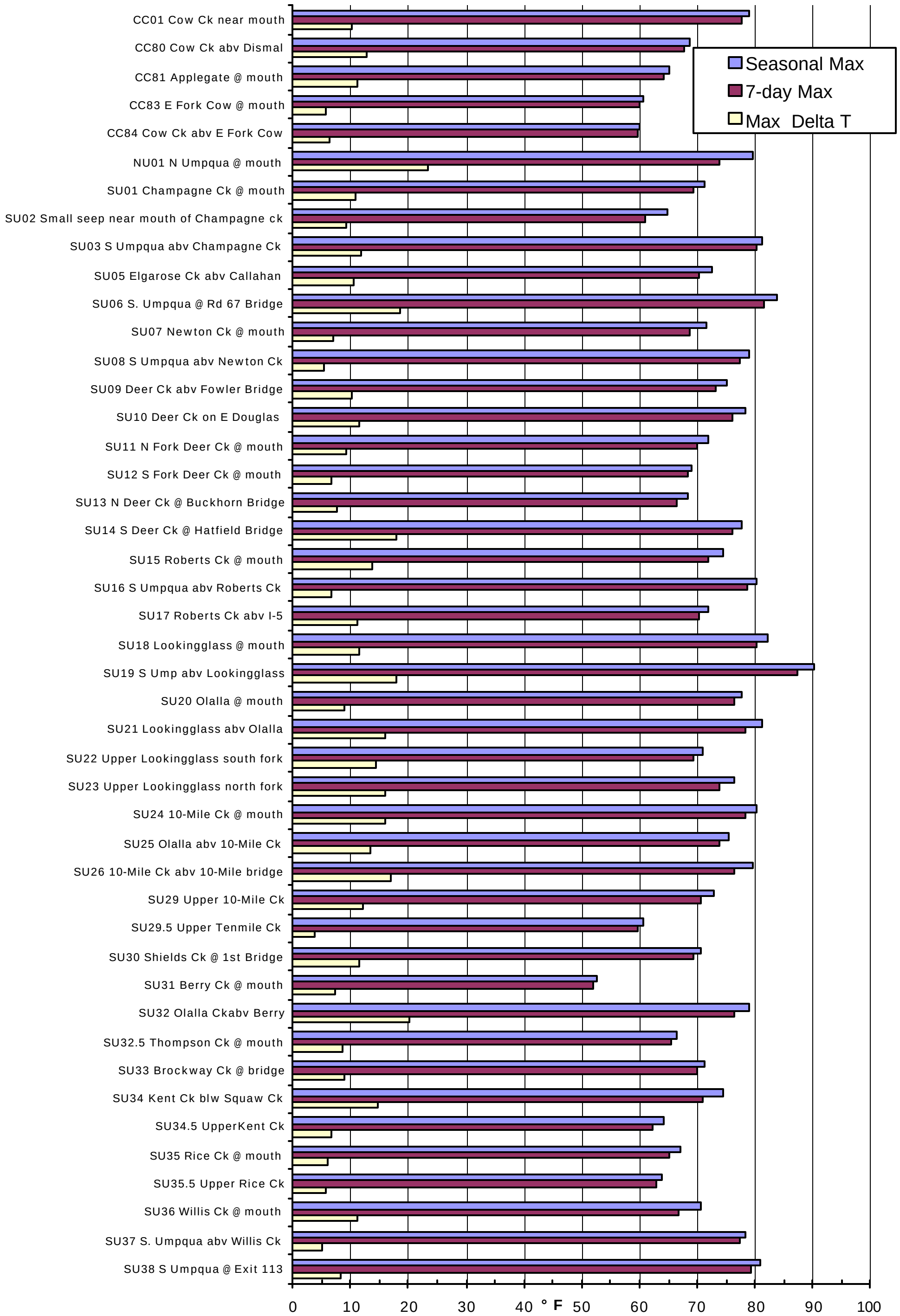
Table 2 Seasonal Statistical Summary

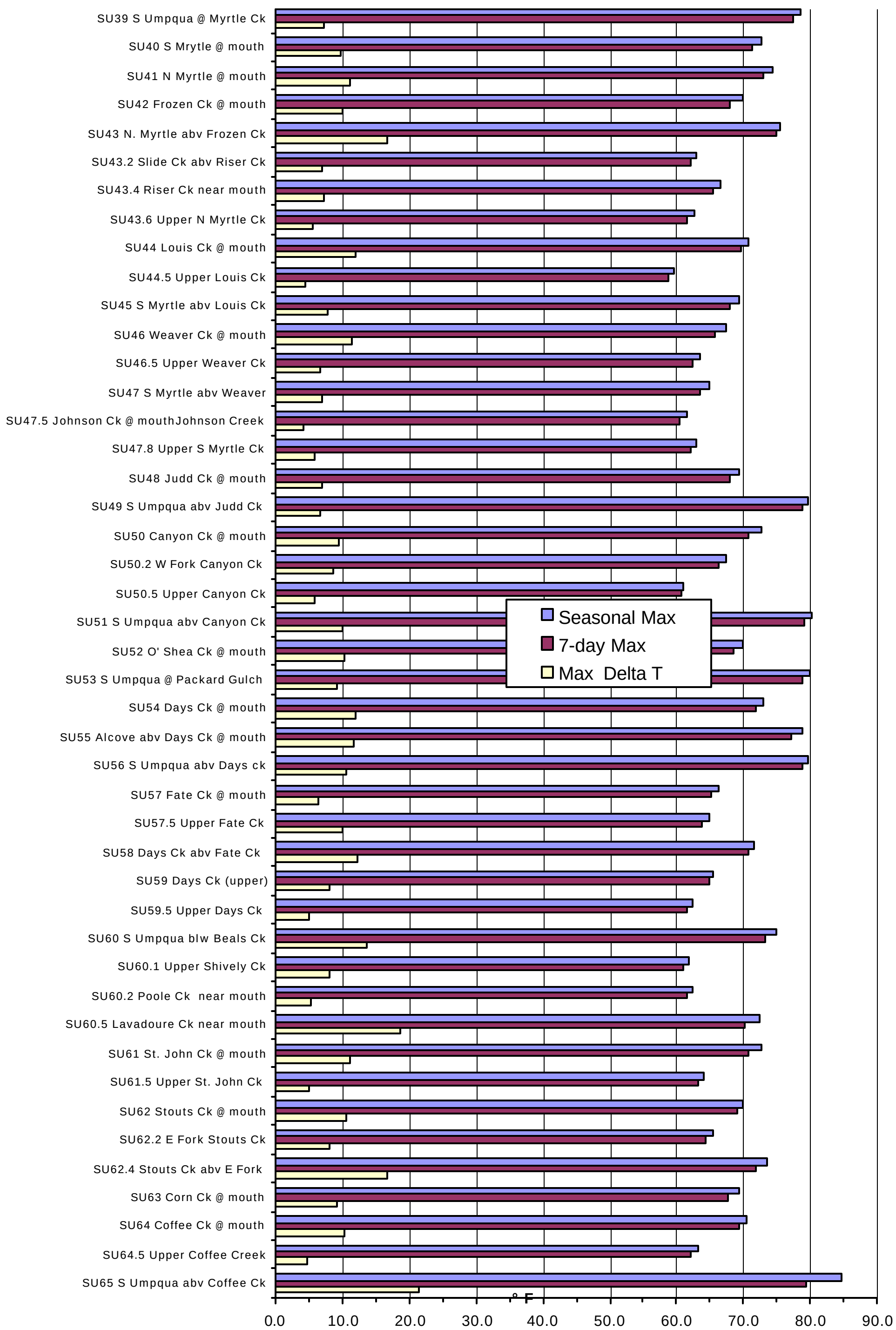
| Site Name | Start Date | Stop date | Seasonal Maximum |  | Seasonal Minimum |  | Seasonal Max ΔT |  | 7-Day averages |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | Date | Value | Date | Value | Date | Value | Date | Maximum | Minimum | ΔT |
| CC01 Cow Ck near mouth | 07/01/99 | 09/13/99 | 07/13/99 | 78.8 | 09/03/99 | 61.0 | 07/05/99 | 10.2 | 07/12/99 | 77.6 | 69.0 | 8.6 |
| CC80 Cow Ck abv Dismal | 06/18/99 | 10/02/99 | 08/04/99 | 68.8 | 09/28/99 | 43.4 | 07/05/99 | 12.6 | 07/29/99 | 67.8 | 56.9 | 10.9 |
| CC81 Applegate @ mouth | 06/18/99 | 10/02/99 | 08/10/99 | 65.2 | 09/28/99 | 43.8 | 07/05/99 | 11.2 | 07/30/99 | 64.2 | 56.2 | 8.1 |
| CC83 E Fork Cow @ mouth | 06/17/99 | 10/02/99 | 08/28/99 | 60.7 | 09/28/99 | 44.2 | 07/05/99 | 5.6 | 08/26/99 | 59.9 | 57.0 | 2.9 |
| CC84 Cow Ck abv E Fork Cow | 06/18/99 | 10/02/99 | 08/28/99 | 60.2 | 09/28/99 | 44.8 | 07/05/99 | 6.4 | 08/26/99 | 59.5 | 56.7 | 2.9 |
| SU03 S Umpqua abv Champagne C | 06/24/99 | 09/09/99 | 08/28/99 | 81.4 | 06/27/99 | 63.9 | 06/29/99 | 11.7 | 08/25/99 | 80.3 | 72.7 | 7.6 |
| SU05 Elgarose Ck abv Callahan | 06/24/99 | 08/30/99 | 08/28/99 | 72.5 | 07/05/99 | 55.4 | 07/09/99 | 10.4 | 07/12/99 | 70.3 | 61.4 | 9.0 |
| SU08 S Umpqua abv Newton Ck | 07/01/99 | 09/14/99 | 08/28/99 | 78.9 | 09/12/99 | 64.7 | 08/30/99 | 5.4 | 08/26/99 | 77.5 | 73.6 | 3.9 |
| SU09 Deer Ck abv Fowler Bridge | 07/01/99 | 09/09/99 | 07/13/99 | 75.0 | 09/03/99 | 57.4 | 07/09/99 | 10.3 | 07/12/99 | 73.3 | 64.4 | 8.9 |
| SU10 Deer Ck on E Douglas | 07/01/99 | 09/09/99 | 07/13/99 | 78.3 | 07/05/99 | 58.5 | 07/09/99 | 11.5 | 07/31/99 | 76.2 | 66.9 | 9.3 |
| SU11 N Fork Deer Ck @ mouth | 07/01/99 | 09/09/99 | 08/10/99 | 71.8 | 09/03/99 | 56.0 | 07/09/99 | 9.2 | 08/26/99 | 70.0 | 65.2 | 4.9 |
| SU13 N Deer Ck @ Buckhorn Bridg | 07/01/99 | 09/09/99 | 08/28/99 | 68.2 | 07/05/99 | 52.6 | 07/05/99 | 7.6 | 08/26/99 | 66.4 | 62.5 | 3.9 |
| SU14 S Deer Ck @ Hatfield Bridge | 07/01/99 | 09/09/99 | 07/12/99 | 77.8 | 07/05/99 | 53.9 | 07/09/99 | 17.8 | 07/31/99 | 76.1 | 62.0 | 14.2 |
| SU15 Roberts Ck @ mouth | 07/01/99 | 09/15/99 | 07/13/99 | 74.4 | 07/05/99 | 56.1 | 07/05/99 | 13.8 | 07/11/99 | 72.0 | 62.8 | 9.2 |
| SU16 S Umpqua abv Roberts Ck | 07/01/99 | 09/15/99 | 07/13/99 | 80.1 | 09/11/99 | 65.9 | 09/07/99 | 6.8 | 07/26/99 | 78.8 | 73.8 | 5.0 |
| SU17 Roberts Ck abv I-5 | 07/01/99 | 09/02/99 | 07/10/99 | 72.1 | 09/02/99 | 55.9 | 07/05/99 | 11.2 | 07/11/99 | 70.3 | 62.6 | 7.7 |
| SU18 Lookingglass @ mouth | 06/24/99 | 09/15/99 | 07/13/99 | 82.3 | 09/11/99 | 62.6 | 06/29/99 | 11.6 | 07/12/99 | 80.2 | 71.1 | 9.2 |
| SU19 S Ump abv Lookingglass | 06/24/99 | 09/15/99 | 08/25/99 | 90.2 | 08/31/99 | 62.5 | 08/25/99 | 18.1 | 08/25/99 | 87.3 | 72.5 | 14.8 |
| SU20 Olalla @ mouth | 06/24/99 | 09/15/99 | 07/12/99 | 77.7 | 07/05/99 | 60.5 | 07/05/99 | 9.0 | 07/12/99 | 76.3 | 70.1 | 6.2 |
| SU21 Lookingglass abv Olalla | 06/24/99 | 09/15/99 | 07/13/99 | 81.2 | 06/27/99 | 56.4 | 07/18/99 | 16.2 | 07/13/99 | 78.4 | 63.7 | 14.6 |
| SU22 Upper Lookingglass south for | 06/24/99 | 09/15/99 | 08/24/99 | 71.0 | 09/11/99 | 50.7 | 07/09/99 | 14.3 | 07/12/99 | 69.3 | 57.0 | 12.3 |
| SU24 10-Mile Ck @ mouth | 06/24/99 | 09/15/99 | 07/13/99 | 80.4 | 07/05/99 | 55.9 | 07/05/99 | 15.9 | 07/12/99 | 78.2 | 63.9 | 14.3 |
| SU25 Olalla abv 10-Mile Ck | 06/24/99 | 09/15/99 | 07/12/99 | 75.4 | 09/11/99 | 53.7 | 07/09/99 | 13.4 | 07/12/99 | 73.8 | 62.2 | 11.6 |
| SU26 10-Mile Ck abv 10-Mile bridge | 06/24/99 | 09/15/99 | 08/10/99 | 79.6 | 07/05/99 | 53.5 | 07/18/99 | 16.8 | 07/12/99 | 76.3 | 60.8 | 15.5 |
| SU29.5 Upper Tenmile Ck | 06/19/99 | 10/13/99 | 08/28/99 | 60.6 | 09/28/99 | 48.1 | 07/26/99 | 3.6 | 08/26/99 | 59.8 | 57.8 | 2.1 |
| SU30 Shields Ck @ 1st Bridge | 07/01/99 | 09/15/99 | 07/13/99 | 70.7 | 09/11/99 | 50.7 | 07/05/99 | 11.6 | 07/12/99 | 69.2 | 59.1 | 10.1 |
| SU31 Berry Ck @ mouth | 07/01/99 | 09/15/99 | 07/09/99 | 52.5 | 07/05/99 | 44.7 | 07/09/99 | 7.3 | 07/10/99 | 52.0 | 45.5 | 6.5 |
| SU32 Olalla Ckabv Berry | 07/01/99 | 09/15/99 | 08/10/99 | 78.9 | 07/05/99 | 54.0 | 07/05/99 | 20.2 | 07/11/99 | 76.5 | 64.5 | 12.0 |
| SU32.5 Thompson Ck @ mouth | 06/15/99 | 10/13/99 | 07/13/99 | 66.5 | 10/03/99 | 43.7 | 07/09/99 | 8.5 | 07/12/99 | 65.3 | 58.1 | 7.2 |
| SU33 Brockway Ck @ bridge | 06/24/99 | 09/15/99 | 08/28/99 | 71.4 | 09/11/99 | 53.3 | 09/04/99 | 8.8 | 08/01/99 | 69.9 | 63.5 | 6.4 |
| SU34 Kent Ck blw Squaw Ck | 06/24/99 | 07/23/99 | 07/23/99 | 74.4 | 07/05/99 | 51.6 | 06/30/99 | 14.8 | 07/12/99 | 70.9 | 59.3 | 11.6 |
| SU34.5 UpperKent Ck | 06/09/99 | 10/06/99 | 08/28/99 | 64.2 | 09/28/99 | 46.8 | 06/11/99 | 6.7 | 08/26/99 | 62.4 | 58.6 | 3.8 |
| SU35 Rice Ck @ mouth | 06/24/99 | 09/15/99 | 08/10/99 | 67.0 | 09/11/99 | 55.3 | 07/26/99 | 6.0 | 08/26/99 | 65.3 | 62.3 | 2.9 |
| SU35.5 Upper Rice Ck | 06/09/99 | 10/06/99 | 08/28/99 | 63.9 | 09/28/99 | 47.3 | 06/11/99 | 5.9 | 08/26/99 | 62.8 | 58.9 | 3.9 |
| SU36 Willis Ck @ mouth | 06/24/99 | 07/08/99 | 06/30/99 | 70.7 | 07/05/99 | 55.2 | 07/05/99 | 11.1 | 06/28/99 | 66.8 | 58.5 | 8.3 |
| SU37 S. Umpqua abv Willis Ck | 07/26/99 | 09/15/99 | 08/03/99 | 78.3 | 09/11/99 | 65.7 | 08/09/99 | 5.1 | 07/31/99 | 77.3 | 73.3 | 4.0 |
| SU38 S Umpqua @ Exit 113 | 07/01/99 | 09/15/99 | 08/28/99 | 80.9 | 09/11/99 | 64.4 | 08/17/99 | 8.2 | 08/25/99 | 79.3 | 73.0 | 6.4 |
| SU39 S Umpqua @ Myrtle Ck | 07/01/99 | 09/13/99 | 07/13/99 | 78.6 | 07/07/99 | 62.8 | 07/19/99 | 7.3 | 07/31/99 | 77.5 | 72.4 | 5.1 |
| SU40 S Mrytle @ mouth | 07/01/99 | 09/13/99 | 08/28/99 | 72.7 | 09/11/99 | 54.5 | 08/16/99 | 9.8 | 08/26/99 | 71.4 | 65.1 | 6.3 |
| SU41 N Myrtle @ mouth | 07/01/99 | 09/13/99 | 08/28/99 | 74.3 | 09/11/99 | 54.7 | 08/16/99 | 11.3 | 08/25/99 | 73.1 | 64.9 | 8.2 |
| SU42 Frozen Ck @ mouth | 07/01/99 | 09/13/99 | 08/28/99 | 70.0 | 07/05/99 | 52.3 | 07/05/99 | 10.1 | 08/25/99 | 68.0 | 61.9 | 6.1 |
| SU43 N. Myrtle abv Frozen Ck | 07/01/99 | 09/13/99 | 08/03/99 | 75.6 | 07/05/99 | 54.1 | 07/05/99 | 16.6 | 07/31/99 | 74.8 | 61.6 | 13.2 |
| SU43.2 Slide Ck abv Riser Ck | 06/08/99 | 10/17/99 | 08/10/99 | 63.0 | 10/17/99 | 41.7 | 06/10/99 | 7.0 | 07/31/99 | 62.0 | 57.1 | 5.0 |
| SU43.4 Riser Ck near mouth | 06/08/99 | 10/17/99 | 08/10/99 | 66.5 | 10/17/99 | 42.4 | 06/11/99 | 7.3 | 07/12/99 | 65.4 | 59.6 | 5.8 |
| SU43.6 Upper N Myrtle Ck | 06/10/99 | 10/17/99 | 08/28/99 | 62.7 | 10/17/99 | 42.3 | 07/18/99 | 5.6 | 08/26/99 | 61.5 | 58.1 | 3.4 |
| SU44 Louis Ck @ mouth | 07/01/99 | 09/13/99 | 08/28/99 | 70.8 | 07/05/99 | 52.4 | 07/05/99 | 11.9 | 08/25/99 | 69.7 | 62.2 | 7.5 |
| SU44.5 Upper Louis Ck | 06/08/99 | 10/17/99 | 08/28/99 | 59.5 | 10/16/99 | 43.6 | 07/05/99 | 4.5 | 08/26/99 | 58.7 | 56.6 | 2.1 |
| SU45 S Myrtle abv Louis Ck | 07/01/99 | 09/13/99 | 08/28/99 | 69.4 | 07/05/99 | 52.8 | 07/05/99 | 7.9 | 08/26/99 | 68.0 | 63.2 | 4.8 |
| SU46.5 Upper Weaver Ck | 06/04/99 | 10/04/99 | 08/28/99 | 63.6 | 06/09/99 | 44.3 | 07/05/99 | 6.7 | 08/26/99 | 62.5 | 58.5 | 4.0 |
| SU47 S Myrtle abv Weaver | 07/01/99 | 09/13/99 | 08/28/99 | 64.9 | 07/05/99 | 50.2 | 07/05/99 | 7.0 | 08/26/99 | 63.5 | 60.2 | 3.3 |
| SU47.5 Johnson Ck @ mouthJohns | 06/04/99 | 10/04/99 | 08/28/99 | 61.5 | 06/09/99 | 45.0 | 06/11/99 | 4.2 | 08/26/99 | 60.5 | 58.7 | 1.8 |
| SU47.8 Upper S Myrtle Ck | 06/04/99 | 10/04/99 | 08/28/99 | 63.0 | 06/09/99 | 44.7 | 07/05/99 | 5.9 | 08/25/99 | 62.1 | 58.9 | 3.1 |
| SU48 Judd Ck @ mouth | 07/01/99 | 09/13/99 | 08/24/99 | 69.4 | 09/11/99 | 54.5 | 07/09/99 | 6.9 | 08/26/99 | 68.1 | 63.9 | 4.2 |
| SU49 S Umpqua abv Judd Ck | 07/01/99 | 09/13/99 | 07/28/99 | 79.7 | 07/05/99 | 62.9 | 07/28/99 | 6.8 | 07/31/99 | 78.7 | 72.5 | 6.2 |
| SU50 Canyon Ck @ mouth | 06/30/99 | 09/13/99 | 08/28/99 | 72.6 | 07/05/99 | 54.2 | 07/09/99 | 9.5 | 08/26/99 | 70.8 | 65.2 | 5.5 |
| SU50.2 W Fork Canyon Ck | 06/10/99 | 10/04/99 | 08/28/99 | 67.3 | 10/03/99 | 46.2 | 07/05/99 | 8.7 | 08/26/99 | 66.3 | 61.8 | 4.6 |
| SU50.5 Upper Canyon Ck | 06/10/99 | 10/04/99 | 08/28/99 | 61.1 | 06/10/99 | 48.5 | 06/10/99 | 5.9 | 08/25/99 | 60.6 | 57.3 | 3.3 |
| SU51 S Umpqua abv Canyon Ck | 07/01/99 | 09/13/99 | 08/03/99 | 80.1 | 07/05/99 | 60.7 | 08/16/99 | 10.1 | 07/31/99 | 79.0 | 70.2 | 8.8 |
| SU52 O' Shea Ck @ mouth | 07/01/99 | 09/13/99 | 08/28/99 | 69.8 | 07/05/99 | 52.8 | 07/05/99 | 10.4 | 08/26/99 | 68.4 | 63.5 | 4.9 |
| SU53 S Umpqua @ Packard Gulch | 06/24/99 | 09/13/99 | 08/25/99 | 79.8 | 06/27/99 | 57.8 | 07/09/99 | 9.2 | 08/25/99 | 78.8 | 72.8 | 6.0 |
| SU54 Days Ck @ mouth | 06/24/99 | 08/30/99 | 08/28/99 | 73.0 | 06/27/99 | 53.7 | 07/05/99 | 12.0 | 08/25/99 | 71.8 | 64.5 | 7.3 |
| SU55 Alcove abv Days Ck @ mouth | 06/24/99 | 09/13/99 | 07/13/99 | 78.8 | 09/11/99 | 56.5 | 07/13/99 | 11.8 | 07/13/99 | 77.2 | 65.9 | 11.3 |
| SU56 S Umpqua abv Days ck | 06/24/99 | 09/13/99 | 08/03/99 | 79.6 | 06/27/99 | 57.8 | 07/18/99 | 10.5 | 07/31/99 | 78.9 | 70.0 | 8.8 |
| SU57 Fate Ck @ mouth | 06/24/99 | 09/13/99 | 08/28/99 | 66.2 | 06/27/99 | 51.2 | 07/09/99 | 6.5 | 08/26/99 | 65.3 | 61.2 | 4.0 |
| SU57.5 Upper Fate Ck | 04/24/99 | 10/04/99 | 08/28/99 | 64.8 | 09/28/99 | 44.4 | 04/24/99 | 10.0 | 08/25/99 | 63.6 | 57.1 | 6.6 |
| SU58 Days Ck abv Fate Ck | 06/24/99 | 09/13/99 | 08/28/99 | 71.6 | 09/11/99 | 53.5 | 07/05/99 | 12.3 | 08/25/99 | 70.8 | 62.5 | 8.3 |
| SU59 Days Ck (upper) | 06/24/99 | 09/13/99 | 08/10/99 | 65.4 | 06/27/99 | 52.1 | 07/05/99 | 8.2 | 07/29/99 | 64.8 | 59.3 | 5.5 |
| SU59.5 Upper Days Ck | 04/24/99 | 10/04/99 | 08/28/99 | 62.5 | 05/09/99 | 40.6 | 05/05/99 | 5.0 | 08/26/99 | 61.7 | 60.2 | 1.5 |
| SU60 S Umpqua blw Beals Ck | 06/24/99 | 09/13/99 | 08/25/99 | 74.9 | 07/18/99 | 56.1 | 08/15/99 | 13.7 | 08/23/99 | 73.3 | 62.5 | 10.8 |
| SU60.1 Upper Shively Ck | 04/23/99 | 10/05/99 | 08/28/99 | 61.9 | 04/28/99 | 42.7 | 04/23/99 | 8.0 | 08/26/99 | 61.0 | 57.5 | 3.5 |
| SU60.2 Poole Ck near mouth | 06/30/99 | 10/05/99 | 08/28/99 | 62.4 | 09/28/99 | 46.7 | 07/18/99 | 5.3 | 08/26/99 | 61.5 | 58.6 | 2.9 |
| SU60.5 Lavadoure Ck near mouth | 04/23/99 | 10/03/99 | 06/14/99 | 72.4 | 05/16/99 | 45.2 | 05/23/99 | 18.6 | 07/12/99 | 70.3 | 58.8 | 11.5 |
| SU61 St. John Ck @ mouth | 06/24/99 | 09/13/99 | 08/28/99 | 72.8 | 06/27/99 | 50.7 | 08/02/99 | 11.2 | 08/25/99 | 70.6 | 61.5 | 9.2 |

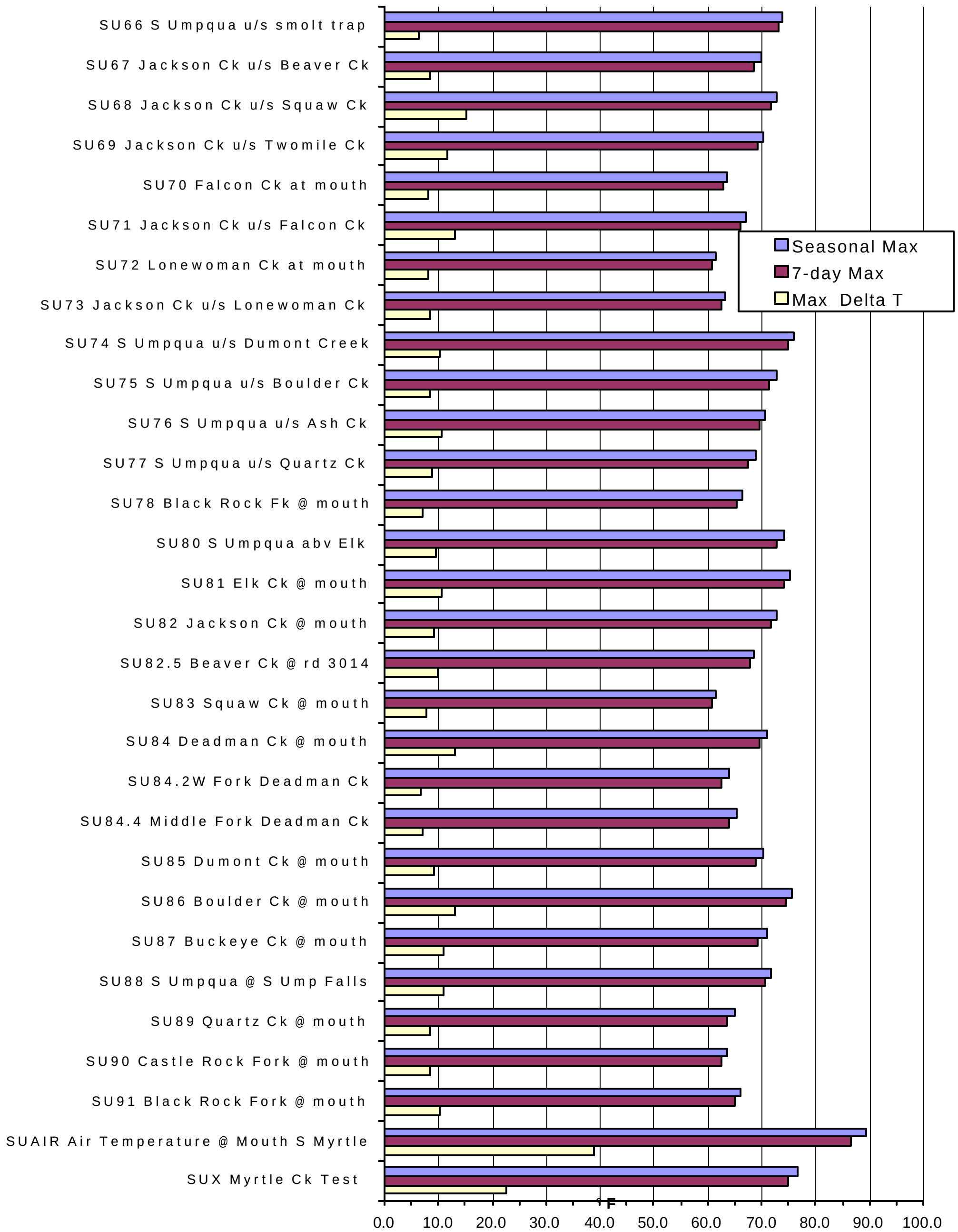
| Site Name | Lat | Long | Days > 55 F | Days > 64 F | Days > 70 F | Hours > 55 F | Hours > 64 F | Hours > 70 F | Warmest day of 7-day max Date | Maximum | Minimum | Agency |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CC01 Cow Ck near mouth | 42 56 34.51 | 123 20 9.36 | 75 | 75 | 57 | 1799.5 | 1678.5 | 979.5 | 07/12/99 | 78.8 | 69.6 | UBWC |
| CC80 Cow Ck abv Dismal | 42 48 48.12 | 123 03 2.01 | 100 | 44 | 0 | 1802.0 | 214.0 | 0.0 | 07/27/99 | 68.5 | 57.3 | FS |
| CC81 Applegate @ mouth | 42 48 52.4 | 123 01 47.3 | 100 | 13 | 0 | 1738.0 | 53.0 | 0.0 | 07/27/99 | 65.2 | 56.4 | FS |
| CC83 E Fork Cow @ mouth | 42 48 11.24 | 122 59 22.8 | 58 | 0 | 0 | 940.0 | 0.0 | 0.0 | 08/28/99 | 60.7 | 57.9 | FS |
| CC84 Cow Ck abv E Fork Cow | 42 48 10.07 | 122 59 23.7 | 62 | 0 | 0 | 943.0 | 0.0 | 0.0 | 08/28/99 | 60.2 | 57.3 | FS |
| SU03 S Umpqua abv Champagne C | 43 15 44.86 | 123 26 58.3 | 78 | 78 | 78 | 1871.5 | 1869.5 | 1535.5 | 08/26/99 | 81.4 | 73.6 | UBWC |
| SU05 Elgarose Ck abv Callahan | 43 14 0.47 | 123 28 54.8 | 68 | 51 | 8 | 1631.5 | 608.0 | 34.0 | 07/12/99 | 72.2 | 62.5 | UBWC |
| SU08 S Umpqua abv Newton Ck | 43 13 21.84 | 123 23 2.23 | 76 | 76 | 71 | 1823.5 | 1823.5 | 1384.5 | 08/28/99 | 78.9 | 74.8 | UBWC |
| SU09 Deer Ck abv Fowler Bridge | 43 12 45.61 | 123 20 19.8 | 71 | 71 | 44 | 1703.5 | 1328.0 | 357.0 | 07/12/99 | 75.0 | 65.4 | UBWC |
| SU10 Deer Ck on E Douglas | 123 18 27.4 | 43 12 33.23 | 71 | 71 | 51 | 1703.5 | 1476.0 | 599.5 | 08/03/99 | 77.7 | 67.1 | UBWC |
| SU11 N Fork Deer Ck @ mouth | 43 12 7.46 | 123 14 25.9 | 71 | 57 | 11 | 1703.5 | 941.0 | 44.5 | 08/28/99 | 70.9 | 67.1 | UBWC |
| SU13 N Deer Ck @ Buckhorn Bridg | 43 12 19.09 | 123 10 49.1 | 71 | 32 | 0 | 1658.5 | 258.5 | 0.0 | 08/28/99 | 68.2 | 64.5 | UBWC |
| SU14 S Deer Ck @ Hatfield Bridge | 43 10 8.25 | 123 14 43.2 | 71 | 70 | 54 | 1696.5 | 1031.5 | 394.5 | 07/28/99 | 77.2 | 61.5 | UBWC |
| SU15 Roberts Ck @ mouth | 43 9 59.41 | 123 22 27.0 | 77 | 69 | 25 | 1847.5 | 1045.0 | 134.5 | 07/13/99 | 74.4 | 66.1 | UBWC |
| SU16 S Umpqua abv Roberts Ck | 43 10 1.02 | 123 22 32.0 | 77 | 77 | 77 | 1847.5 | 1847.5 | 1525.0 | 07/28/99 | 79.8 | 73.9 | UBWC |
| SU17 Roberts Ck abv I-5 | 43 7 38.94 | 123 21 44.8 | 64 | 56 | 5 | 1535.5 | 652.0 | 26.0 | 07/10/99 | 72.1 | 63.0 | UBWC |
| SU18 Lookingglass @ mouth | 43 7 2.95 | 123 25 37.0 | 84 | 84 | 78 | 2015.5 | 1984.5 | 1305.5 | 07/13/99 | 82.3 | 73.8 | UBWC |
| SU19 S Ump abv Lookingglass | 43 7 2.21 | 123 25 38.1 | 84 | 84 | 79 | 2015.5 | 1998.0 | 1512.0 | 08/25/99 | 90.2 | 72.2 | UBWC |
| SU20 Olalla @ mouth | 43 9 35.3 | 123 29 36.4 | 84 | 84 | 55 | 2015.5 | 1807.5 | 961.0 | 07/12/99 | 77.7 | 71.3 | UBWC |
| SU21 Lookingglass abv Olalla | 43 9 36.73 | 123 29 36.1 | 84 | 81 | 55 | 2015.5 | 1541.5 | 559.5 | 07/13/99 | 81.2 | 65.5 | UBWC |
| SU22 Upper Lookingglass south for | 43 10 53.44 | 123 33 9.92 | 84 | 56 | 8 | 1798.0 | 580.0 | 18.0 | 07/12/99 | 71.0 | 57.4 | UBWC |
| SU24 10-Mile Ck @ mouth | 43 6 13.47 | 123 31 1.66 | 84 | 83 | 58 | 2015.5 | 1500.0 | 511.5 | 07/13/99 | 80.4 | 65.3 | UBWC |
| SU25 Olalla abv 10-Mile Ck | 43 6 13.22 | 123 31 0.14 | 84 | 69 | 31 | 1984.0 | 853.0 | 193.0 | 07/12/99 | 75.4 | 63.0 | UBWC |
| SU26 10-Mile Ck abv 10-Mile bridge | 43 5 38.13 | 123 34 39.6 | 84 | 77 | 53 | 1985.0 | 1175.0 | 458.5 | 07/13/99 | 78.3 | 62.5 | UBWC |
| SU29.5 Upper Tenmile Ck | 43.14387 | 123.65044 | 72 | 0 | 0 | 1217.0 | 0.0 | 0.0 | 08/28/99 | 60.6 | 58.9 | BLM |
| SU30 Shields Ck @ 1st Bridge | 43 4 15.66 | 123 36 11.8 | 77 | 45 | 2 | 1705.5 | 404.5 | 6.5 | 07/12/99 | 70.7 | 60.0 | UBWC |
| SU31 Berry Ck @ mouth | 43 2 4.84 | 123 32 43.1 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 07/09/99 | 52.5 | 45.3 | UBWC |
| SU32 Olalla Ckabv Berry | 43 2 3.66 | 123 32 42.8 | 77 | 75 | 52 | 1843.5 | 1431.0 | 546.0 | 07/10/99 | 78.3 | 65.0 | UBWC |
| SU32.5 Thompson Ck @ mouth | 42.98904 | 123.55644 | 99 | 18 | 0 | 2025.5 | 84.5 | 0.0 | 07/12/99 | 66.5 | 58.8 | BLM |
| SU33 Brockway Ck @ bridge | 43 6 42.07 | 123 26 28.2 | 84 | 62 | 11 | 2002.5 | 875.5 | 20.5 | 07/31/99 | 70.5 | 63.8 | UBWC |
| SU34 Kent Ck blw Squaw Ck | 43 5 56.6 | 123 26 6.88 | 30 | 20 | 8 | 673.5 | 243.5 | 50.0 | 07/13/99 | 73.8 | 62.6 | UBWC |
| SU34.5 UpperKent Ck | 43.05597 | 123.46844 | 108 | 1 | 0 | 1882.0 | 2.0 | 0.0 | 08/28/99 | 64.2 | 59.6 | BLM |
| SU35 Rice Ck @ mouth | 43 5 1.09 | 123 24 49.3 | 84 | 40 | 0 | 2015.5 | 278.0 | 0.0 | 08/28/99 | 65.8 | 63.5 | UBWC |
| SU35.5 Upper Rice Ck | 43.02274 | 123.46869 | 98 | 0 | 0 | 1822.5 | 0.0 | 0.0 | 08/28/99 | 63.9 | 60.2 | BLM |
| SU36 Willis Ck @ mouth | 43 4 42.44 | 123 23 51.6 | 15 | 9 | 2 | 359.5 | 51.0 | 2.0 | 06/30/99 | 70.7 | 61.1 | UBWC |
| SU37 S. Umpqua abv Willis Ck | 43 4 43.31 | 123 23 50.2 | 52 | 52 | 42 | 1247.5 | 1247.5 | 821.0 | 08/03/99 | 78.3 | 74.0 | UBWC |
| SU38 S Umpqua @ Exit 113 | 43 4 47.64 | 123 21 59.5 | 77 | 77 | 73 | 1847.5 | 1847.5 | 1313.5 | 08/28/99 | 80.9 | 74.1 | UBWC |
| SU39 S Umpqua @ Myrtle Ck | 43 1 26.08 | 123 17 39.4 | 75 | 75 | 57 | 1799.5 | 1768.5 | 1096.5 | 07/28/99 | 78.3 | 72.5 | UBWC |
| SU40 S Mrytle @ mouth | 43 1 23.23 | 123 17 1.26 | 75 | 64 | 25 | 1796.5 | 1030.5 | 147.0 | 08/28/99 | 72.7 | 66.5 | UBWC |
| SU41 N Myrtle @ mouth | 43 1 23.42 | 123 17 0.42 | 75 | 72 | 40 | 1797.0 | 1092.0 | 271.5 | 08/24/99 | 74.3 | 64.6 | UBWC |
| SU42 Frozen Ck @ mouth | 43 4 42.96 | 123 11 33.9 | 75 | 45 | 0 | 1731.0 | 480.0 | 0.0 | 08/28/99 | 70.0 | 64.1 | UBWC |
| SU43 N. Myrtle abv Frozen Ck | 43 4 4197 | 123 11 30.6 | 75 | 73 | 47 | 1795.5 | 1010.0 | 320.5 | 07/28/99 | 75.6 | 61.7 | UBWC |
| SU43.2 Slide Ck abv Riser Ck | 43.10409 | 123.12707 | 103 | 0 | 0 | 1854.5 | 0.0 | 0.0 | 08/03/99 | 62.7 | 57.6 | BLM |
| SU 43.4 Riser Ck near mouth | 43.10865 | 123.12803 | 111 | 45 | 0 | 2463.5 | 308.5 | 0.0 | 07/12/99 | 66.5 | 60.4 | BLM |
| SU43.6 Upper N Myrtle Ck | 43.13733 | 123.12353 | 96 | 0 | 0 | 1607.0 | 0.0 | 0.0 | 08/28/99 | 62.7 | 59.6 | BLM |
| SU44 Louis Ck @ mouth | 43 2 3.59 | 123 8 57.19 | 75 | 55 | 4 | 1722.0 | 582.0 | 10.0 | 08/28/99 | 70.8 | 64.0 | UBWC |
| SU44.5 Upper Louis Ck | 43.10646 | 123.08522 | 65 | 0 | 0 | 935.0 | 0.0 | 0.0 | 08/28/99 | 59.5 | 57.5 | BLM |
| SU45 S Myrtle abv Louis Ck | 43 2 2.84 | 123 8 57.1 | 75 | 39 | 0 | 1727.5 | 440.5 | 0.0 | 08/28/99 | 69.4 | 64.7 | UBWC |
| SU46.5 Upper Weaver Ck | 43.08465 | 123.07171 | 94 | 0 | 0 | 1618.5 | 0.0 | 0.0 | 08/28/99 | 63.6 | 59.6 | BLM |
| SU47 S Myrtle abv Weaver | 43 2 44.65 | 123 3 56.02 | 71 | 1 | 0 | 1422.0 | 7.0 | 0.0 | 08/28/99 | 64.9 | 61.7 | UBWC |
| SU47.5 Johnson Ck @ mouthJohns | 43.08572 | 123.02176 | 85 | 0 | 0 | 1577.5 | 0.0 | 0.0 | 08/28/99 | 61.5 | 59.8 | BLM |
| SU47.8 Upper S Myrtle Ck | 43.08443 | 123.02052 | 98 | 0 | 0 | 1937.5 | 0.0 | 0.0 | 08/28/99 | 63.0 | 60.1 | BLM |
| SU48 Judd Ck @ mouth | 42 58 23.27 | 123 20 46.0 | 75 | 48 | 0 | 1795.5 | 656.0 | 0.0 | 08/24/99 | 69.4 | 64.5 | UBWC |
| SU49 S Umpqua abv Judd Ck | 42 58 22.4 | 123 20 44.1 | 75 | 75 | 57 | 1799.5 | 1787.5 | 1171.5 | 07/28/99 | 79.7 | 72.9 | UBWC |
| SU50 Canyon Ck @ mouth | 42 56 32.48 | 123 16 49.3 | 76 | 57 | 12 | 1818.5 | 905.0 | 52.0 | 08/28/99 | 72.6 | 66.1 | UBWC |
| SU50.2 W Fork Canyon Ck | 42.88334 | 123.26579 | 109 | 41 | 0 | 2384.0 | 366.5 | 0.0 | 07/12/99 | 67.3 | 62.4 | BLM |
| SU 50.5 Upper Canyon Ck | 42.88562 | 123.23856 | 108 | 0 | 0 | 1967.0 | 0.0 | 0.0 | 08/24/99 | 61.1 | 57.4 | BLM |
| SU51 S Umpqua abv Canyon Ck | 42 56 33.23 | 123 16 48.3 | 75 | 75 | 67 | 1799.5 | 1725.0 | 1012.0 | 07/28/99 | 80.1 | 70.2 | UBWC |
| SU52 O' Shea Ck @ mouth | 42 56 25.29 | 123 16 19.1 | 75 | 48 | 0 | 1756.0 | 628.5 | 0.0 | 08/28/99 | 69.8 | 64.3 | UBWC |
| SU53 S Umpqua @ Packard Gulch | 42 58 16.26 | 123 12 48.3 | 82 | 80 | 66 | 1967.5 | 1781.0 | 1089.5 | 08/25/99 | 79.8 | 73.0 | UBWC |
| SU54 Days Ck @ mouth | 42 58 17.62 | 123 10 7.22 | 68 | 61 | 31 | 1622.5 | 928.0 | 166.0 | 08/28/99 | 73.0 | 65.9 | UBWC |
| SU55 Alcove abv Days Ck @ mouth | 42 58 16.57 | 123 10 6.89 | 82 | 71 | 29 | 1967.5 | 958.0 | 162.0 | 07/13/99 | 78.8 | 67.1 | UBWC |
| SU56 S Umpqua abv Days ck | 42 58 16.57 | 123 10 6.89 | 82 | 81 | 60 | 1967.5 | 1772.5 | 994.5 | 07/28/99 | 79.6 | 70.3 | UBWC |
| SU57 Fate Ck @ mouth | 42 59 14.83 | 123 6 6.64 | 82 | 11 | 0 | 1758.5 | 79.5 | 0.0 | 08/28/99 | 66.2 | 62.7 | UBWC |
| SU57.5 Upper Fate Ck | 42.9996 | 123.10185 | 125 | 2 | 0 | 1984.5 | 5.0 | 0.0 | 08/28/99 | 64.8 | 58.8 | BLM |
| SU58 Days Ck abv Fate Ck | 42 59 14.02 | 123 6 6.05 | 82 | 72 | 18 | 1952.5 | 782.0 | 77.0 | 08/24/99 | 71.6 | 62.5 | UBWC |
| SU59 Days Ck (upper) | 43 1 25.56 | 123 2 42.23 | 82 | 18 | 0 | 1886.0 | 69.5 | 0.0 | 07/27/99 | 65.4 | 59.4 | UBWC |
| SU59.5 Upper Days Ck | 43.05389 | 123.00237 | 90 | 0 | 0 | 1725.0 | 0.0 | 0.0 | 08/28/99 | 62.5 | 61.3 | BLM |
| SU60 S Umpqua blw Beals Ck | 42 56 55.29 | 123 10 21.3 | 82 | 74 | 38 | 1967.5 | 920.0 | 138.0 | 08/25/99 | 74.9 | 62.3 | UBWC |
| SU60.1 Upper Shively Ck | 42.90197 | 123.15191 | 90 | 0 | 0 | 1398.0 | 0.0 | 0.0 | 08/28/99 | 61.9 | 58.2 | BLM |
| SU60.2 Poole Ck near mouth | 42.9293 | 123.10803 | 85 | 0 | 0 | 1604.5 | 0.0 | 0.0 | 08/28/99 | 62.4 | 59.5 | BLM |
| SU60.5 Lavadoure Ck near mouth | 42.94968 | 123.10556 | 151 | 93 | 18 | 2938.0 | 843.5 | 46.5 | 07/13/99 | 71.7 | 59.8 | BLM |
| SU61 St. John Ck @ mouth | 42 55 48.47 | 123 3 23.48 | 82 | 47 | 4 | 1770.5 | 408.5 | 15.0 | 08/28/99 | 72.8 | 63.4 | UBWC |

| Site Name | Start Date | Stop date | Seasonal Maximum | | Seasonal Minimum | | Seasonal Max ΔT | | 7-Day averages | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Date | Value | Date | Value | Date | Value | Date | Maximum | Minimum | ΔT |
| SU61.5 Upper St. John Ck | 06/24/99 | 10/05/99 | 08/28/99 | 63.9 | 09/28/99 | 47.7 | 07/05/99 | 5.0 | 08/26/99 | 63.1 | 60.3 | 2.8 |
| SU62 Stouts Ck @ mouth | 06/24/99 | 09/13/99 | 08/28/99 | 69.9 | 09/11/99 | 51.4 | 07/05/99 | 10.7 | 08/25/99 | 69.1 | 61.7 | 7.4 |
| SU62.2 E Fork Stouts Ck | 06/24/99 | 10/05/99 | 08/28/99 | 65.4 | 09/28/99 | 45.7 | 07/05/99 | 8.1 | 08/26/99 | 64.4 | 60.2 | 4.2 |
| SU62.4 Stouts Ck abv E Fork | 06/24/99 | 10/05/99 | 07/12/99 | 73.6 | 09/28/99 | 44.7 | 07/05/99 | 16.8 | 07/12/99 | 71.9 | 58.0 | 13.9 |
| SU63 Corn Ck @ mouth | 06/24/99 | 09/13/99 | 08/28/99 | 69.2 | 06/27/99 | 51.0 | 07/05/99 | 9.2 | 08/25/99 | 67.8 | 61.0 | 6.8 |
| SU64 Coffee Ck @ mouth | 06/24/99 | 09/13/99 | 08/28/99 | 70.6 | 09/03/99 | 51.4 | 07/05/99 | 10.4 | 08/25/99 | 69.2 | 61.7 | 7.5 |
| SU64.5 Upper Coffee Creek | 06/25/99 | 10/26/99 | 08/28/99 | 63.3 | 10/17/99 | 43.0 | 07/05/99 | 4.6 | 08/26/99 | 62.1 | 59.5 | 2.7 |
| SU65 S Umpqua abv Coffee Ck | 06/24/99 | 09/13/99 | 07/20/99 | 84.6 | 06/27/99 | 55.0 | 07/19/99 | 21.5 | 07/17/99 | 79.4 | 63.3 | 16.1 |
| SU67 Jackson Ck u/s Beaver Ck | 06/29/99 | 09/14/99 | 08/04/99 | 70.0 | 07/05/99 | 51.4 | 07/05/99 | 8.5 | 08/01/99 | 68.7 | 63.0 | 5.7 |
| SU68 Jackson Ck u/s Squaw Ck | 06/29/99 | 09/14/99 | 07/28/99 | 72.9 | 07/05/99 | 49.3 | 07/05/99 | 15.1 | 07/31/99 | 71.8 | 59.1 | 12.7 |
| SU69 Jackson Ck u/s Twomile Ck | 06/29/99 | 09/14/99 | 08/04/99 | 70.3 | 07/05/99 | 48.6 | 07/18/99 | 11.7 | 08/01/99 | 69.4 | 58.5 | 10.9 |
| SU70 Falcon Ck at mouth | 06/29/99 | 09/14/99 | 08/28/99 | 63.5 | 07/05/99 | 45.5 | 07/18/99 | 8.3 | 08/01/99 | 62.9 | 55.5 | 7.4 |
| SU71 Jackson Ck u/s Falcon Ck | 06/29/99 | 09/14/99 | 08/04/99 | 67.1 | 07/05/99 | 45.9 | 07/18/99 | 13.0 | 07/29/99 | 66.2 | 54.2 | 12.0 |
| SU72 Lonewoman Ck at mouth | 06/29/99 | 09/14/99 | 08/28/99 | 61.3 | 07/03/99 | 45.1 | 07/18/99 | 8.1 | 08/25/99 | 61.0 | 55.6 | 5.3 |
| SU73 Jackson Ck u/s Lonewoman C | 06/29/99 | 09/14/99 | 08/04/99 | 63.3 | 07/05/99 | 46.4 | 07/18/99 | 8.5 | 08/01/99 | 62.5 | 54.8 | 7.7 |
| SU74 S Umpqua u/s Dumont Creek | 06/29/99 | 09/14/99 | 08/04/99 | 76.1 | 07/04/99 | 52.7 | 07/27/99 | 10.3 | 08/01/99 | 74.8 | 65.0 | 9.7 |
| SU75 S Umpqua u/s Boulder Ck | 06/29/99 | 09/14/99 | 08/04/99 | 72.9 | 07/04/99 | 51.4 | 07/05/99 | 8.6 | 08/01/99 | 71.4 | 65.0 | 6.4 |
| SU76 S Umpqua u/s Ash Ck | 06/29/99 | 09/14/99 | 08/05/99 | 70.5 | 07/04/99 | 50.4 | 07/05/99 | 10.6 | 08/02/99 | 69.6 | 64.3 | 5.3 |
| SU77 S Umpqua u/s Quartz Ck | 06/29/99 | 09/14/99 | 08/04/99 | 68.9 | 07/04/99 | 48.2 | 07/05/99 | 9.0 | 08/01/99 | 67.4 | 59.5 | 7.9 |
| SU78 Black Rock Fk @ mouth | 06/29/99 | 09/14/99 | 08/04/99 | 66.4 | 07/05/99 | 48.7 | 07/05/99 | 7.2 | 08/01/99 | 65.2 | 59.6 | 5.7 |
| SU81 Elk Ck @ mouth | 06/19/99 | 10/02/99 | 08/03/99 | 75.1 | 10/02/99 | 49.8 | 07/05/99 | 10.6 | 08/01/99 | 74.2 | 65.6 | 8.5 |
| SU82 Jackson Ck @ mouth | 06/17/99 | 10/01/99 | 08/04/99 | 72.9 | 09/28/99 | 47.2 | 07/18/99 | 9.2 | 08/01/99 | 71.8 | 63.7 | 8.1 |
| SU82.5 Beaver Ck @ rd 3014 | 06/18/99 | 10/01/99 | 08/28/99 | 68.5 | 09/28/99 | 46.7 | 07/05/99 | 9.8 | 08/01/99 | 67.7 | 59.4 | 8.3 |
| SU83 Squaw Ck @ mouth | 07/03/99 | 10/01/99 | 08/28/99 | 61.5 | 09/28/99 | 45.8 | 07/05/99 | 7.8 | 07/31/99 | 60.9 | 55.0 | 5.9 |
| SU84 Deadman Ck @ mouth | 06/18/99 | 10/01/99 | 08/28/99 | 71.1 | 09/28/99 | 45.8 | 07/05/99 | 13.3 | 07/30/99 | 69.7 | 60.0 | 9.7 |
| SU84.2W Fork Deadman Ck | 06/23/99 | 10/05/99 | 08/28/99 | 63.8 | 09/28/99 | 44.3 | 07/18/99 | 6.9 | 08/26/99 | 62.7 | 59.3 | 3.4 |
| SU84.4 Middle Fork Deadman Ck | 06/23/99 | 10/05/99 | 08/28/99 | 65.4 | 09/28/99 | 45.2 | 07/05/99 | 7.2 | 08/26/99 | 64.0 | 59.5 | 4.5 |
| SU85 Dumont Ck @ mouth | 06/18/99 | 10/01/99 | 08/28/99 | 70.4 | 09/28/99 | 47.1 | 07/05/99 | 9.2 | 08/01/99 | 68.8 | 60.1 | 8.7 |
| SU86 Boulder Ck @ mouth | 06/16/99 | 10/01/99 | 07/28/99 | 75.7 | 09/28/99 | 47.6 | 07/18/99 | 13.0 | 07/30/99 | 74.4 | 62.8 | 11.7 |
| SU87 Buckeye Ck @ mouth | 06/16/99 | 10/01/99 | 07/13/99 | 71.0 | 09/28/99 | 44.9 | 07/05/99 | 11.0 | 07/31/99 | 69.3 | 60.0 | 9.3 |
| SU88 S Umpqua @ S Ump Falls | 06/17/99 | 09/09/99 | 08/04/99 | 71.6 | 06/27/99 | 48.0 | 07/27/99 | 11.0 | 08/01/99 | 70.6 | 60.5 | 10.1 |
| SU89 Quartz Ck @ mouth | 06/16/99 | 10/02/99 | 07/29/99 | 64.9 | 06/17/99 | 46.4 | 07/05/99 | 8.4 | 07/30/99 | 63.6 | 56.9 | 6.7 |
| SU90 Castle Rock Fork @ mouth | 06/16/99 | 10/02/99 | 08/28/99 | 63.7 | 09/28/99 | 44.6 | 07/05/99 | 8.4 | 08/26/99 | 62.7 | 58.7 | 3.9 |
| SU91 Black Rock Fork @ mouth | 06/16/99 | 10/02/99 | 08/04/99 | 66.0 | 09/28/99 | 45.7 | 07/05/99 | 10.3 | 08/01/99 | 65.0 | 57.0 | 8.0 |
| SUAIR Air Temperature @ Mouth S | 07/01/99 | 09/13/99 | 08/24/99 | 89.4 | 09/11/99 | 45.8 | 09/12/99 | 38.8 | 08/25/99 | 86.6 | 61.2 | 25.4 |
| SUX Myrtle Ck Test | 07/01/99 | 09/13/99 | 08/24/99 | 76.6 | 09/11/99 | 47.9 | 09/12/99 | 22.6 | 08/25/99 | 75.0 | 62.6 | 12.5 |

| Site Name | Lat | Long | Days > 55 F | Days > 64 F | Days > 70 F | Hours > 55 F | Hours > 64 F | Hours > 70 F | Warmest day of 7-day max | | | Agency |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Date | Maximum | Minimum | |
| SU61.5 Upper St. John Ck | 42.94241 | 123.04778 | 94 | 0 | 0 | 1887.5 | 0.0 | 0.0 | 08/28/99 | 63.9 | 61.1 | BLM |
| SU62 Stouts Ck @ mouth | 42 55 45.68 | 123 3 5.91 | 82 | 52 | 0 | 1854.5 | 582.5 | 0.0 | 08/24/99 | 69.9 | 61.8 | UBWC |
| SU62.2 E Fork Stouts Ck | 42.91491 | 123.04793 | 94 | 9 | 0 | 1811.5 | 44.0 | 0.0 | 08/28/99 | 65.4 | 61.4 | BLM |
| SU62.4 Stouts Ck abv E Fork | 42.91444 | 123.04823 | 99 | 67 | 35 | 2059.0 | 705.0 | 150.0 | 07/12/99 | 73.6 | 59.1 | BLM |
| SU63 Corn Ck @ mouth | 42 56 25.88 | 123 1 24.31 | 82 | 34 | 0 | 1790.5 | 313.5 | 0.0 | 08/28/99 | 69.2 | 63.1 | UBWC |
| SU64 Coffee Ck @ mouth | 42 56 24.83 | 122 59 58.8 | 82 | 49 | 1 | 1827.0 | 537.5 | 2.0 | 08/28/99 | 70.6 | 63.5 | UBWC |
| SU 64.5 Upper Coffee Creek | 43.00524 | 122.99664 | 78 | 0 | 0 | 1567.5 | 0.0 | 0.0 | 08/28/99 | 63.3 | 61.0 | BLM |
| SU65 S Umpqua abv Coffee Ck | 42 56 21.72 | 122 59 57.9 | 82 | 74 | 48 | 1967.5 | 1550.0 | 721.5 | 07/20/99 | 84.6 | 63.8 | UBWC |
| SU67 Jackson Ck u/s Beaver Ck | 42 57 17.49 | 122 48 16.2 | 78 | 48 | 0 | 1772.0 | 688.0 | 0.0 | 08/04/99 | 70.0 | 64.6 | DEQ |
| SU68 Jackson Ck u/s Squaw Ck | 42 58 11.4 | 122 41 55.2 | 78 | 57 | 21 | 1646.0 | 570.5 | 67.0 | 07/28/99 | 72.9 | 60.3 | DEQ |
| SU69 Jackson Ck u/s Twomile Ck | 42 59 52.24 | 122 38 37.6 | 78 | 47 | 1 | 1570.5 | 306.0 | 0.5 | 08/04/99 | 70.3 | 59.9 | DEQ |
| SU70 Falcon Ck at mouth | 42 59 53.02 | 122 33 7.35 | 70 | 0 | 0 | 1155.5 | 0.0 | 0.0 | 08/04/99 | 63.5 | 56.8 | DEQ |
| SU71 Jackson Ck u/s Falcon Ck | 42 59 58.22 | 122 33 3.64 | 76 | 26 | 0 | 1143.0 | 86.5 | 0.0 | 07/28/99 | 66.9 | 55.8 | DEQ |
| SU72 Lonewoman Ck at mouth | 43 00 35.20 | 122 31 41.9 | 57 | 0 | 0 | 744.0 | 0.0 | 0.0 | 08/26/99 | 61.3 | 55.4 | DEQ |
| SU73 Jackson Ck u/s Lonewoman C | 43 00 40.92 | 122 31 43.8 | 68 | 0 | 0 | 1005.5 | 0.0 | 0.0 | 08/04/99 | 63.3 | 55.9 | DEQ |
| SU74 S Umpqua u/s Dumont Creek | 43 2 8.84 | 122 48 31.8 | 78 | 61 | 36 | 1846.0 | 1055.5 | 238.0 | 08/04/99 | 76.1 | 66.6 | DEQ |
| SU75 S Umpqua u/s Boulder Ck | 43 3 11.5 | 122 46 28.7 | 78 | 53 | 21 | 1827.0 | 950.5 | 107.0 | 08/04/99 | 72.9 | 66.6 | DEQ |
| SU76 S Umpqua u/s Ash Ck | 43 02 47.3 | 122 43 29.7 | 78 | 51 | 6 | 1784.5 | 821.5 | 15.5 | 08/04/99 | 70.5 | 66.0 | DEQ |
| SU77 S Umpqua u/s Quartz Ck | 43 4 55.72 | 122 38 50.8 | 77 | 31 | 0 | 1532.0 | 270.5 | 0.0 | 08/04/99 | 68.9 | 61.2 | DEQ |
| SU78 Black Rock Fk @ mouth | 43 6 30.41 | 122 35 16.2 | 76 | 25 | 0 | 1572.5 | 138.0 | 0.0 | 08/04/99 | 66.4 | 61.2 | DEQ |
| SU81 Elk Ck @ mouth | 42 55 35.98 | 122 57 0.92 | 100 | 72 | 46 | 2400.0 | 1316.5 | 317.0 | 08/03/99 | 75.1 | 66.2 | FS |
| SU82 Jackson Ck @ mouth | 42 58 9.13 | 122 52 46.6 | 102 | 53 | 26 | 2245.5 | 940.5 | 131.0 | 08/04/99 | 72.9 | 65.8 | FS |
| SU82.5 Beaver Ck @ rd 3014 | | | 102 | 48 | 0 | 2214.5 | 397.5 | 0.0 | 08/04/99 | 68.5 | 61.5 | FS |
| SU83 Squaw Ck @ mouth | 42 58 6.75 | 122 42 0.45 | 70 | 0 | 0 | 1099.5 | 0.0 | 0.0 | 07/28/99 | 61.5 | 55.6 | FS |
| SU84 Deadman Ck @ mouth | 42 58 19.47 | 122 52 35.5 | 101 | 61 | 10 | 2254.0 | 771.0 | 49.0 | 07/27/99 | 70.8 | 60.4 | FS |
| SU 84.2W Fork Deadman Ck | 43.02245 | 122.92635 | 77 | 0 | 0 | 1396.0 | 0.0 | 0.0 | 08/28/99 | 63.8 | 60.4 | BLM |
| SU84.4 Middle Fork Deadman Ck | 43.02236 | 122.92579 | 90 | 4 | 0 | 1647.5 | 21.5 | 0.0 | 08/28/99 | 65.4 | 60.8 | BLM |
| SU85 Dumont Ck @ mouth | 43 02 8.98 | 122 48 36.6 | 102 | 46 | 1 | 2220.5 | 498.0 | 2.0 | 08/04/99 | 69.8 | 62.3 | FS |
| SU86 Boulder Ck @ mouth | 43 03 11.65 | 122 46 34.4 | 107 | 71 | 44 | 2465.0 | 1098.5 | 253.5 | 07/28/99 | 75.7 | 64.4 | FS |
| SU87 Buckeye Ck @ mouth | 43 02 52.02 | 122 41 58.3 | 102 | 59 | 5 | 2186.0 | 555.0 | 15.5 | 07/28/99 | 70.7 | 61.4 | FS |
| SU88 S Umpqua @ S Ump Falls | 43 03 17.60 | 122 41 7.46 | 80 | 50 | 13 | 1602.5 | 495.0 | 31.5 | 08/04/99 | 71.6 | 62.3 | FS |
| SU89 Quartz Ck @ mouth | 43 04 54.58 | 122 38 52.6 | 90 | 1 | 0 | 1805.0 | 3.5 | 0.0 | 07/29/99 | 64.9 | 57.5 | FS |
| SU90 Castle Rock Fork @ mouth | 43 06 25.46 | 122 35 19.1 | 78 | 0 | 0 | 1314.0 | 0.0 | 0.0 | 08/28/99 | 63.7 | 60.0 | FS |
| SU91 Black Rock Fork @ mouth | 43 06 26.64 | 122 35 19.6 | 93 | 16 | 0 | 1579.5 | 52.5 | 0.0 | 08/04/99 | 66.0 | 58.5 | FS |
| SUAIR Air Temperature @ Mouth S | 43 | 123 | 75 | 70 | 63 | 1612.5 | 935.0 | 576.0 | 08/24/99 | 89.4 | 61.5 | UBWC |
| SUX Myrtle Ck Test | 43 | 123 | 75 | 65 | 35 | 1647.5 | 763.0 | 222.0 | 08/24/99 | 76.6 | 62.7 | UBWC |


CC01 Cow Ck near mouth
CC80 Cow Ck abv Dismal
CC81 Applegate @ mouth
CC83 E Fork Cow @ mouth
CC84 Cow Ck abv E Fork Cow
NU01 N Umpqua @ mouth
SU01 Champagne Ck @ mouth
SU02 Small seep near mouth of Champagne ck
SU03 S Umpqua abv Champagne Ck
SU05 Elgarose Ck abv Callahan
SU06 S. Umpqua @ Rd 67 Bridge
SU07 Newton Ck @ mouth
SU08 S Umpqua abv Newton Ck
SU09 Deer Ck abv Fowler Bridge
SU10 Deer Ck on E Douglas
SU11 N Fork Deer Ck @ mouth
SU12 S Fork Deer Ck @ mouth
SU13 N Deer Ck @ Buckhorn Bridge
SU14 S Deer Ck @ Hatfield Bridge
SU15 Roberts Ck @ mouth
SU16 S Umpqua abv Roberts Ck
SU17 Roberts Ck abv I-5
SU18 Lookingglass @ mouth
SU19 S Ump abv Lookingglass
SU20 Olalla @ mouth
SU21 Lookingglass abv Olalla
SU22 Upper Lookingglass south fork
SU23 Upper Lookingglass north fork
SU24 10-Mile Ck @ mouth
SU25 Olalla abv 10-Mile Ck
SU26 10-Mile Ck abv 10-Mile bridge
SU29 Upper 10-Mile Ck
SU29.5 Upper Tenmile Ck
SU30 Shields Ck @ 1st Bridge
SU31 Berry Ck @ mouth
SU32 Olalla Ckabv Berry
SU32.5 Thompson Ck @ mouth
SU33 Brockway Ck @ bridge
SU34 Kent Ck blw Squaw Ck
SU34.5 UpperKent Ck
SU35 Rice Ck @ mouth
SU35.5 Upper Rice Ck
SU36 Willis Ck @ mouth
SU37 S. Umpqua abv Willis Ck
SU38 S Umpqua @ Exit 113
Seasonal Max
7-day Max
Max Delta T
0
10
20
30
40
° F
50
60
70
80
90
100


SU39 S Umpqua @ Myrtle Ck
SU40 S Mrytle @ mouth
SU41 N Myrtle @ mouth
SU42 Frozen Ck @ mouth
SU43 N. Myrtle abv Frozen Ck
SU43.2 Slide Ck abv Riser Ck
SU43.4 Riser Ck near mouth
SU43.6 Upper N Myrtle Ck
SU44 Louis Ck @ mouth
SU44.5 Upper Louis Ck
SU45 S Myrtle abv Louis Ck
SU46 Weaver Ck @ mouth
SU46.5 Upper Weaver Ck
SU47 S Myrtle abv Weaver
SU47.5 Johnson Ck @ mouthJohnson Creek
SU47.8 Upper S Myrtle Ck
SU48 Judd Ck @ mouth
SU49 S Umpqua abv Judd Ck
SU50 Canyon Ck @ mouth
SU50.2 W Fork Canyon Ck
SU50.5 Upper Canyon Ck
SU51 S Umpqua abv Canyon Ck
SU52 O' Shea Ck @ mouth
SU53 S Umpqua @ Packard Gulch
SU54 Days Ck @ mouth
SU55 Alcove abv Days Ck @ mouth
SU56 S Umpqua abv Days ck
SU57 Fate Ck @ mouth
SU57.5 Upper Fate Ck
SU58 Days Ck abv Fate Ck
SU59 Days Ck (upper)
SU59.5 Upper Days Ck
SU60 S Umpqua blw Beals Ck
SU60.1 Upper Shively Ck
SU60.2 Poole Ck near mouth
SU60.5 Lavadoure Ck near mouth
SU61 St. John Ck @ mouth
SU61.5 Upper St. John Ck
SU62 Stouts Ck @ mouth
SU62.2 E Fork Stouts Ck
SU62.4 Stouts Ck abv E Fork
SU63 Corn Ck @ mouth
SU64 Coffee Ck @ mouth
SU64.5 Upper Coffee Creek
SU65 S Umpqua abv Coffee Ck
Seasonal Max
7-day Max
Max Delta T
° F
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0


SU66 S Umpqua u/s smolt trap
SU67 Jackson Ck u/s Beaver Ck
SU68 Jackson Ck u/s Squaw Ck
SU69 Jackson Ck u/s Twomile Ck
SU70 Falcon Ck at mouth
SU71 Jackson Ck u/s Falcon Ck
SU72 Lonewoman Ck at mouth
SU73 Jackson Ck u/s Lonewoman Ck
SU74 S Umpqua u/s Dumont Creek
SU75 S Umpqua u/s Boulder Ck
SU76 S Umpqua u/s Ash Ck
SU77 S Umpqua u/s Quartz Ck
SU78 Black Rock Fk @ mouth
SU80 S Umpqua abv Elk
SU81 Elk Ck @ mouth
SU82 Jackson Ck @ mouth
SU82.5 Beaver Ck @ rd 3014
SU83 Squaw Ck @ mouth
SU84 Deadman Ck @ mouth
SU84.2W Fork Deadman Ck
SU84.4 Middle Fork Deadman Ck
SU85 Dumont Ck @ mouth
SU86 Boulder Ck @ mouth
SU87 Buckeye Ck @ mouth
SU88 S Umpqua @ S Ump Falls
SU89 Quartz Ck @ mouth
SU90 Castle Rock Fork @ mouth
SU91 Black Rock Fork @ mouth
SUAIR Air Temperature @ Mouth S Myrtle
SUX Myrtle Ck Test
Seasonal Max
7-day Max
Max Delta T
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
°F

## Spatial analysis of the data

*Distance from the mouth*

A basic objective of this project is to better understand the distribution pattern of the stream temperatures within the watershed. To accomplish this on a two dimensional chart, it is helpful to plot the site data as a function of the distance from the mouth of the watershed being studied. This approach emphasizes the distance "up-the- river" from the mouth to a particular site and it provides the opportunity to compare the temperature of the mainstem stream with the temperature of the contributing tributaries.

To provide a synoptic or "snapshot" view of the data it was necessary to select an appropriate date for the analysis. The seasonal statistics were not used since the seasonal maximum did not occur on the same day at all of the sites. Statistics from August 28 was used because the majority of sites experienced their seasonal maximum on this date. The interested reader can do a similar analysis for other dates using data gleaned from the appendix.

Chart 6 shows how the maximum and minimum temperatures that were measured on 8/28/99 varied when displayed as a function of their distance from the mouth of the South Umpqua River.

**Chart Use Example:** To fully understand the chart, it is helpful to look at an example. Site 56 is on the South Umpqua above Days Creek. Directly below it at the same distance is Site 54, Days Creek at the mouth. A fish in this area would experience cooler temperatures in the mouth of Days than in the South Umpqua River. Sites 58, 59 and 59.5 represent points further up Days Creek.

**General Observations:** Note that the maximum temperature of the tributaries is generally about 10°F cooler than the main stem temperatures. An important implication is that the tributaries can provide a cooler refuge for fish when there is sufficient habitat and cover. It should also be noted that the streams tend to increase in temperature as they flow downstream (left direction) and that the tributaries appear to warm quicker than the main river. The zigzag pattern on the river probably results from the "edge effect" of the sampling procedure. It is expected that there is more temperature variation along the edges and that the pattern of the central portion of the river would show a smoother increase in the downstream direction. This effect is less on the smaller streams because the data loggers were typically placed in the active flow zone.

The extreme values are of interest. The point near 90°F on the Maximum chart is Site 19, the South Umpqua above Lookingglass Ck. The temperature logger was initially in active flow but by the end of the season the flow had receded and the unit was in a pool that was nearly isolated from the main river flows. This area was dominated by bedrock, which may have helped accumulate heat. However, isolated edge conditions don't necessarily imply warm zones. Site 60 shows up as a significant low point near the middle of the South Umpqua profile line. This site was also a backwater pool that became nearly isolated from the main river flow. A possible explanation is that groundwater flow from the Beals Creek channel contributed cool water to the site.

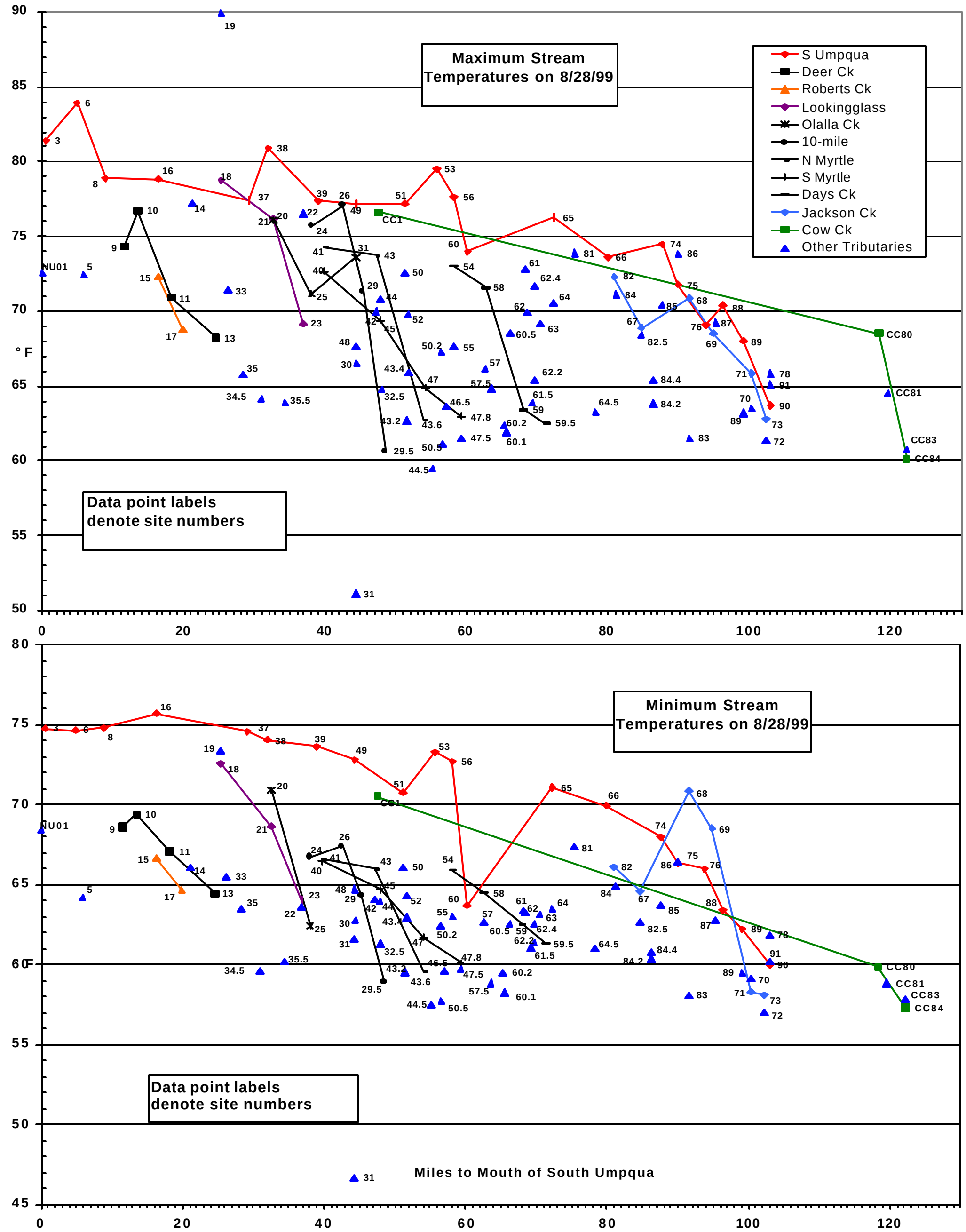



*Chart 6  Maximum and minimum temperatures by river mile.*

Site 31 shows up near the 45-mile mark on the bottom edge of the chart. This site is on Berry Creek at the mouth and is strongly influenced by the release from Berry Creek dam which is located a short distance upstream. The lower values at site 25 on Olalla Creek may be a result of the influence of Berry Creek.

Chart 7 shows the variation in ΔT between the sites. Since the solar radiation is the only variable that changes regularly on a daily basis, most of the ΔT value at a site is associated with changes in the amount of solar energy received by the stream. Vegetative shade, topographic shade, cloud cover, and solar path influence the amount of solar energy received on any give day. Sites with high ΔT are apparently receiving a higher level of solar energy per unit volume throughout the day. Large streams and rivers may experience a lower ΔT due to the large volume of water that is being heated.

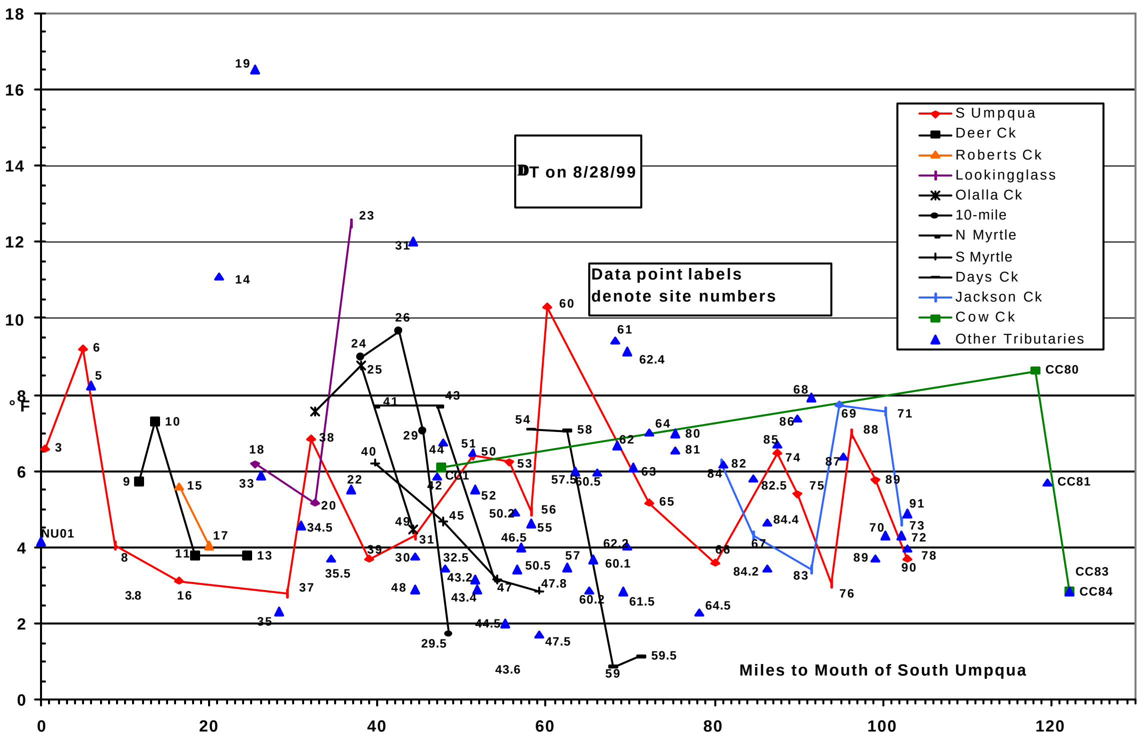



***Chart 7 ΔT vs. distance to the mouth of the South Umpqua.***

An example of this effect is shown in Chart 8, which plots the temperature data for the Umpqua River at Site SU16 above the mouth of Roberts Creek. Since the river is very wide and the riparian shading is minimal, the water surface is receiving the full amount of solar radiation. However, the mass of the water is so great that the solar energy does not raise the water temperature very rapidly. Nevertheless, the accumulated net temperature is relatively high as shown in Chart 6.

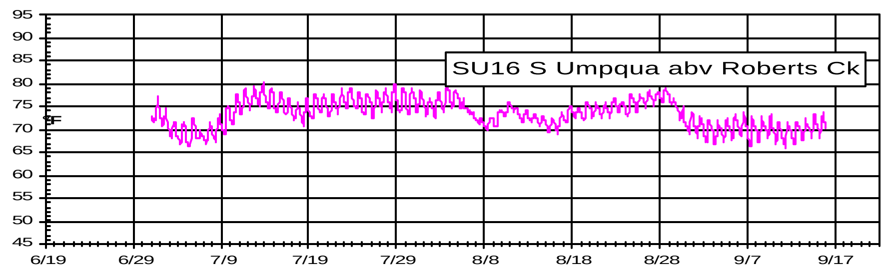



***Chart 8  Stream Temperature at Site SU16 South Umpqua River above Roberts Creek***

An extreme example of the effect of a large, massive quantity of water is the Berry Creek data shown in chart 9.  In this case the deep reservoir apparently isolates the data logger from seasonal variations.

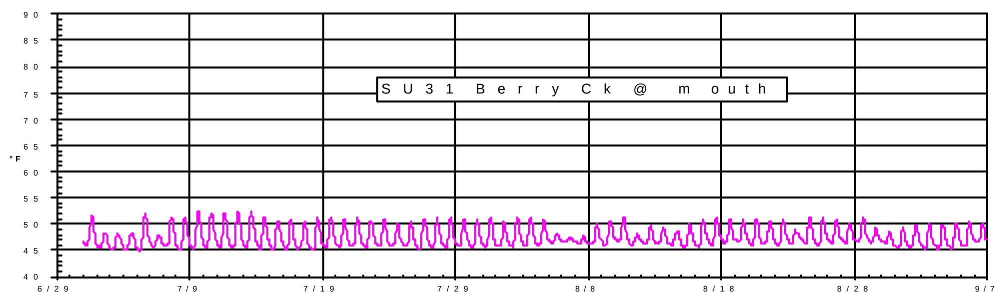



***Chart 9  Berry Creek Stream temperature.***

An example of the effect of a low mass situation as shown in Chart 10 which plots the air temperature near SU41.  The low mass and heat capacity of the air results in high temperatures even in a well shaded microenvironment.  Air convection is also a factor that can bring heated air from the surrounding area.

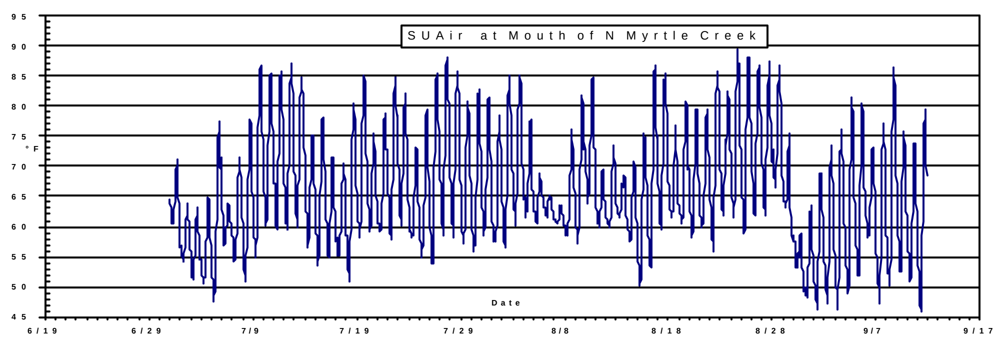



***Chart 10  Air Temperature at site SU41 in Myrtle Creek.***

Very small streams also have small mass but can still have a small $\Delta T$ as shown in Chart 11. This site is located less than three miles from the source ridge. Heat reaching such a small quantity of water would tend to cause a large temperature increase. Apparently, the effects of shade, evaporation and groundwater contribution outweigh the effect of any solar energy reaching the water.

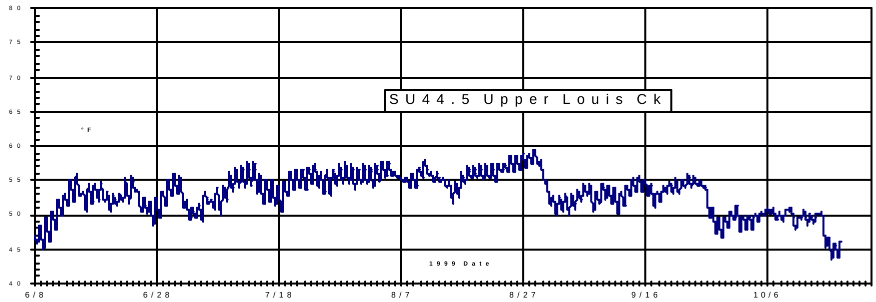



***Chart 11 Stream temperature at Site 44.5 Upper Louis Creek.***

*Distance to the source ridge*

It is apparent from the above discussion that there is a strong association between the size of a stream and its temperature. It is well known that streams generally get larger as they accumulate more water while moving down through the watershed. With increased flow, they generally get wider, deeper and flow faster. Also, the channel bank and bed characteristics change as well as the type and extent of riparian vegetation. Likewise, the proportional contribution of groundwater inflow also generally decreases. All of these effects can influence the stream temperature and generally contribute to higher stream temperatures in the down stream direction.

Likewise, the quality of the fish habitat tends to be related to the size of the stream. The very small streams may be the coldest but they may not have a sufficient volume of water for adequate rearing during the summer months. The large streams have sufficient water but may get too warm. If temperature is limiting the health and development of the fish, there may be an optimum stream size range that has the right mix of water and temperature. If this proves to be the case, these areas should be identified and receive management emphasis.

Plotting the sites as a function of the distance to their respective ridgelines is a way to roughly sort the streams by size. In general, sites that are the same distance to their respective source ridge will be more similar than other sites. For example, points 5 miles from the ridge of each stream will tend to have similar flows and channel characteristics. Of course, this relationship breaks down if the streams are in a significantly different geographic area or have different watershed geometry. For that reason, this type of comparison is effective only when made in the same geographic area and, even then, there may be considerable variability. It should be noted that this sorting does not directly account for elevation but it does account, to some extent, for vertical drop from the source ridge.

Chart 12 shows how the maximum and minimum temperatures observed on 8/28 varied as a function of the distance of the site to the stream's respective source ridgeline. The site numbers are not shown in this chart because the data is too tightly clustered to effectively show them however, the site number are shown in multiple charts in Appendix D. Note that most of the sites are located between 5 and 15 miles downstream from their source point. These are the streams that may have cool water in sufficient quantity to provide fish habitat.

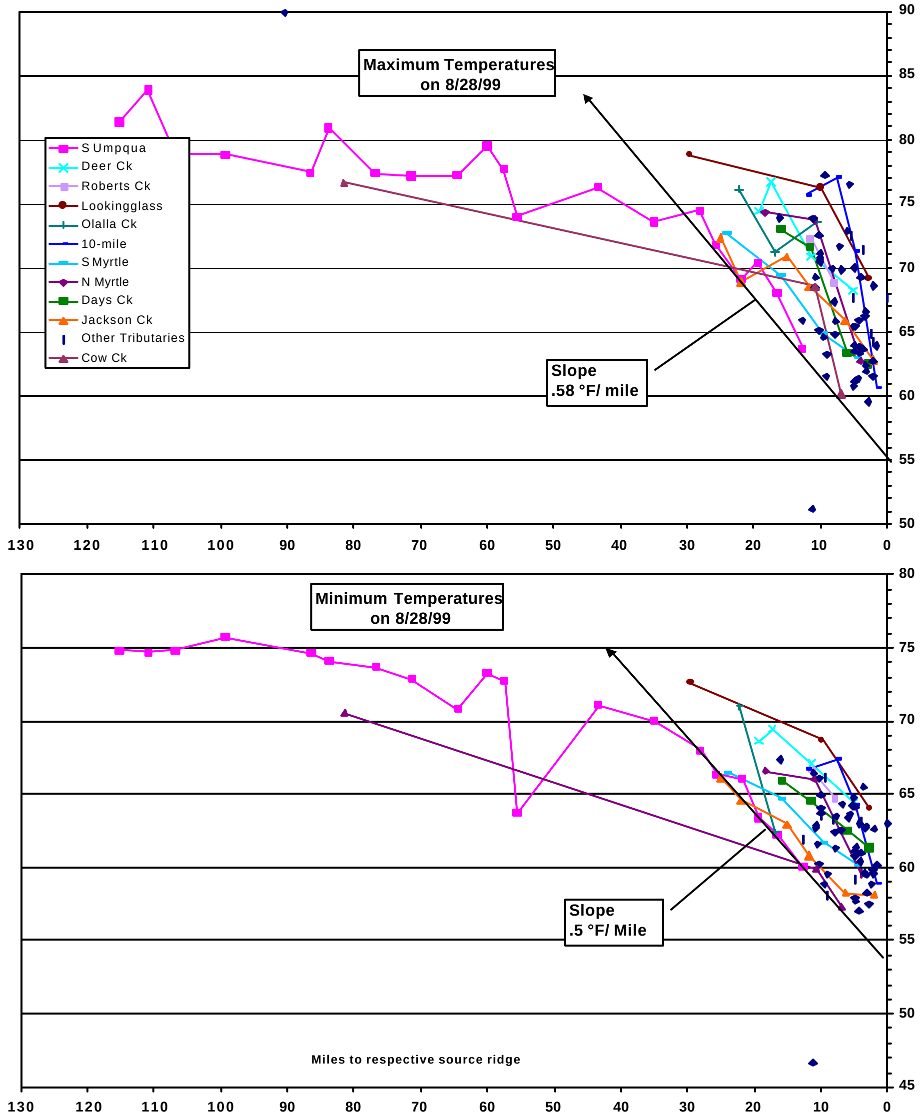



*Chart 12 Max and Min Temperatures for August 28, 1999 V s Distance to the respective source ridge.*

Since the streams associated with a particular ridge distance will tend to have similar size and flow characteristics, one would expect they would have similar temperatures if they had similar shade characteristics. It is readily apparent from Chart 12 that there is considerable temperature variability between sites at any given ridge distance. To the extent that these sites have similar size, shape and flow, most of the remaining variability can be associated with differences in shade. Consequently, the chart provides a “first cut” view of sites that may benefit from improved shade. However, it needs to be emphasized that there may be other factors that would cause a particular site to have elevated temperatures and a local field assessment would be required before a site-specific management plan could be developed.

These charts can help show how streams gain heat as they move downstream from their source point. A typical temperature for emergent groundwater at a headwater source is about 52°F and the stream temperature generally tends to increase in the downward direction as the channel get wider, exposure increases and the percent of local groundwater contribution to total flow decreases.

The sites along the lower edge of the data cluster are of interest because they represent the best temperatures in the watershed under current conditions. The important implication is that shade management on the other sites may bring the maximum temperatures down to at least this level. The question remains open whether these sites represent the best possible conditions and the lowest possible temperatures. Further analysis and modeling is needed to determine the expected temperatures under “ideal” watershed conditions. Nevertheless, it is apparent that there are many streams in the 4 to 12 mile range with potentially good habitat that could be cooled as much as 10°F. Cold-water fish that are trying to survive in these areas would certainly benefit from this reduction.

Chart 13 shows the ΔT pattern with respect to distance to the source ridge. It is of interest to note that this pattern appears to peak in the 8 to 15 mile range that may also be the range for good fish habitat. The implication is that improved vegetative shading may be particularly effective in this zone. The isolated peaks along the lower portion of the river may represent edge effects as previously discussed.

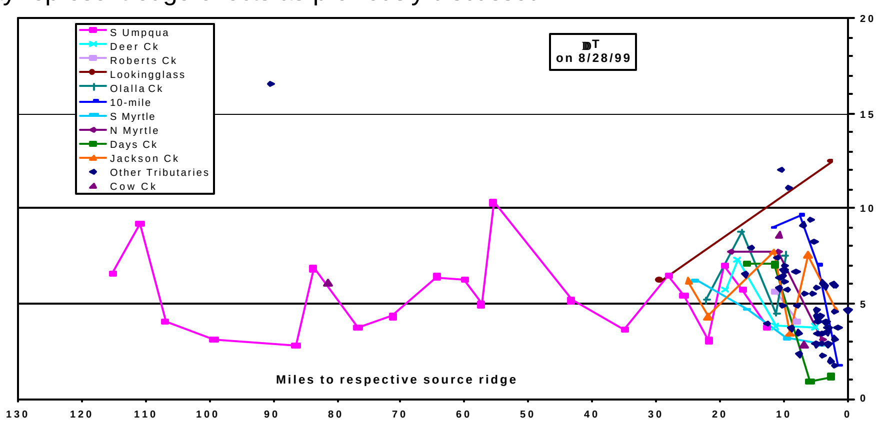



***Chart 13 ΔT vs. distance to the source ridge.***

*Results from the bucket test (Site SUX)*

To provide a reference to the stream data, a 10-inch diameter bucket with 11 inches of water was placed in a well-shaded area near the mouth of North Myrtle Creek. A rain cover was placed about 12 inches above the bucket and a data logger unit was suspended in the water about 1 inch above the bottom.

During the 78-day test period, seven inches of water was lost due to evaporation. Using a vaporization value 38 BTU/ $in^3$ of water yields an average surface heat loss rate of 3.4 BTU/$in^2$/day. Chart 14 shows the temperature pattern for the bucket that is quite similar to that of the stream temperatures. It is interesting to note that the $\Delta$T increases slightly with reduced mass as expected. Streams that have $\Delta$T decreases with diminishing flow are probably dominated by a groundwater influence. When the flow contribution from upstream diminishes, a higher proportion of cool groundwater cools the stream locally.

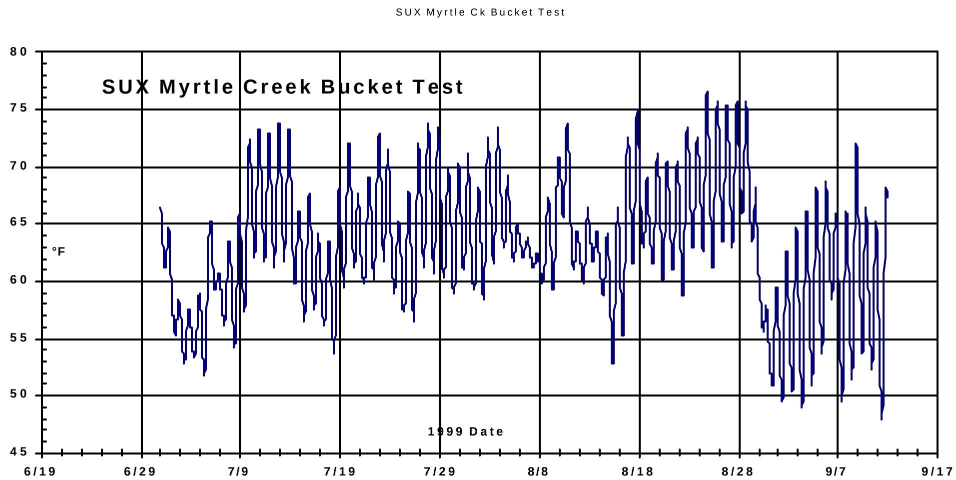



***Chart 14 Temperature pattern from bucket test.***

## Conclusions

When the results of the South Umpqua River study are combined with the previous studies several important points can be inferred.

*Key Observations:*

- For this collection of data, the zone of maximum temperatures below 64 °F extended from 0 to about 15 miles as shown in Chart 12. This is in contrast to zones of 0 to seven miles in other studies. Further study will be needed to determine the relative contribution of various factors such as forest cover, elevation etc
- There is a general tendency for streams in the 0-20 mile range to heat in the downstream direction. However, downstream temperatures for individual streams can be colder than points upstream if conditions are significantly different. (Example: Site SU9 Deer Ck @ Fowler St Bridge is cooler than the upstream site SU 10 Deer

Ck @ Douglas.) The implication is that local conditions can significantly affect the stream temperature during low flow conditions.

- The "edge" temperature areas along the main stem can be very warm or relatively cool as shown with sites SU19 and SU 60. There is evidence (Site 60) that tributaries with no surface flow may still contribute cold hyporheic flow to the main river. Typically these sources would have a streambed dominated with alluvium that could effectively pass the groundwater.
- The warmer sites appear to have a strong association with exposure to direct solar radiation (absence of shade) based on general observation..
- The low flow period represents an extreme condition in the stream channels. Surface flow velocities tend toward zero as the streams go dry. The resulting isolated pools apparently can remain relatively cool. Hyporheic (groundwater flow) circulation may be a contributing factor. The data from these pools provides an opportunity to test the calibration of the stream temperature models by assigning zero surface flow conditions to the model.
- Maximum $\Delta T$ values may tend to occur between 8 and 15 miles of the ridgeline.

*Management Implications:*

The small tributaries may be providing important thermal refuge areas for the cold-water fish species and other aquatic life. Since the watershed does support a population of cold-water fish, they would likely benefit from any temperature reductions at any point in the lower portion of the watershed. Increasing stream shade may be the most direct way to obtain these reductions. A long-term management objective could be to achieve a full shade condition for all perennial streams in the watershed. However, it should be noted that a significant benefit could be realized by improving the effectiveness of the existing riparian shade. Assigning implementation priority to improving existing buffers would have the advantage of (1) faster results since vegetation is already established and (2) not requiring a land use change.

*Recommended additional work:*

- Inventory the stream shade in the watershed and use models to determine potential stream temperatures under various shade and flow conditions. In particular, determine the relative contributions of local conditions and upstream influence.
- Correlate fish presence data with the temperature data to identify the optimum habitat zones if they exist.
- Develop a temperature management plan for the watershed.
- Monitor the stream temperature at site SU 41 each year to provide a link between current conditions and the 1999 data.
- Conduct similar characterization studies in other watersheds in the Umpqua Basin.
- Manage the watershed for increased/ optimum shade to reduce the maximum summer heating.

## Other Information

### About the Data used for the analysis

The following provides source and accuracy information for the data used in the analysis:

*Tidbit data loggers*

Appendix B contains the specifications for the logger as well as results from the pre and post deployment accuracy checks and the field audit. The procedure was discussed in the "Accuracy Check" section of this report.

*Stream Distance*

Stream mile distance between major streams was obtained from the ODFW stream database. The distance to the source ridge was measured using Terrain Navigator® mapping software from Maptech. The error between any two stations is estimated as +/- 0.2 miles.

*Position*

The longitude and latitude were measured using Terrain Navigator® mapping software from Maptech. Maximum error is estimated at +/- .1 minute.

*Elevation*

Elevation data for the monitoring sites were estimated from USGS 1:24000 quad maps with 40-foot contours. Error in elevation data is estimated at +/- 10 feet.

### Field Materials and equipment

The following materials were used to conduct this study:

- 70 temperature loggers
- camcorder
- Traceable thermometer
- rebar wire
- surgical tubing
- hip waders
- brush clippers

### Further Information

For information on obtaining the following:

1. VHS Video "Field Notes" approximately 2.5 hr. Shows details of each sensor location and some general site characteristics.
2. .jpg picture files of each site.
3. Raw data files from each site.

Contact:

Umpqua Basin Watershed Council, 1758 N.E. Airport Road, Roseburg, Or 97470.
InSight Consultants, PO Box 10, Yoncalla OR 97499.