0289

Department of Ecology
Water Quality Program

DEC 16 2004

Underwood Conservation District
170 NW Lincoln, Park Center Building
P.O. Box 96 - White Salmon, WA 98672 - Phone (509) 493-1936

December 14, 2004

Ken Koch
Water Quality Program
WA Department of Ecology
POB 47600
Olympia, WA 98504

Ken,

Attached is the report that we submitted to you electronically on December 14, so that you also have a hardcopy. Thanks for the opportunity to comment on the Water Quality Assessment. Please let us know if you have any questions.

Jim White

Jim White
Manager
Underwood Conservation District
PO Box 96
White Salmon, WA 98672
509-493-1936
jimwhite@gorge.net
ucd@gorge.net

CONSERVATION · DEVELOPMENT · SELF-GOVERNMENT

Department of Ecology
Water Quality Program

DEC 16 2004

December 13, 2004

Ken Koch
Water Quality Program
Washington Department of Ecology

Ken, following are some comments from the Underwood Conservation District regarding the new 303d list. Please take them under consideration, and let us know if you have any questions of us. We will follow this electronic document up with a hardcopy.

Jim White
Underwood Conservation District
PO Box 96
170 NW Lincoln
White Salmon, WA 98672
509-493-1936
ucd@gorge.net or jimwhite@gorge.net

1. **Listing ID 21590, Trout Lake Creek (Fecal coliform)**
Ecology has corrected information on this listing, and it now corresponds to our data for station WQ-9. Previously, dates and data appeared to have been mixed up. Our data for WQ-9 are listed below:

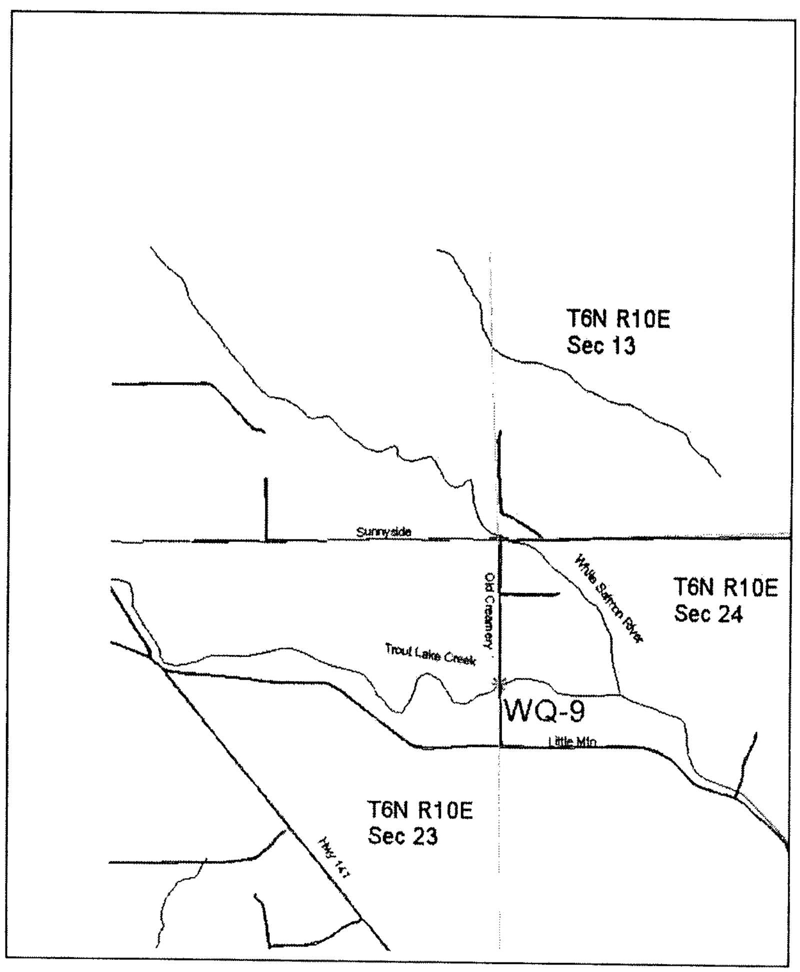
Fecal Coliform WQ 9

Station ID	DATE	fecal coliform
WQ-9	10/5/1992	20
WQ-9	1/11/1993	18
WQ-9	3/29/1993	18
WQ-9	5/31/1993	
WQ-9	7/19/1993	110
WQ-9	1/3/1994	110
WQ-9	6/27/1995	330
WQ-9	8/8/1995	490
WQ-9	8/29/1995	45
WQ-9	9/5/1995	260
WQ-9	9/19/1995	1700
WQ-9	10/3/1995	230
WQ-9	10/18/1995	330
WQ-9	1/3/1996	18
WQ-9	4/9/1996	170
WQ-9	11/18/1996	45

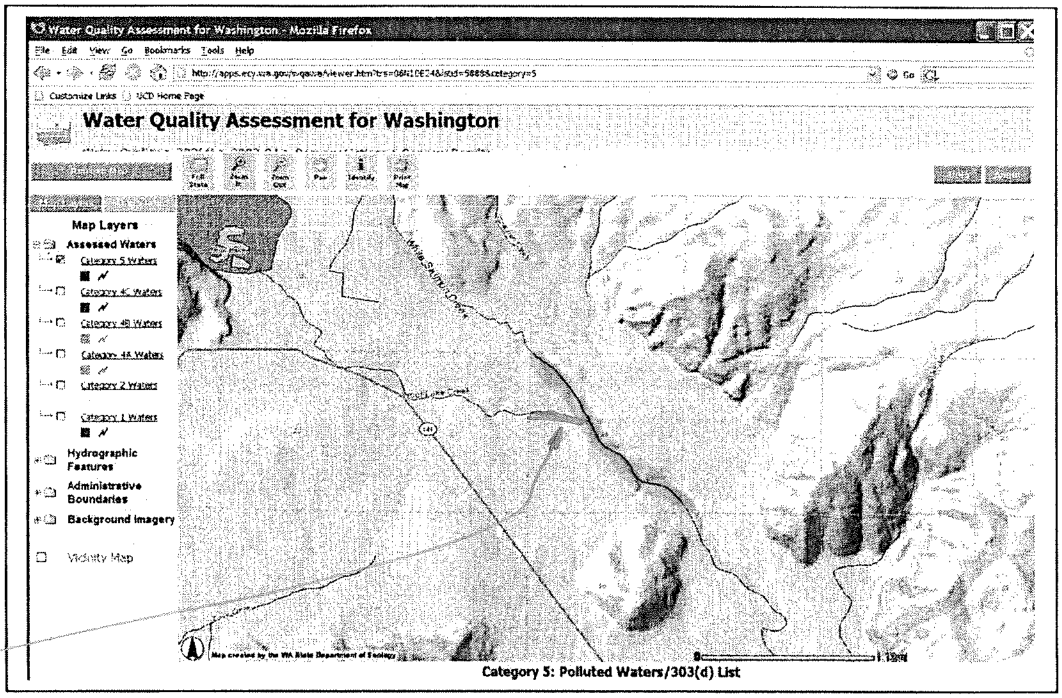
#5868 SHOULD BE CAT 2
4 SAMPLES, SO CANNOT USE GEO. MEAN BUT ONLY 1 SAMPLE VIOLATES CRITERIA

2. Listing ID 5888, Trout Lake Creek (Fecal coliform)
This listing is described as being on Trout Lake Creek, "at the mouth", yet the map on the DOE web page shows the 303(d) listing on the White Salmon River. UCD has never collected data at the "mouth" (named Trout lake Creek at 'Base' in UCD files) of Trout Lake Creek, and not in the White Salmon River near the mouth of Trout Lake Creek. Our nearest station is on lower Trout Lake Creek, WQ-9, and is covered in Listing ID 21590. Listing ID 5888 may refer to early data from WQ-9; it says that the information is not in the administrative record. Even if this listing did refer to WQ-9 data, there is a problem. WQ-9 fecal coliform data for the period mentioned in Listing ID 5888 (10/92 to 7/93, see the 1st 5 stations above) have a geometric mean of 29 by my calculations, so it is curious that the site was listed as category 5 based on those early records. We have attached the records for station WQ-9, from 10/92 to 7/93 under #1 above.

The map below shows the location of station WQ-9.



Ecology's map for Listing 5888 shows the White Salmon River, not Trout Lake Creek:



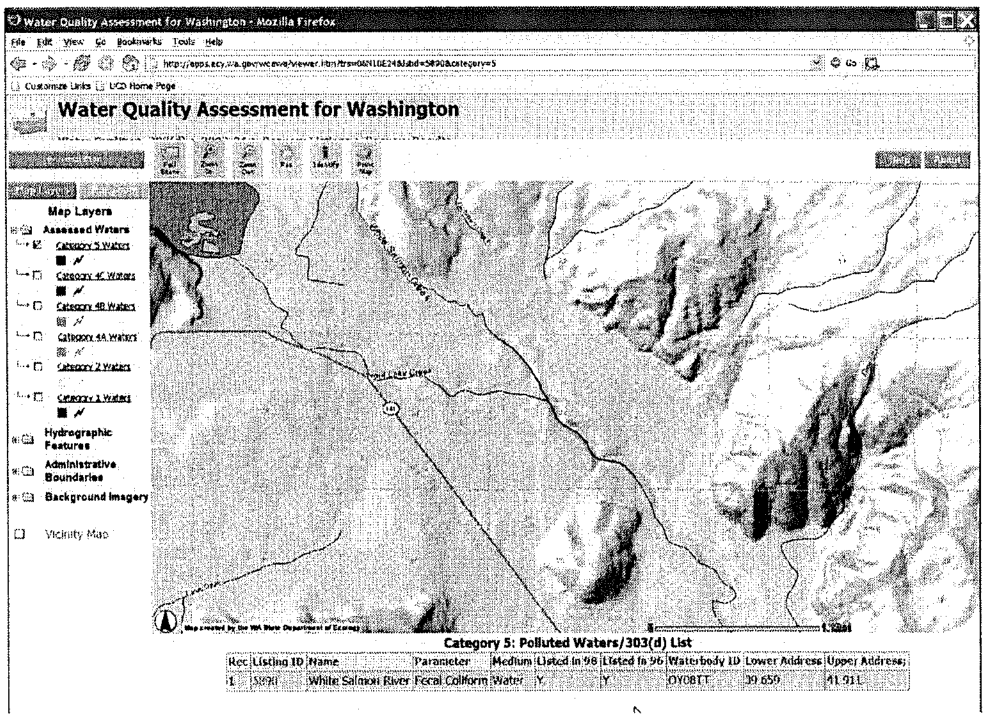
Should be same as 21590

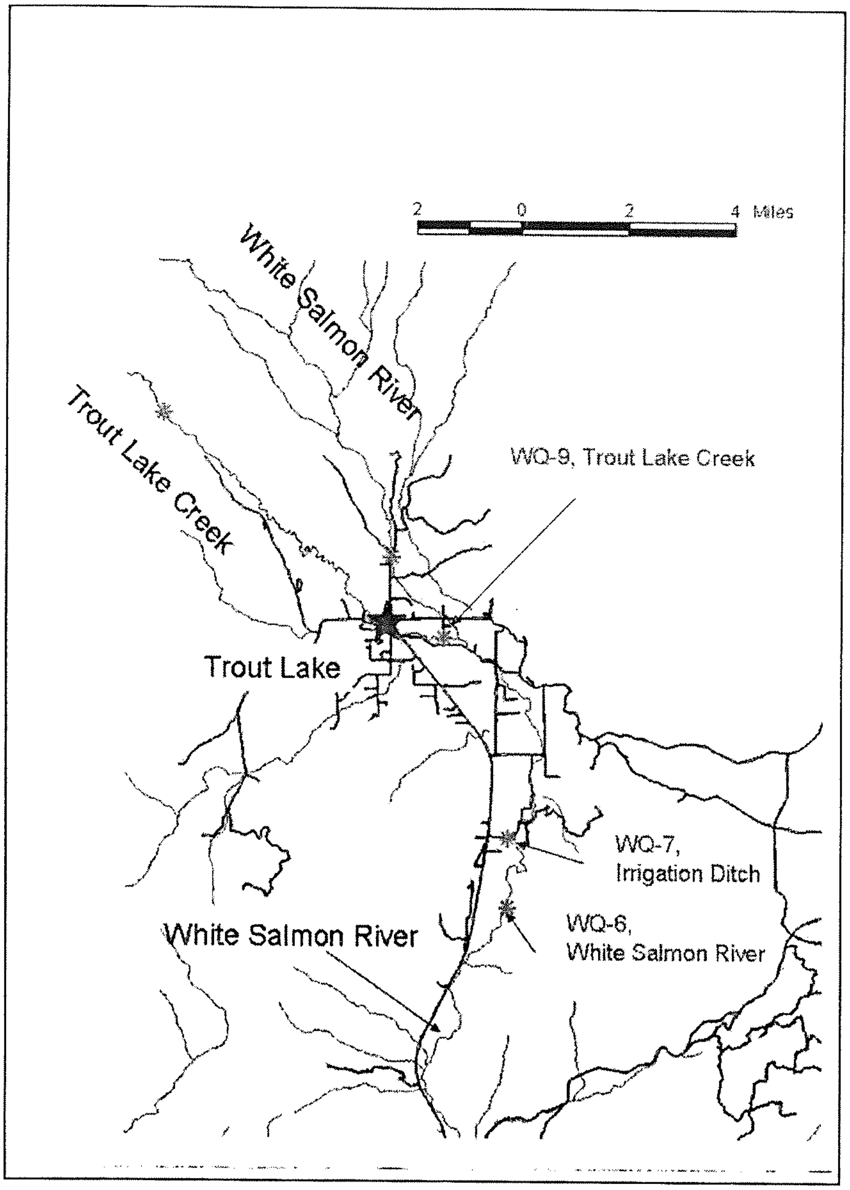
Recommendation for Listing 5888: Remove listing. It appears that the data used for this listing came from Trout Lake Creek, and are reflected in listing # 21590. At minimum, change the map to show the listing refers to Trout Lake Creek, not the White Salmon River.

PZ25RR 0.000

3. Listing 5890, White Salmon River (Fecal coliform)

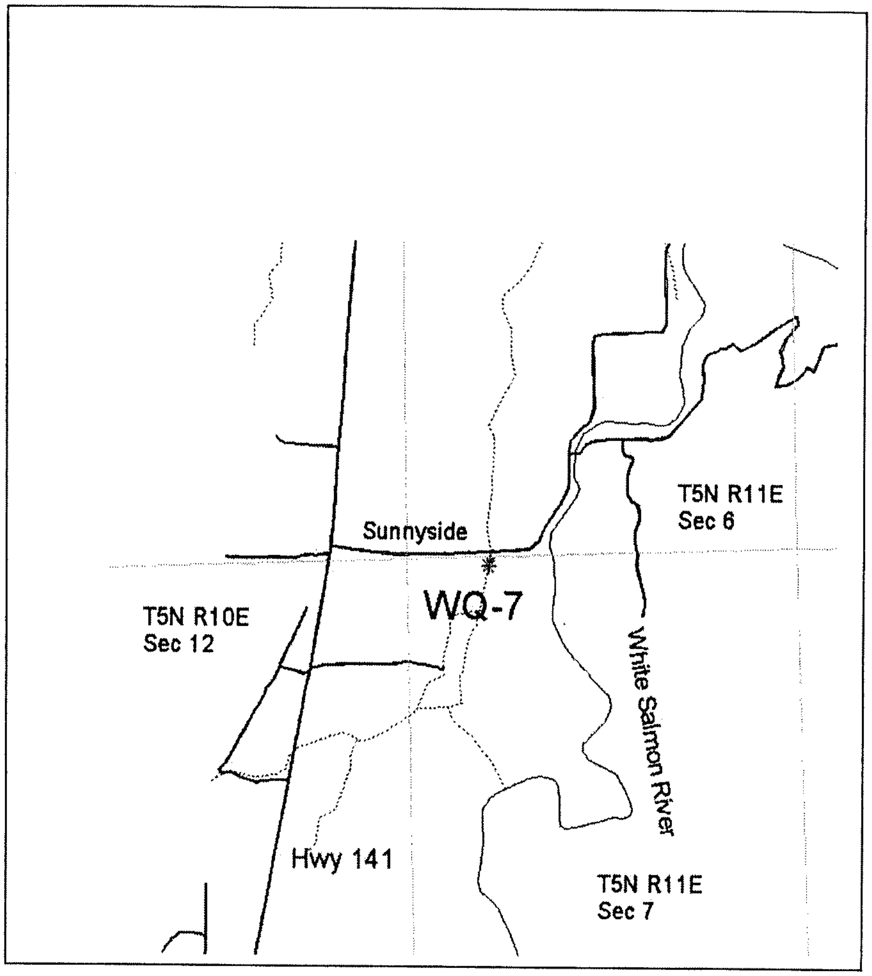
The map of this listing is identical to the map for listing 5888 (see below), except that this listing is described as being on the White Salmon River, "below Trout Lake Creek". UCD has not collected data on the White Salmon River near the mouth of Trout Lake Creek, so we are not sure what data this listing is based on. The listing says that the "raw data needed to reassess the segment are not in the administrative record". Listing 5890 may refer to early data from WQ-9 in Trout Lake Creek. UCD has not collected any water quality data on the White Salmon River in this vicinity. The nearest water quality sampling site on the White Salmon River that is downstream from Trout Lake Creek is WQ-6 (see map below).

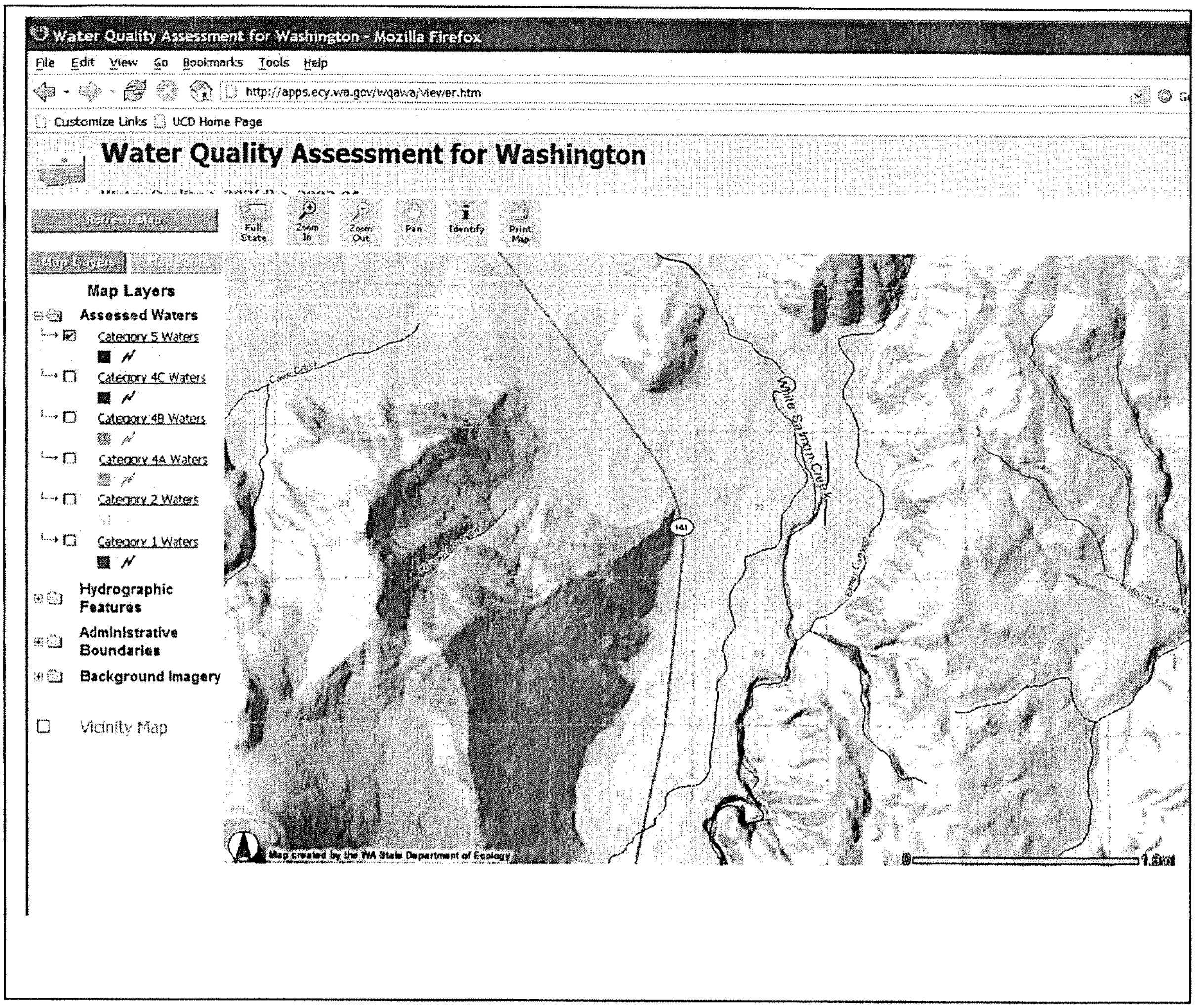




Recommendation for Listing 5890: Remove this listing. It again appears to reflect information collected at WQ-9, on Trout Lake Creek, which is already covered in listing 21590.

4. **Listing 21588, Trout Lake Ditch (Fecal coliform)**
Information for this listing is correct, but we have a couple of comments. First, the site is on an Irrigation Ditch, not a stream, if that means anything. Second, the location is not correct. This site is on the west side of the White Salmon River; the DOE map shows the site on the east side of the White Salmon River. Hopefully the map below will help. The irrigation ditch enters the White Salmon River via an overflow channel (which is not running all the time) located in Section 7, T5N R11E.





Recommendation for Listing 21588: Revise map to show correct location of WQ-7, which is further south than indicated on the DOE map.

5. Listing 16775, Gilmer Creek (Fecal coliform)
The "Basis" narrative for this listing has 3 incorrect paragraphs. They are paragraphs 5, 6, and 7, the first three that reference the Underwood Conservation District. Those three refer to fecal coliform data collected by UCD in 2002, 2001, and 1997. UCD did not collect any fecal coliform data in the White Salmon after 1996.
The final 5 paragraphs describe UCD data collected from 1992 to 1996, and correspond to our records. It appears that DOE corrected the data after we mentioned errors with data and corresponding dates, but missed deleting the old paragraphs in this listing.
Recommendation for Listing 16775: Remove the three paragraphs that refer to UCD data collected in 2002, 2001, and 1997.

6. Listing 21587, White Salmon River (Fecal coliform)
The last paragraph under "Basis" in this listing does not appear to be correct. Our records show two samples with numbers of 5400 and 45, for a geometric mean of 493, not 439.
Recommendation for Listing 21587: Check math on this listing.

7. Listing 21676, Wind River (pH)
This listing is based on 3 samples taken by UCD in 1999 and 2000. Equipment error may have been involved in these instances. We recently (June 2004) completed a study of pH in Trout Creek under a BPA contract, data that has not been submitted to DOE. That study included 130 samples taken in Trout Creek, including 29 at WR-4a, the same site mentioned in Listing 21676. The new data were taken between August 2002 and June 2004.
We have attached the report from that recent sampling to be considered as new information that may change this listing. ***The pH data are in table 5***. Of the 130 samples we took, none were outside DOE standards.
Recommendation for Listing 21676: We request that DOE consider our new pH data, information that may change the listing.

Trout Creek pH Assessment
Annual Report
For the period: August 2002-June 2004.

Prepared by Jim White and Rozalind Plumb
(Underwood Conservation District)

Introduction

The following reports the results obtained from the Trout Creek pH Assessment. The pH monitoring program is intended to systematically sample (by season and location) portions of the Trout Creek sub-basin to determine if low pH (acid) surface waters exist.

Trout Creek represents an important summer steelhead spawning and rearing tributary of the Wind River. Recent fish health studies by US Geological Service Columbia River Research laboratory (CRRL) and US Fish and Wildlife Service (USFWS), have observed the presence of the fish parasite *Heteropolaria lwoffi,* in the Trout Creek basin and surrounding watersheds. This parasite has been associated with low pH levels in waters. This study is aimed at providing data to assist in understanding the mechanisms of the parasite, and to see what conditions make Trout Creek favorable.

UCD, along with CRRL, and US Forest Service created a monitoring schedule and determined which parameters to assess. UCD performed general water chemistry assessments on site for pH, conductivity, dissolved oxygen, and turbidity. Advanced laboratory assessments for alkalinity, total sulfate, total suspended solids and tannins and lignins, were carried out by an approved laboratory. Although pH is the main parameter of interest in this study, the general chemistry parameters were taken to obtain an overall picture of the health of the creek. The advanced laboratory parameters were assessed so the potential source of low pH could be identified (e.g. Sulfate levels may indicate geothermal influences, and Tannins and Lignins may indicate wetland/soil influences).

The frequency of sampling was set at once per month. This would allow for the identification of seasonal variations. In addition, weekly sampling would take place during the months of March and November. These two months were seen as critical as they most often encounter the spring snow melt (March) and the first hard rains after the summer (November). During such times the water quality may be adversely affected by accumulations of factors influencing pH (e.g. the topsoil following a dry summer may enter the creek carrying acidic elements. Snow melt is thought to be a carrier of sulfates from acid rain/ precipitation).

Table 1 Site locations and analyses conducted.

Site ID	Site Description	Distance from mouth of Wind River (km)	General water chemistry (pH, Conductivity, turbidity, DO, temp)	Advanced Chemistry (Alkalinity, TSS, Sulfate, Tannin/Lignin*)
4a	Trout Creek at USFS 43 road	27.29	•	•
4d	Crater Creek	31.46	•	•
4b	Compass Creek	32.54	•	•
4f	Trout Creek at USFS 42 Road	32.03	•	•
4g	Trout Creek at gravel pit	33.15	•	•

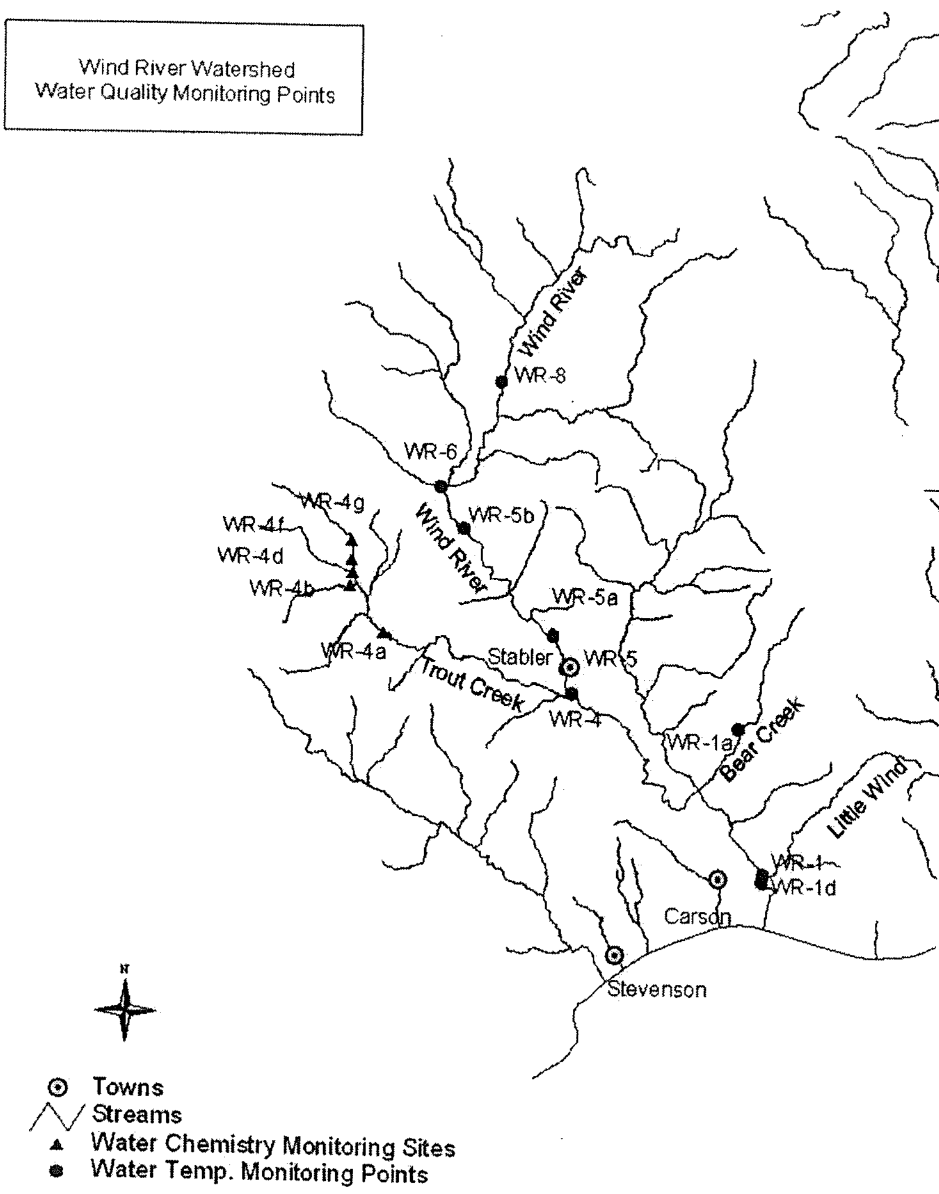


Figure 1. Map of Wind River Water Quality sampling sites used by UCD. pH sampling sites (WR-4a, WR-4b, WR-4d, WR-4f and WR-4g) are on Trout Creek, on the left side of the map.

Table 2. List of monitoring parameters used.

General Water Chemistry	Method
pH (acidity)	Orion 250A meter
Conductivity	Orion 126 meter
Water Temperature	Hanna HI 90-60 digital thermometer
Air Temperature	Alcohol bulb thermometer
Turbidity	HACH 2100P
Dissolved Oxygen	YSI 55/12 meter (and HACH modified Winkler test kit for QA)
Advanced Laboratory Analyses	
Total Suspended Solids (TSS)	EPA 160.2
Alkalinity, total as CaCO3	EPA 310.1
Sulfate	EPA 300.0
Tannins / Lignins	SM 5550 B

Table 3. Monitoring schedule

Site	**Monthly sampling** (12 rounds per year, except if inaccessible due to snow)	**Weekly sampling** (3 extra rounds per month in March and November)
4a Trout Creek at 43 road	•	•
4b Compass Creek	•	•
4d Crater Creek	•	•
4f Trout Creek at 42 road	•	•
4g Trout Creek at gravel pit	•	•

The first year of sampling (winter 2002-2003) was quite dry. UCD and USGS, with approval of BPA, decided to continue for a second year, in case the dry conditions affected results. In the second year, heavy snows blocked access to the sites from late November through March. A limited amount of sampling was accomplished in March, due to logistics and safety considerations. WR-4f was sampled on March 1, and WR-4a was sampled during the remaining weeks of March. Complete sampling began again in April 2004. A total of 30 sampling rounds were accomplished for the 2-year study. Table 4 summarizes the samples collected by each site.

Table 4: Samples per Site

Site	Samples Taken
WR-4a	29
WR-4b	26
WR-4d	26
WR-4f	27
WR-4g	22

Parameter Review and Results.

pH

The major reason for this investigation of Trout Creek water chemistry was an evaluation of pH levels in the stream, as mentioned earlier. pH is a measure of how acidic or basic a water body is. The pH can directly affect the survival of aquatic organisms. Pure water is neutral, with a pH of 7. pH readings below 7 indicate acidic conditions. Waters with pH less than 4 generally have no vertebrate life forms in them. pH readings above pH7 indicate basic conditions. 'pH affects many chemical and biological processes in water. For example, different organisms flourish within different ranges of pH. The majority of aquatic organisms prefer a range of 6.5 – 8.0. pH outside this range reduces the diversity in the stream because it stresses the physiological systems of most organisms and can reduce reproduction. Low pH can also allow toxic elements and compounds to become mobile and "available" for uptake by aquatic plants and animals. This can produce conditions that are toxic to aquatic life, particularly to sensitive species like rainbow trout. Changes in acidity can be caused by atmospheric deposition (acid rain), surrounding rock, and certain wastewater discharges.' (EPA ref 2).

Table 5. pH levels for the sample period Aug 2002-June 2004, with maximum, minimum, mean, and standard deviation.

Date	WR-4a	WR-4b	WR-4d	WR-4f	WR-4g
29-Aug-02	7.85	6.85	6.69	6.59	6.95
25-Sep-02	6.6	6.59	6.54	6.52	6.69
30-Oct-02	7.15	6.95	6.75	6.85	6.91
12-Nov-02	6.98	6.93	6.83	6.92	6.92
18-Nov-02	6.92	6.55	6.74	6.85	6.82
25-Nov-02	6.95	6.91	6.93	6.86	6.94
18-Dec-02	6.82	6.89	6.95	6.84	6.83
29-Jan-03	6.83	6.88	6.76	6.94	6.63
25-Feb-03	7.1	7.08	6.98	7.16	7.01
04-Mar-03	7.11	7.07	7.05	7.1	7.32
11-Mar-03	7.15	7.07	7.04	7.17	7.09
18-Mar-03	7.23	7.26	7.08	7.1	7.13
25-Mar-03	7.02	7.06	7.02	7.08	6.91
29-Apr-03	7.22	7.33	7.15	7.12	7.18
27-May-03	7.34	7.24	7.06	7	7.06
23-Jun-03	7.22	7.08	7.05	7.07	7.04
21-Jul-03	7.2	7.08	7.02	7.07	7.18
18-Aug-03	7.32	6.85	6.77	7.05	7.14
22-Sep-03	7.2	6.71	7.02	7.03	7.21
27-Oct-03	7.31	7.09	7.09	7.26	7.12
04-Nov-03	7.32	7.08	7.21	7.27	
12-Nov-03	7.19	7.22	7.21	7.34	
17-Nov-03	7.01	7.04	7	7.19	
01-Mar-04				6.93	
09-Mar-04	7.21				
16-Mar-04	7.21				
22-Mar-04	6.93				
26-Apr-04	7.13	6.98	6.8	6.98	
24-May-04	7.08	7.12	7.09	7.15	7.1
29-Jun-04	7.19	7.12	7.1	7.2	7.05
Ave	7.13069	7.001154	6.958846	7.023704	7.010455
Max	7.85	7.33	7.21	7.34	7.32
Min	6.6	6.55	6.54	6.52	6.63
Sdev	0.220404	0.189954	0.171542	0.191354	0.170251

Note: On March 22, 2004, the pH meter did not properly calibrate at the end of the day. The measurement taken that day thus may be in error.

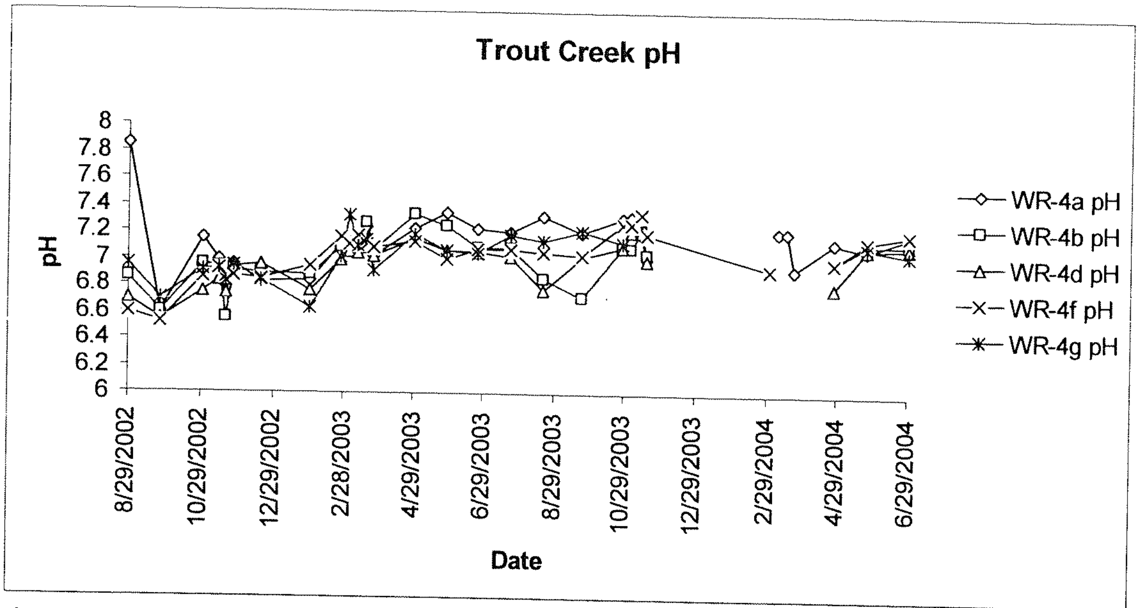


Figure 2. pH for each site displayed by date.

pH Results

Table 5 and Figure 2 display pH data for the entire sampling timeframe. As noted last year, there may have been a slight trend in increasing pH over time, and an increasing trend downstream.

No unusually low pH values were noted during the approximately 2 years of data collection. The lowest value recorded was 6.52, and each of the 5 sites averaged very close to pH 7.0. The lower pH values recorded occurred on a range of sites (Table 6). It does not appear that any one site showed significantly lower pH than other sites.

Table 6: The 10 lowest pH readings

Site	date	pH
WR-4f	9/25/2002	6.52
WR-4d	9/25/2002	6.54
WR-4b	11/18/2002	6.55
WR-4f	8/29/2002	6.59
WR-4b	9/25/2002	6.59
WR-4a	9/25/2002	6.6
WR-4g	1/29/2003	6.63
WR-4d	8/29/2002	6.69
WR-4g	9/25/2002	6.69
WR-4b	9/22/2003	6.71

There does appear to be a slight trend toward lower pH values in winter, and higher in summer. Also, as noted last year, there may be a slight indication of higher pH downstream. WR-4a, the furthest downstream site, had the highest average pH value.

Temperature

The temperature of water in a stream can adversely affect the biological and chemical processes that take place in the water body. 'Aquatic organisms from microbes to fish are dependent on certain temperature ranges for their optimal health. Optimal temperatures for fish depend on the species: some survive best in colder water, whereas others prefer warmer water. Benthic macroinvertebrates are also sensitive to temperature and will move in the stream to find their optimal temperature. If temperatures are outside this optimal range for a prolonged period of time, organisms are stressed and can die.' (EPA ref 1).

For fish there are two kinds of limiting temperatures, the maximum temperature for short exposures, and a weekly average temperature that varies according to the time of year and the life cycle stage of the fish species. Reproductive stages (spawning and embryo development) are the most sensitive stages.' (EPA ref 1) See table 1 for temperature criteria for salmonid fishes found in the Columbia River region.

Table 8. Lethal temperatures for selected salmonid species (Bjornn and Reiser 1991).

Species	Lower Lethal temp. °C	Upper Lethal temp. °C	Preferred Range °C
Coho Salmon	1.7	28.8	12-14
Chinook Salmon	0.8	26.2	12-14
Steelhead	0.0	23.9	10-13
Rainbow Trout	-	29.4	-
Cutthroat trout	0.6	22.8	-

Washington State Department of Ecology has set water quality standards for surface waters (WAC 173-201A). Limits have been set for temperatures, dissolved oxygen (DO),and turbidity in different class streams. Washington State has 4 classes ranging from Class AA (extraordinary), through Class C (fair). All the sites in this study are on federal land (US Forest Service) and are required to meet Class AA standards (table 5).

Table 9 Washington State surface water quality standards.

Class	Temperature °C shall not exceed	DO mg/L shall exceed	pH range shall be within
AA	16	9.5	6.5 - 8.5

'Temperature affects the oxygen content of the water (oxygen levels become lower as temperature increases); the rate of photosynthesis by aquatic plants; the metabolic rates of aquatic organisms; and the sensitivity of organisms to toxic wastes, parasites, and diseases.' (EPA ref 1) As temperature increases the organisms use up more oxygen as respiration increases while they adjust to cope with the rising temperature.

Factors affecting stream water temperatures include the weather, the amount of vegetation providing shade along the stream bank, groundwater inflows, the volume of water, the depth of the water, impoundments (barriers such as dams that restrict the flow), and the turbidity of the water. Wide shallow streams with slow flows are more likely to have increased temperatures as more of the water body is exposed to sunlight for a longer period of time compared to water in a narrow, deep channel with a rapid flow. 'Stream temperatures can be altered by removal of streambank vegetation, withdrawal and return of water for irrigation, release of water from deep reservoirs, and cooling of nuclear power plants.' (Bjornn and Reiser, 1991).

Manual temperatures were collected during the sampling period, while gathering general water chemistry data (pH, DO, etc.). This temperature data helps to monitor the effect water temperature may have on the other data. The data also gives us a "snapshot" in time of temperature information. However, since it is only a snapshot, it probably tells us little about the temperature status of the stream. For detailed temperature data continuous monitoring is required (see USGS annual reports).

Table 10. Temperature data gathered during water chemistry sampling at each site, with maximum, minimum, mean, standard deviation and state maximum.

Site	WR-4a	WR-4b	WR-4d	WR-4f	WR-4g
		water Temp*C			
29-Aug-02	14.8	13.5	14.8	5.8	13.6
25-Sep-02	10.5	10.1	9.8	5.1	9
30-Oct-02	3.6	3.3	5	4	2
12-Nov-02	6.9	6.3	6.4	5.8	7.1
18-Nov-02	6.5	6.1	6.1	5.6	6.5
25-Nov-02	4.9	4.4	4.2	4.7	3.8
18-Dec-02	4.4	4.2	4.2	4.7	5
29-Jan-03	4.3	4	4	4.5	4.6
25-Feb-03	3.6	2.1	2.8	3.7	2.5
04-Mar-03	4.7	3.6	3.7	4.3	3.8
11-Mar-03	4.9	4	4.2	4.7	4.7
18-Mar-03	5.1	4.4	4.3	4.6	4.6
25-Mar-03	5.2	4.5	4.6	4.7	4.9
29-Apr-03	7.9	6.1	6.5	5.3	6
27-May-03	9.5	7.7	8	4.8	7.1
23-Jun-03	9.1	8.2	9.1	4.8	8.3
21-Jul-03	13.3	13	13.1	5.2	13.8
18-Aug-03	16	13.6	15.1	5.3	13
22-Sep-03	12.9	11	10.5	6.1	9.6
27-Oct-03	9	8.7	8.4	6.3	
04-Nov-03	4.7	4.4	4.3	5.4	
12-Nov-03	6.5	5.8	5.9	5.9	
17-Nov-03	6.6	6.4	6.3	6.4	6.8
01-Mar-04				5.7	
09-Mar-04	5.5				
16-Mar-04	5.5				
22-Mar-04	6.4				
26-Apr-04	8.8	6.2	6.4	5.7	
24-May-04	7.5	8.2	8.9	6.4	8.6
29-Jun-04	14.6	11.3	12.7	6.7	10.5
Ave	7.696551724	6.965384615	7.280769231	5.266667	7.081818
Max	16	13.6	15.1	6.7	13.8
Min	3.6	2.1	2.8	3.7	2

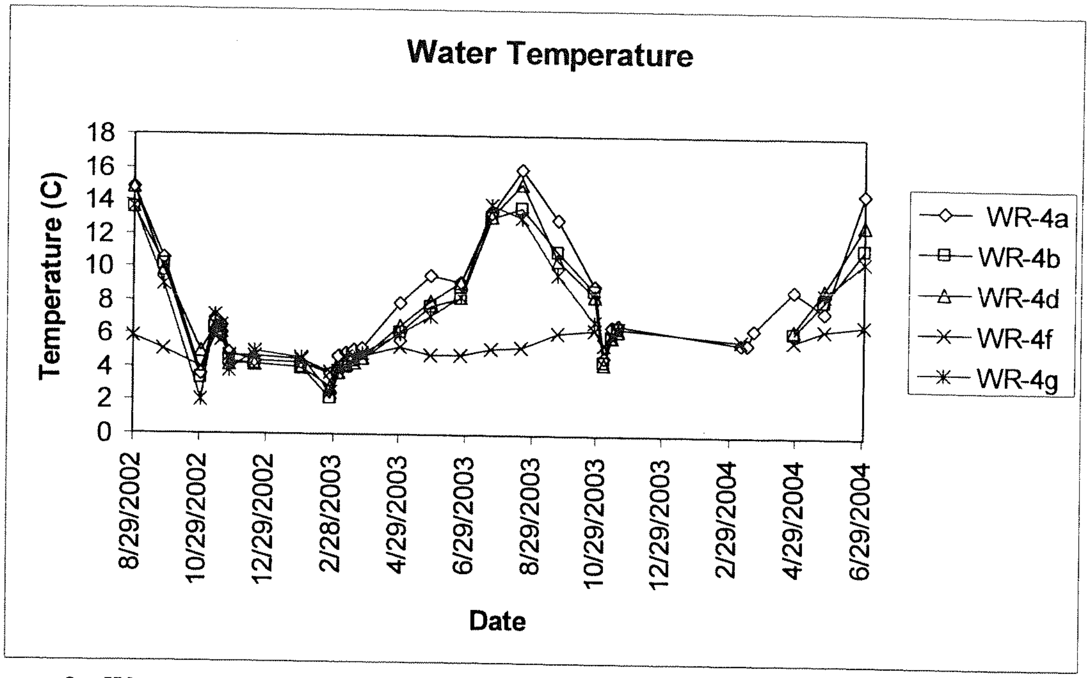


Figure 3. Water temperature data collected during the sampling period August 2002 to June 2004.

As would be expected, temperature fluctuated seasonally. Site 4f continued to display consistently cool temperatures throughout the year (max. 6.7, min. 3.7), likely due to groundwater input just upstream.

The mean of all temperatures recorded at each site for the sample period (table 11) indicate a slight increase downstream. Maximum temperatures recorded were 16°C in August 2003. While this is below the state maximum for Class AA streams it should be noted that the temperatures were recorded during the morning and early afternoon, and temperatures may still rise well into the afternoon. UCD and USGS also used continuous-reading temperature loggers (Onset® HOBOs® and Stowaways®) throughout the Wind River watershed to gather temperature data. Refer to the 2003 BPA report by USGS for the results.

Table 11
Average Temperature by Site

Site	Avg water Temp*C
WR-4a	7.70
WR-4b	6.97
WR-4d	7.28
WR-4f	5.27
WR-4g	7.08

Dissolved Oxygen

Dissolved oxygen (DO) is a measure of the amount of oxygen dissolved in water. It is important for determining whether the water body can support organisms which require oxygen – aerobic organisms – such as fish and zooplankton. High dissolved oxygen levels are better. Generally, levels of 5-6 mg/L can support diverse forms of aquatic life (USGS ref1).

DO is both produced and consumed in the stream system. Oxygen is acquired from the atmosphere and from plants as a result of photosynthesis. Running water dissolves more oxygen than still water as the turbulence at the water surface traps more air. Aquatic animal respiration, decomposition, and various chemical reactions consume oxygen. 'Oxygen is measured in its dissolved form as DO. If more oxygen is consumed than is produced, DO levels decline and some sensitive animals may move away, weaken, or die.' (EPA ref 3).

'DO levels fluctuate seasonally and over a 24-hour period. They vary with water temperature and altitude. Cold water holds more oxygen than warm water and water holds less oxygen at higher altitude. Aquatic animals are most vulnerable to lowered DO levels in the early morning on hot summer days when stream flows are low. Water temperatures are high, and aquatic plants have not been producing oxygen since sunset.' (EPA ref 3).

Table 12. DO levels with minimum, maximum, mean, standard deviation, and the state minimum requirement for the creeks on federal land. (DO not reported for 4a on 12 Nov 2002, due to recording error)

	WR-4a	WR-4b	WR-4d	WR-4f	WR-4g
Date	DO mg/L	DO mg/L	DO mg/L	DO mg/L	DO mg/L
29-Aug-02	8.96	7.8	7.59	10.5	8.39
25-Sep-02	11.36	9.22	10.65	12.25	10.51
30-Oct-02	12.86	11.54	9.84	12.4	12.75
12-Nov-02		11.48	11.49	11.84	11.43
18-Nov-02	11.86	11.77	11.77	12.17	11.75
25-Nov-02	12.13	12.15	12.43	12.42	12.61
18-Dec-02	11.18	12.33	12.44	12.57	11.18
29-Jan-03	10.25	12.04	12.17	12.24	12.58
25-Feb-03	12.67	13.14	12.82	12.51	13.21
04-Mar-03	12.23	12.24	12.56	12.34	12.97
11-Mar-03	12.21	12.55	12.63	12.55	13.26
18-Mar-03	12.19	12.54	12.7	12.71	12.5
25-Mar-03	12	12.35	12.56	12.54	13.65
29-Apr-03	11.86	12.06	12.04	12.3	12.13
27-May-03	11.84	11.43	11.33	12.13	11.45
23-Jun-03	11.4	10.94	10.69	11.27	11.21
21-Jul-03	10.04	8.51	8.27	11.89	8.92
18-Aug-03	10.38	8.28	8.2	12.62	9.45
22-Sep-03	10.9	9.42	9.8	12.03	11.71
27-Oct-03	10.98	10.54	10.74	11.6	12.02
04-Nov-03	12.57	12.44	12.26	12.61	
12-Nov-03	11.89	11.74	12.01	12.15	
17-Nov-03	11.85	11.97	11.88	12	
09-Mar-04	12.73			12.42	
16-Mar-04	12.73				
22-Mar-04	12.83				
26-Apr-04	11.92	12.41	12.05	15.9	
24-May-04	10.93	11.65	11	12.05	12.09
29-Jun-04	10.38	10.7	9.88	11.92	11.15
Ave	11.61179	11.27846	11.22308	12.2937	11.67818
Max	12.83	13.14	12.82	15.9	13.65
Min	10.04	8.28	8.2	11.27	8.92
Sdev	0.972507	1.457056	1.492318	0.859737	1.380427
Class AA Min.	9.5	9.5	9.5	9.5	9.5

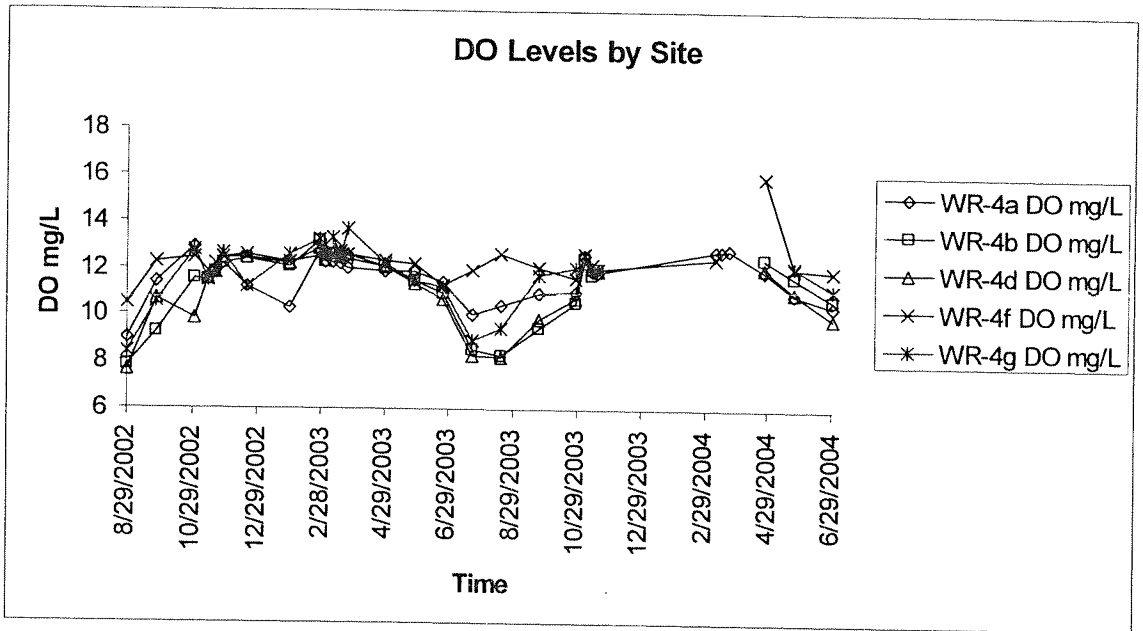


Figure 4. DO levels for each site over the sampling period.

Trout Creek at site 4f (km 32.03) has higher DO on average throughout the year compared to the other sites (figure 4 and table 12), and varies the least. This correlates with the temperatures recorded at the time of sampling (fig 10). Site 4f is consistently cooler and temperature fluctuates little over the year. The general trend in fig 11 indicates a decrease in DO downstream. It also indicates that the two tributaries, Compass Creek and Crater Creek, have slightly lower average DO compared to Trout Creek.

DO remains fairly constant but there are slight variations that appear to correlate with changes in temperature, which would be expected. August 2002 shows all but site 4f, were below the state Class AA minimum. This also coincides with the highest temperatures recorded for all the sites. 4b (Crater Creek) was also below the state standard in September. Site 4f has consistently cool temperatures which helps DO remain fairly constant and above the state minimum.

DO Summary

Dissolved oxygen levels were above the state standard (9.5 mg/L) in all but 12 measurements. Those 12 all occurred in July, August, and September, indicating an expected trend toward lower dissolved oxygen levels with increasing water temperature. Site WR-4f displayed the most consistent DO levels, reflecting its cool, consistent temperature.

Turbidity

Turbidity is a measure of the clarity of the water. The amount of debris, soil particles, or plankton in the water affects the amount of sunlight that reaches aquatic plants. High turbidity will reduce the amount of light passing through the water column and reduce the plant's ability for photosynthesis, and so reduce the amount of available oxygen in the water. Excess silt and detritus in the water can also smother spawning areas, covering eggs with silt so they cannot breathe.

'Higher turbidity increases water temperatures because suspended particles absorb more heat. This in turn, reduces the concentration of dissolves oxygen (DO) because warm water holds less DO than cold.' (EPA ref 4). 'Suspended materials can clog fish gills, reducing resistance to disease in fish, lowering growth rates, and affecting egg and larval development. As the particles settle, they can blanket the stream bottom, especially in slower waters, and smother fish eggs and benthic macroinvertebrates. Sources of turbidity include; soil erosion, waste discharge, urban runoff, eroding stream banks, and excessive algal growth.

Regular monitoring of turbidity can help detect trends that might indicate increasing erosion in developing watersheds. However, turbidity is closely related to stream flow and velocity and should be correlated with these factors. Comparisons of the change in turbidity over time, therefore should be made at the same point at the same flow. Turbidity is not a measurement of the amount of suspended solids present or the rate of sedimentation of a stream since it measures only the amount of light that is scattered by suspended particles.' (EPA ref 4).

Table 13. Turbidity data for the sample period. (No turbidity data exists for May and June 2003 as the meter was out of service).

	WR-4a	WR-4b	WR-4d	WR-4f	WR-4g
Date	Turbidity	Turbidity	Turbidity	Turbidity	Turbidity
29-Aug-02	0.24	0.9	0.63	1.97	1.64
25-Sep-02	0.29	0.25	0.69	0.51	0.64
30-Oct-02	0.26	0.37	0.27	0.41	2.82
12-Nov-02	2.32	0.76	0.67	1.41	0.96
18-Nov-02	0.57	0.42	0.27	0.29	0.36
25-Nov-02	0.28	0.24	0.28	0.24	0.6
18-Dec-02	0.76	0.54	0.36	1.08	0.76
29-Jan-03	1.85	0.64	0.66	0.46	0.66
25-Feb-03	0.65	0.46	0.36	0.37	0.41
04-Mar-03	0.54	0.27	0.33	0.29	0.5
11-Mar-03	1	0.41	0.35	0.34	0.45
18-Mar-03	0.7	0.37	0.33	0.43	0.47
25-Mar-03	1.19	0.57	0.58	0.55	0.51
29-Apr-03	0.51	0.25	0.39	0.3	0.51
27-May-03					
23-Jun-03					
21-Jul-03	0.52	0.25	0.41	0.8	0.63
18-Aug-03	0.67	0.3	0.59	0.43	0.94
22-Sep-03	0.47	0.33	0.5	0.56	1.34
27-Oct-03	0.33	0.35	0.4	0.51	0.69
04-Nov-03	0.34	0.31	0.31	0.31	
12-Nov-03	0.46	0.3	0.37	0.36	
17-Nov-03	1.94	1.88	1.72	0.79	
09-Mar-04	0.98			0.31	
16-Mar-04	0.98				
22-Mar-04	0.6				
26-Apr-04	0.7	1.08	0.3	0.82	
24-May-04	0.53	0.41	0.52	0.41	0.63
29-Jun-04	0.41	0.45	0.51	0.52	0.8
Ave	0.744074	0.504583	0.491667	0.5788	0.816
Max	2.32	1.88	1.72	1.97	2.82
Min	0.24	0.24	0.27	0.24	0.36
Sdev	0.120208	0.318198	0.084853	1.025305	0.59397

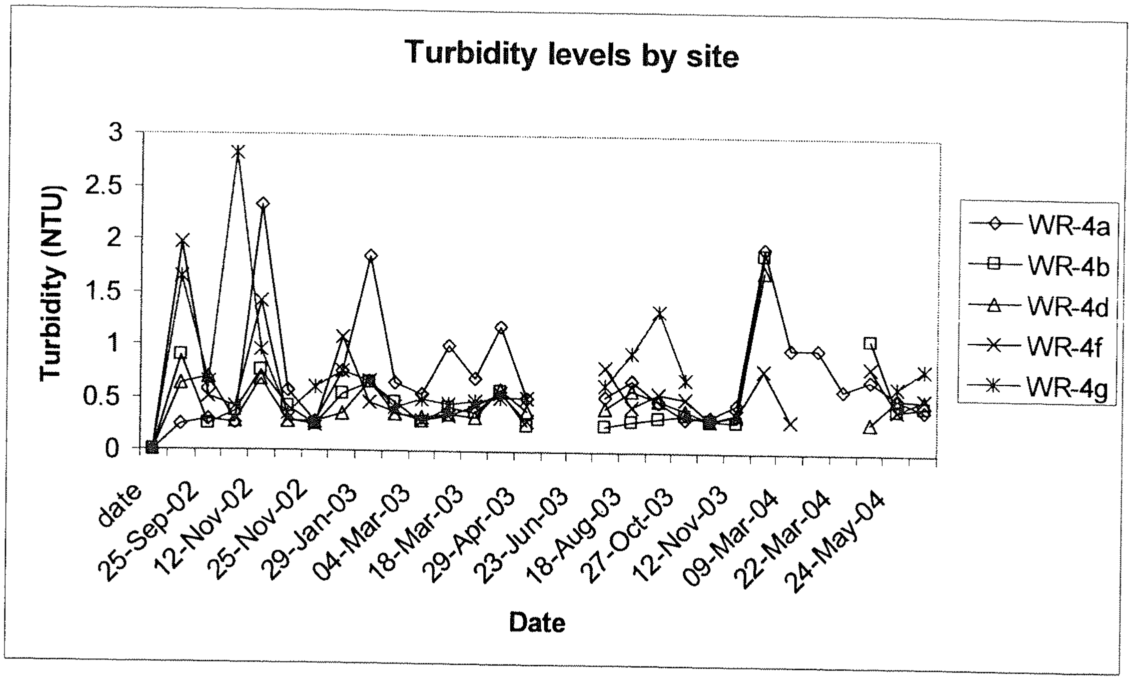


Figure 5. Turbidity levels by site during the sampling period.

Turbidity levels were consistently low on all the dates sampled, with higher levels generally occurring during winter storms and periods of higher flow. Sites WR-4a and 4g showed the highest average turbidity and the highest individual values.

Conductivity

Conductivity is a measure of the ability of water to pass an electrical current. Conductivity in water is affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate, and phosphate anions. (ions that carry a negative charge) or sodium, magnesium, calcium, iron, and aluminum cations (ions that carry a positive charge). Organic compounds like oil, phenol, alcohol, and sugar do not conduct electrical current very well and therefore have low conductivity when in water. Conductivity is also affected by temperature; the warmer the water, the higher the conductivity. For this reason, conductivity is reported at 25 degrees Celsius (25C). Conductivity in streams and rivers is affected primarily by the geology of the area through which the water flows. Streams that run through areas with clay soils tend to have higher conductivity because of the presence of materials that ionize when washed into the water. Ground water inflows can have the same effects depending on the bedrock they flow through.

The conductivity of rivers in the United States generally ranges from 50 to 1500 us/cm. Studies of inland fresh waters indicate that streams supporting good mixed fisheries have a range between 150 and 500 ms/cm. Conductivity outside this range could indicate that the water is not suitable for certain species of fish or macroinvertebrates.' (EPA ref 5)

Conductivity is useful as a general measure of stream water quality. Each stream tends to have a relatively constant range of conductivity that, once established, may be used as a baseline for comparison with regular conductivity measurements. Significant changes in conductivity could then be an indicator that a discharge or some other source of pollution has entered a stream (EPA ref. 5).

Table 14. Conductivity levels for the sample period August 2002 to June 2004, with Minimum, maximum, mean, and standard deviation.

Date	WR-4a	WR-4b	WR-4d	WR-4f	WR-4g
29-Aug-02	29.1	36.1	34	27.2	33.4
25-Sep-02	30.7	39.3	36	28.5	35.3
30-Oct-02	31.3	36.8	38.7	28.3	34.8
12-Nov-02	31.2	31.4	30.7	29.6	32.9
18-Nov-02	28	27	26	28	31.9
25-Nov-02	27.4	28	25	25.6	31.7
18-Dec-02	21.5	21.9	18.4	20.4	21.5
29-Jan-03	19.7	21.4	17.8	19.3	20.2
25-Feb-03	21.1	21.7	18.3	20.7	22.6
04-Mar-03	20.1	23.9	20.3	21.4	24
11-Mar-03	21.4	21.2	18.96	22.3	23.8
18-Mar-03	22.1	23.3	19.14	20.9	22.5
25-Mar-03	21	22.2	18.17	19.74	20.8
29-Apr-03	24.8	26	22.1	22.9	26.2
27-May-03	27.2	26.7	25	24.1	28.1
23-Jun-03	28.1	32.2	29.3	25.3	31.1
21-Jul-03	30.2	77	36.1	27.6	34.7
18-Aug-03	31	42.3	38.2	28.8	37.4
22-Sep-03	33.3	37.4	39.5	30	38
27-Oct-03	33.4	32.6	34.9	30.5	30.26
04-Nov-03	32.2	31.2	32.7	30	
12-Nov-03	31.8	30.5	28.6	30.6	
17-Nov-03	27.6	24.6	25.7	30.6	
09-Mar-04	23.2			23.9	
16-Mar-04	23.2				
22-Mar-04	24.1				
26-Apr-04	24.7	25.4	21.7	22.3	
24-May-04	26.6	28.8	23.6	22.9	27.9
29-Jun-04	28	31.3	27.2	24.3	29.3
Ave	26.68966	30.77692	27.15654	25.39778	29.01636
Max	33.4	77	39.5	30.6	38
Min	19.7	21.2	17.8	19.3	20.2
Sdev	4.29737	11.1476	7.22538	3.792581	5.605149

Conductivity Summary

Based on the data collected, conductivity ranges from the high teens to high 30s. Site WR-4b, on July 21 2003, showed a value about twice as high as any other measure during the study; this may be an error in reading the instrument, or an instrument error, it does not seem to be consistent with other data. Dramatic increases or decreases were not observed, other than this one instance. In general conductivity was higher during low flow periods, (possibly due to increased concentration with less water volume).

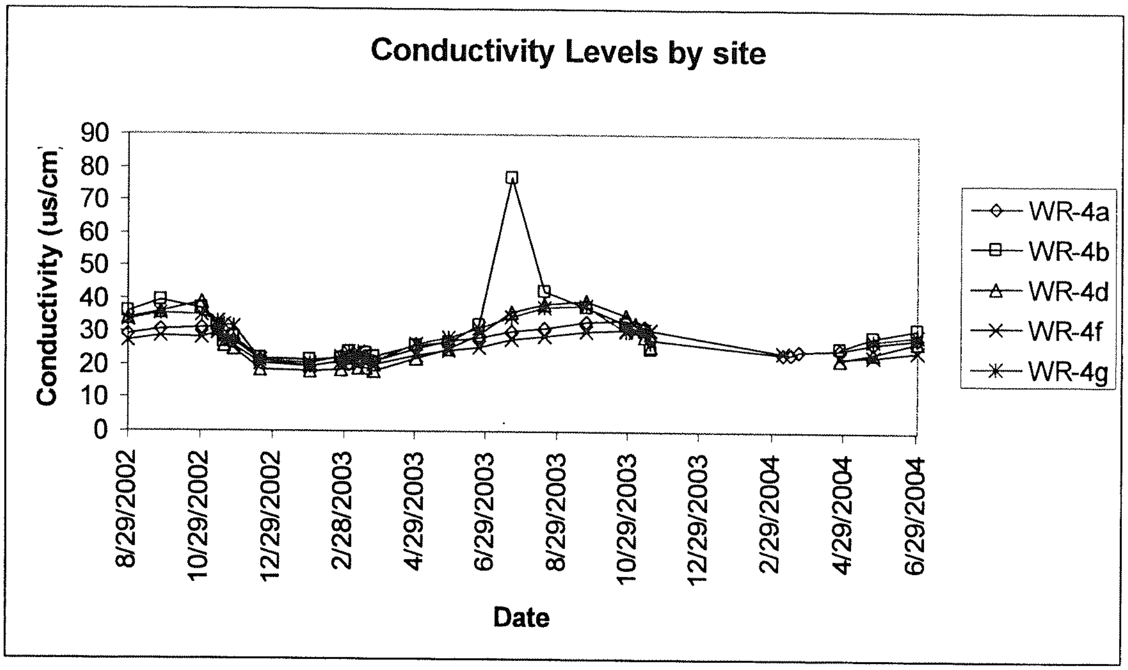


Figure 6. Conductivity levels by site during the sampling period.

Advanced Chemical Analysis

Samples were collected in laboratory prepared sample bottles for Alkalinity, Total suspended solid. Sulfate, tannins and lignins. The samples were sent to an EPA certified laboratory who analyzed the samples using EPA methodologies.

Columbia Analytical Services
1317 South 13th Avenue
Kelso WA.

Total Suspended Solids

Total suspended solids (TSS) is an assessment of the amount of solid material suspended in the water column. Suspended solids include silt, clay, plankton, algae, organic debris, and other particulate matter. High concentrations act as carriers for toxins. As with turbidity, suspended sediments can affect fish habitat by increasing water temperatures and reduction of dissolved oxygen from reduced photosynthesis.

Sampling in Trout Creek almost always resulted in no detection of TSS, the water was very clear. With the EPA TSS testing method 160.2 the reporting level was 5mg/L, only 6 out of the 64 samples were above this reporting level, and each of those readings were low (5, 6, or 7mg/L).

TSS Summary

Based on the data collected, TSS levels were very low, (almost always below the tests reporting/detection limit). Although it appears that the readings are non existent, this is still 'good data' as it is contributing to the establishment of normal / background levels (normally below 5mg/L).

Table 15. Total Suspended Solid (TSS) levels for the sample period August 2002-June 2004.

	WR-4a	WR-4b	WR-4d	WR-4f	WR-4g
date	TSS mg/L	TSS mg/L	TSS mg/L	TSS mg/L	TSS mg/L
29-Aug-02	<5	<5	<5	<5	<5
25-Sep-02	<5	<5	<5	<5	<5
30-Oct-02	<5	<5	<5	<5	<5
12-Nov-02	<5	<5	<5	<5	<5
18-Nov-02	<5	<5	<5	<5	<5
25-Nov-02	<5	<5	<5	<5	<5
18-Dec-02	<5	<5	<5	<5	<5
29-Jan-03	<5	<5	<5	<5	<5
25-Feb-03	<5	<5	<5	<5	<5
04-Mar-03	<5	<5	<5	6	<5
11-Mar-03	<5	<5	<5	<5	6
18-Mar-03	<5	<5	<5	<5	<5
25-Mar-03	<5	<5	<5	<5	<5
29-Apr-03	<5	<5	<5	5	<5
27-May-03	<5	<5	6	<5	<5
23-Jun-03	<5	<5	7	<5	7
21-Jul-03	<5	<5	<5	<5	<5
18-Aug-03					
22-Sep-03	<5	<5	<5	<5	<5
27-Oct-03	<5	<5	<5	<5	
04-Nov-03	<5	<5	<5	<5	
12-Nov-03	<5	<5	<5	<5	
17-Nov-03	<5	<5	<5	<5	<5
09-Mar-04	<5			<5	
16-Mar-04	<5				
22-Mar-04	<5				
26-Apr-04	<5	<5	<5	<5	
24-May-04	<5	<5	<5	<5	<5
29-Jun-04					

Alkalinity

Alkalinity is a measure of the capacity of water to neutralize acids (see pH description). Alkaline compounds in the water such as bicarbonates (baking soda is one type), carbonates, and hydroxides remove H+ ions and lower the acidity of the water (which means increased pH). They usually do this by combining with the H+ ions to make new compounds. Without this acid-neutralizing capacity, any acid added to a stream would cause an immediate change in the pH. Measuring alkalinity is important in determining a stream's ability to neutralize acidic pollution from rainfall or wastewater. It's one of the best measures of the sensitivity of the stream to acid inputs.

Alkalinity in streams is influenced by rocks and soils, salts, certain plant activities, and certain industrial wastewater discharges. For fish, alkalinity can be important in maintaining the acidic level of streams in an acceptable range.

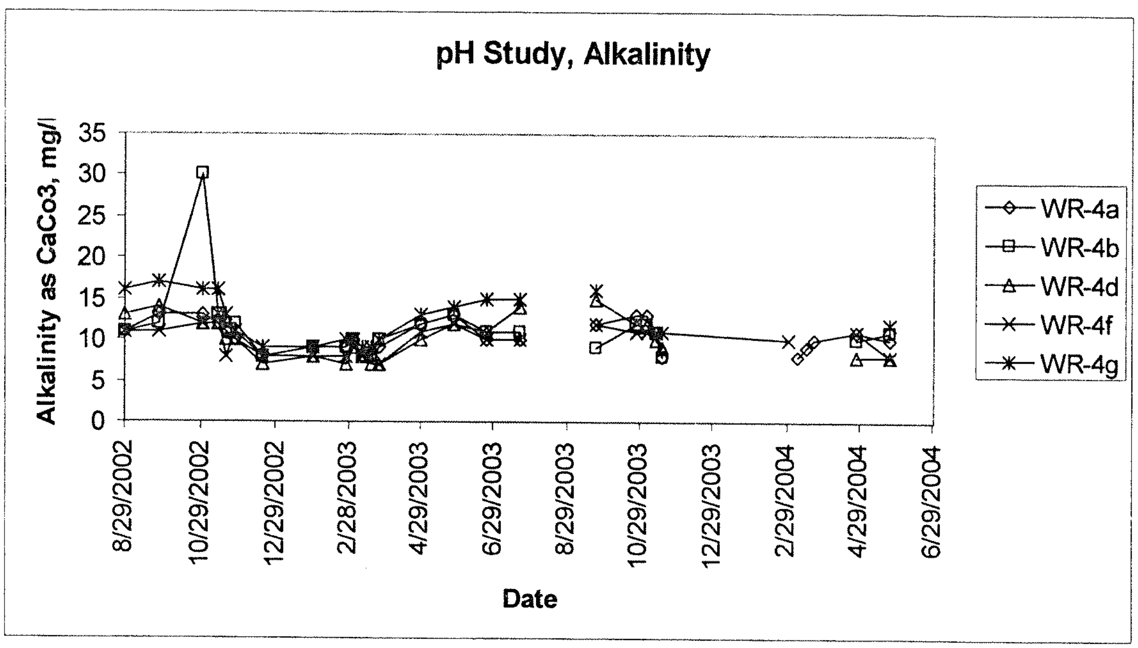
Total alkalinity is assessed by measuring the amount of acid (e.g., sulfuric acid) needed to bring the sample to a pH of 4.2. At this pH all the alkaline compounds in the sample are "used up." The result is reported as milligrams per liter of calcium carbonate (mg/L $CaCO_3$).

Table 16. Alkalinity levels for each site with minimum, maximum, mean, standard deviation and method reporting limit.

			Alkalinity as CaCo3 mg/L		
date	WR-4a	WR-4b	WR-4d	WR-4f	WR-4g
29-Aug-02	11	11	13	11	16
25-Sep-02	13	12	14	11	17
30-Oct-02	13	30	12	12	16
12-Nov-02	12	13	12	13	16
18-Nov-02	11	12	10	8	13
25-Nov-02	10	12	10	11	11
18-Dec-02	8	8	7	8	9
29-Jan-03	9	9	8	8	9
25-Feb-03	9	9	7	8	10
04-Mar-03	10	10	9	9	10
11-Mar-03	8	8	8	8	9
18-Mar-03	8	8	7	8	9
25-Mar-03	9	10	7	7	10
29-Apr-03	12	12	10	11	13
27-May-03	13	13	12	12	14
23-Jun-03	10	11	11	10	15
21-Jul-03	10	11	14	10	15
18-Aug-03					
22-Sep-03	12	9	15	12	16
27-Oct-03	13	12	12	11	
04-Nov-03	13	12	12	11	
12-Nov-03	11	11	10	11	

17-Nov-03	8	8	9	11	11
				10	
09-Mar-04	8				
16-Mar-04	9				
22-Mar-04	10				
26-Apr-04	11	10	8	11	
24-May-04	10	11	8	8	12
29-Jun-04					
Ave	10.40741	11.33333	10.20833	10	12.55
Max	13	30	15	13	17
Min	8	8	7	7	9
Sdev	1.759791	4.290198	2.466809	1.683251	2.874113

Figure 7 Alkalinity level for each site, August 2002 to June 2004.



Trout Creek samples show fairly stable levels of CaCO3. The lowest levels appear in the winter and increase as flows decrease in to the summer. Compass Creek (4b) has the highest reading (30 mg/L) in October 2002. This is unusually high compared to the rest of the sites on that date, and even compared to previous and subsequent readings at the same site.

Alkalinity Summary

Overall alkalinity fluctuated gradually, and coincided with seasonal changes in temperatures and flow.

Sulfate

Sulfate is a measure of the acid in water. Sulfates enter streams from acid rain, rocks and soils, and from plant materials. Coniferous plants are often acidic and produce acidic soils. Precipitation falling onto acidic detritus and soils will pick up some of the acidity. It was speculated that the snow pack may contribute to increased acidity into Trout Creek. Snow may fall as an acidic precipitation, and /or pick up acid from the soils and plants on which it settles. The slow melting of snow allows the water to remain on acidic surfaces longer than a rain storm might, and so have a better chance of absorbing acids. Samples were analyzed using EPA method 300.0, with a method reporting limit of 0.2mg/L.

Table 17. Sulfate levels recorded for the sample period August 2002 to June 2004, with minimum, maximum, mean, standard deviation and method reporting limit.

date	WR-4a	WR-4b	WR-4d	WR-4f	WR-4g
29-Aug-02	1.1	1.1	1.5	1	0.4
25-Sep-02	1.2	1.2	1.8	1	0.4
30-Oct-02	1.1	0.9	1.8	1.1	0.3
12-Nov-02	0.9	0.8	1.3	0.9	0.4
18-Nov-02	0.7	0.7	0.8	0.9	0.4
25-Nov-02	0.8	0.7	0.9	1	0.4
18-Dec-02	0.5	0.6	0.6	0.6	0.4
29-Jan-03	0.5	0.6	0.5	0.5	0.3
25-Feb-03	0.6	0.7	0.7	0.6	0.5
04-Mar-03	0.6	0.7	0.8	0.6	0.4
11-Mar-03	0.6	0.7	0.7	0.6	0.5
18-Mar-03	0.6	0.6	0.6	0.6	0.4
25-Mar-03	0.6	0.7	0.7	0.6	0.5
29-Apr-03	0.7	0.8	0.7	0.7	0.5
27-May-03	0.6	0.7	0.7	0.6	0.3
23-Jun-03	0.7	0.9	1	0.7	0.3
21-Jul-03	0.9	1	1.4	0.8	0.3
18-Aug-03					
22-Sep-03	1.1	0.9	2.3	1.1	0.2
27-Oct-03	1	0.9	1.3	1.1	0.3
04-Nov-03	1	0.8	1.3	1.2	0.3
12-Nov-03	0.8	0.7	0.9	1.1	
17-Nov-03	0.6	0.5	0.8	0.7	
				0.6	
09-Mar-04	0.5				
16-Mar-04	0.5			0.6	
22-Mar-04	0.5			0.6	
26-Apr-04	0.5	0.6	0.6	0.6	

24-May-04	0.6	0.7	0.6	0.6	0.3
29-Jun-04					
Ave	0.733333	0.770833	1.0125	0.777778	0.371429
Max	1.2	1.2	2.3	1.2	0.5
Min	0.5	0.5	0.5	0.5	0.2
Sdev	0.223607	0.168056	0.472102	0.218972	0.084515
Method Reporting Limit	0.2	0.2	0.2	0.2	0.2

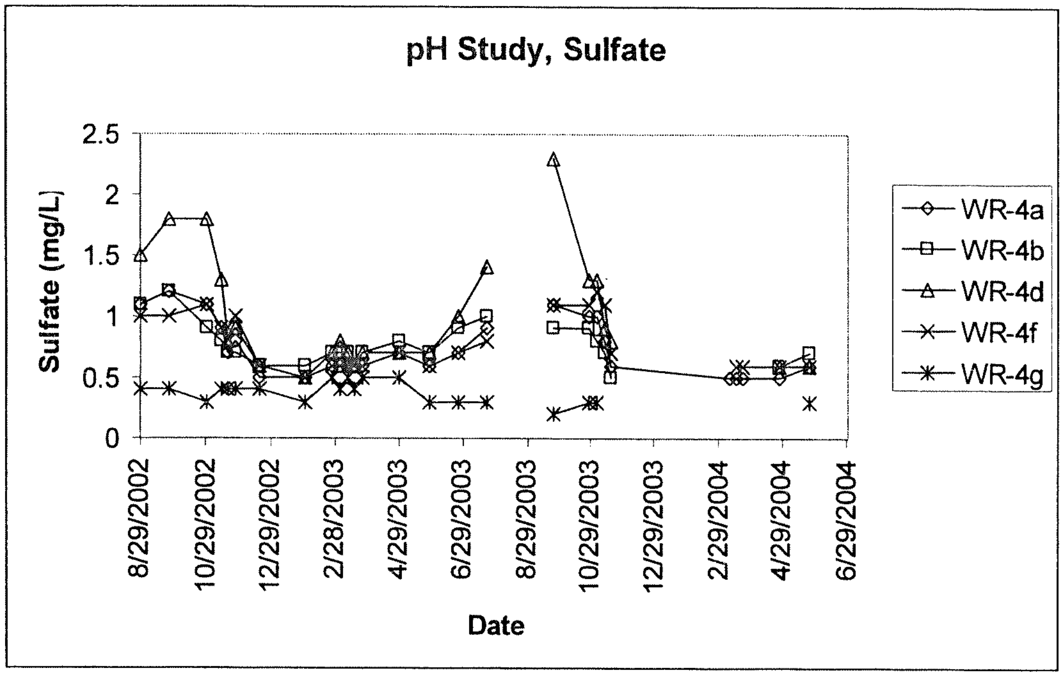


figure 8. Sulfate levels for each site from August 2002 to June 2004.

Based on the data collected, the sulfate levels appeared to be higher in fall, and lowest in winter, when flows were highest. over the sample period. The lowest levels were in the winter when flows were highest. The highest sulfate levels were in September and October. In particular, Compass Creek had very high readings during periods of low flow. Upper Trout Creek at site 4g consistently displayed the lowest levels throughout the year, and fluctuated very little. The higher sulfate readings in the late summer may have been due to increased temperatures and low flows causing sulfate to be in higher concentration.

Sulfate Summary

Sulfate was highest in the late summer, and appears to fluctuate seasonally being lower in winter when flows are higher (possibly diluting sulfate levels). The trend appears to coincide with the lowest pH readings also in late summer. pH increased slightly as sulfate decreased through the winter. Sulfate levels increased slightly downstream.

Tannins and Lignins

Tannins and lignins can enter the stream system from decaying plant material. They can contribute to the acidity of water, lowering the pH. Sampling for tannins and lignins may help identify a source if the waters are found to be acidic.

Samples were taken only a few times during the sample period due to the high cost of the analysis. Columbia Analytical Services used Standard Method SM 5550 B with a method reporting limit of 0.2mg/L.

Table 18. Tannin and lignin levels recorded during the sampling period August 2002-June 2004.

Date	WR-4a	WR-4b	WR-4d	WR-4f	WR-4g
29-Aug-02	<.2	<.2	0.2	<.2	0.2
25-Sep-02					
30-Oct-02					
12-Nov-02					
18-Nov-02	0.4	0.3	0.4	<.2	0.3
25-Nov-02					
18-Dec-02					
29-Jan-03					
25-Feb-03					
04-Mar-03					
11-Mar-03	<.2	<.2	<.2	<.2	<.2
18-Mar-03	0.3	0.2	0.3	<.2	<.2
25-Mar-03	0.3	<.2	0.2	<.2	<.2
29-Apr-03	0.2	<.2	<.2	<.2	<.2
27-May-03	<.2	<.2	<.2	<.2	<.2
23-Jun-03	<.2	<.2	0.3	<.2	<.2
21-Jul-03	<.2	<.2	0.3	<.2	0.3
18-Aug-03	<.2	<.2	0.3	<.2	0.3
22-Sep-03					
27-Oct-03					0.9
04-Nov-03	0.2	0.2	0.3	<0.2	
12-Nov-03	0.6	0.4	0.6	0.3	
17-Nov-03	0.9	0.6	0.8	0.7	
01-Mar-04				<.2	
09-Mar-04	0.3				
16-Mar-04	0.2				
22-Mar-04	<.2				
26-Apr-04	<.2	<.2	<.2	<.2	
24-May-04	.2	<.2	0.2	<.2	0.3
29-Jun-04					
Ave	0.414286	0.34	0.354545	0.5	0.383333
Max	0.9	0.6	0.8	0.7	0.9
Min	0.2	0.2	0.2	0.3	0.2
Sdev	0.254484	0.167332	0.186353	0.282843	0.256255

From the data gathered, it appears that tannins and lignins contribute limited amounts to the water. A majority of the readings were below the method reporting limit of 0.2mg/L.

pH values did not appear to be lower when tannins and lignins were detected. On the 28 samples where tannins and lignins were detectable, the pH average was 7.06. This does not differ materially from the overall average pH of 7.03.

Tannins and Lignins Summary

Tannin and Lignin levels appear to be very low, with values commonly below the detection limit. Also, there appeared to be no connection between detectable tannin and lignin levels and lower pH values.

Overall Summary

Based on approximately 2 years of data involving 130 sample collections, pH does not appear to be unusually low in Trout Creek. The overall average pH from these samples was 7.03, with sites varying from an average pH of 6.96 to 7.13. In no cases was a pH level lower than 6.5 detected. Other parameters collected generally were indicative of a healthy stream system.