The Winlaw Creek Water Monitoring Program

Summary Report 1996 - 2010

The Winlaw Watershed Committee

Background

The Winlaw Creek Monitoring Program was initiated in 1996 with a grant from the Provincial Government under the Forest Renewal B.C. Program (FRBC). The Winlaw Watershed Committee has sponsored the program.since 1999.

The objectives of the program are to obtain baseline data on water quantity and quality and use this information in conjunction with ecosystem based forest management as basis for sustainable forest management.

With the development of a Community Based Forest License, this ideal is now a real possibility.

To date, the program has compiled 13 years of data on water and air temperature, flow, sediment, turbidity, conductivity and coliform bacteria levels. Data on macro invertebrates, nutrients, and low-level metals were also been collected in 1997 – 1999, 2006 and again in 2010. In Fall, 2006 and 2010, invertebrate samples were again collected under Environment Canada's CABIN protocol. Now in its 14th year, the Winlaw Creek monitoring program is currently funded through on-going community efforts including the annual Winlaw "May Day" celebrations.

Acknowledgements

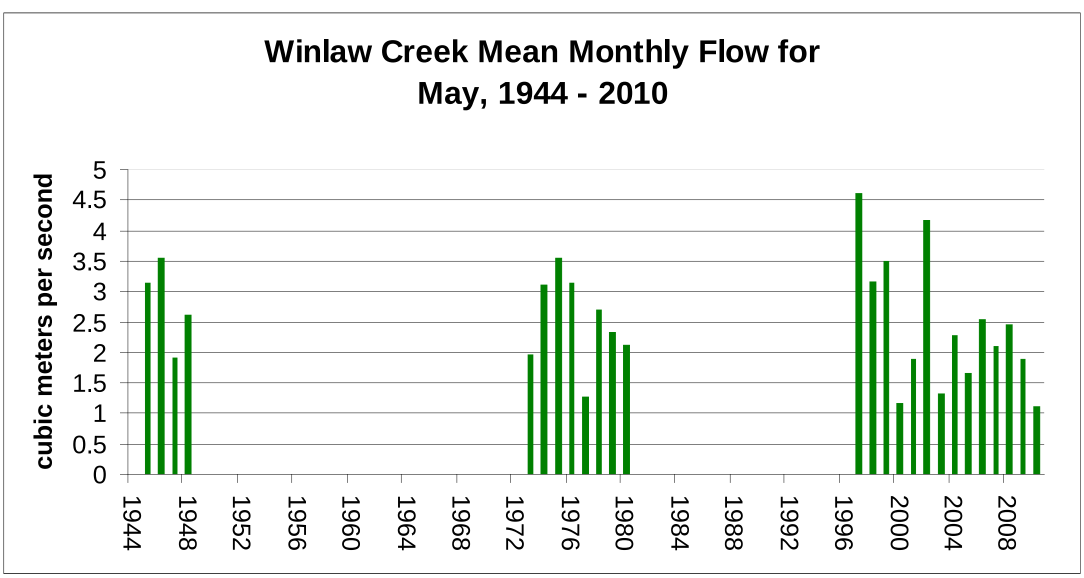
Many folks from Winlaw have helped to make this program successful. Those who have been there from the beginning are Lesley & Peter Mayfield, Ricardo Hubbs, Shanoon Bennett and Phil Larstone . Tony and Aram Yeow did the hydrometric work & Jennifer Yeow wrote this report. Water Tests for Conductivity, Turbidity, Sediment and Coliform Bacteria were performed at Passmore Laboratory Ltd.

Findings for Flow

Like many rivers and creeks in the West Kootenays, Water Survey Canada measured Winlaw's flow during the 1940's through 70's. Although readings were only taken between April and September, the information from the readings is invaluable in helping to discern trends.

One way to look at flow trends is to plot the mean monthly flow. The chart below shows Winlaw May mean flows between 1944 – 2010. May is chosen because high water normally comes during this time. While the recent years trend downward, year 2011 will likely show a reverse in the trend.

Chart 1.

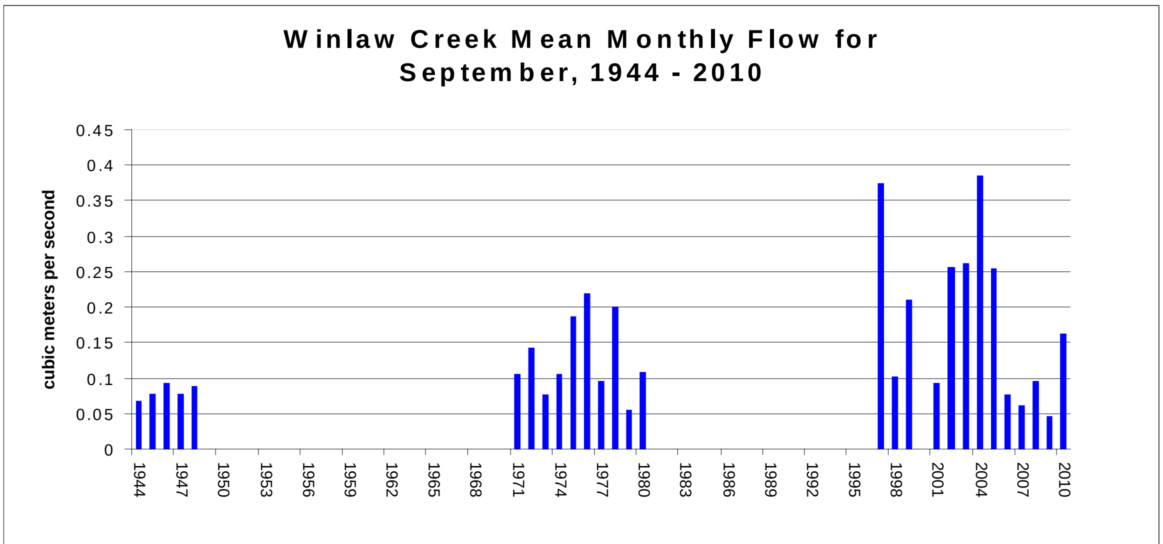


Winlaw Water Monitoring Report 2006 - 2010 *Findings for Flow cont.*

The trend appears to decline ***slightly***, although 1997 ,8&9 and 2002 did show some of the highest mean flows recorded. While the recent years trend downward, year 2011 will likely be up. In conversation with Environment Canada, we were told the flow trends on small mountain creeks are cyclic e.g. a number of years in a row when flow tends low or high, then reverses. Hence, we may being seeing a trend towards greater fluctuation in high flows e.g. highs are higher and lows are lower.

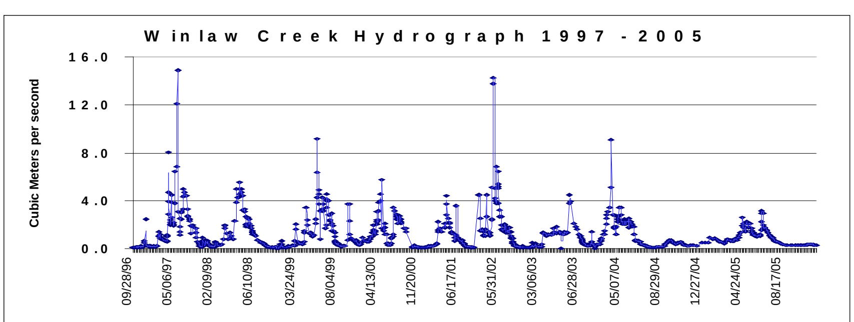
Normally, historic low flows for Winlaw occur in Fall. We occasionally see minimum flows in December, through February. September is charted below because most low flows occur during this month. Other factors to consider when looking at Winlaw flow include the fact that the automated sensor was installed mid 2006 and in 2010, the creek was slightly diverted to the north away from the gauge. While still accurate, small changes in pressure readings represented large changes in actual flow.

Chart 2.



When we compare recent data up to 2005 with historic values it looks like there is a trend towards higher low flows. However, between 2006 and 2009 we saw four years of very low September flows. That trend seems to end in 2010. Increased low flows can result from development activities (forestry, roads, homes). However, Winlaw Creek has seen little development. An increase in precipitation and/or timing of rain events could also be a factor.

Like other medium sized creeks in the West Kootenays, with a snow dominated flow regime, Winlaw creek has a fairly extreme flow pattern that is characterized by sudden, short lasting high water, and low summer flows. See Chart 3 below:



Winlaw Water Monitoring Report 2006 – 2010 *Findings for Flow cont***.**

Regarding fluctuations in flow, Winlaw creek is known for sudden and dramatic shifts in its channel. In fact, channel shifts above monitoring stations over the course of six years have resulted in the need to establish and calibrate three new gauge sites for measuring flow.

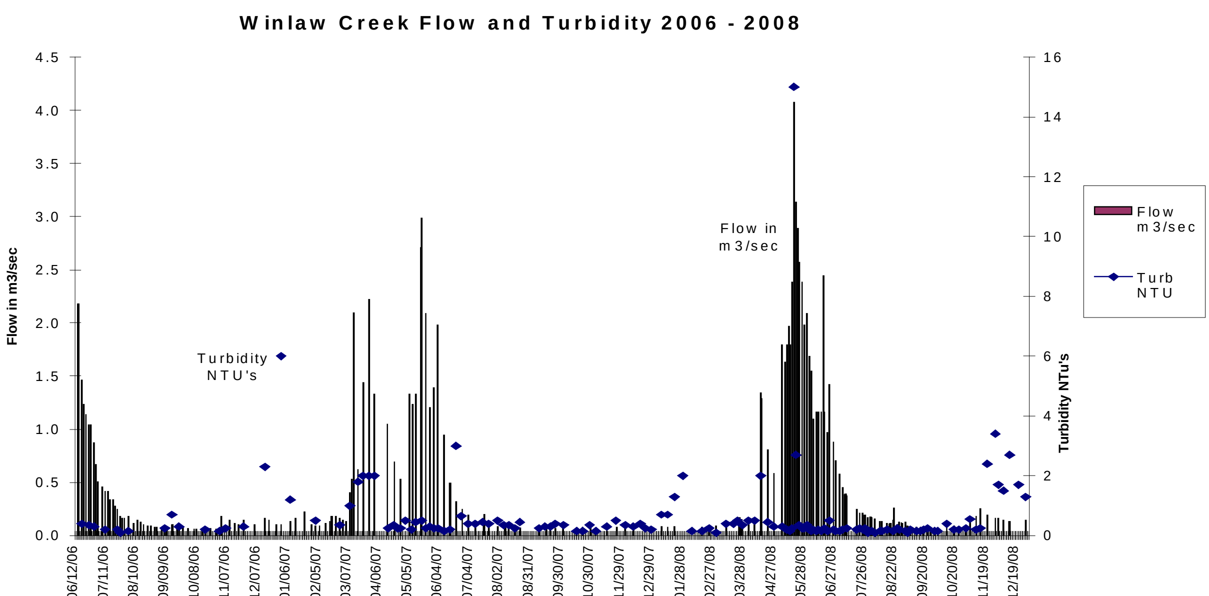
Findings for Turbidity & Sediment

Winlaw, like most of the Slocan tributary creeks studied, shows a direct relation between flow and sediment e.g. when flow is high, sediment and turbidity increases. In addition, Winlaw's sediment levels are highest when the creek is rising and drop sharply after spring high flows. There is also a direct relation between sediment and turbidity. Turbidity, in this case, measures mainly fine particles.
The program has been set up so that when Turbidity levels rise above 1NTU the sample is tested for Suspended Solids. This is because there is a historic relation between these two parameters and makes the program more cost efficient, however, we occasionally see large variations from the 2 parameters.
The table below summarizes Turbidity findings:

(Table 1) Years	Percentage Turbidity less than 1 NTU	Total number of samples
1996 - 2001	68%	303
2002 - 2005	87%	196
2006 - 2011	89%	280

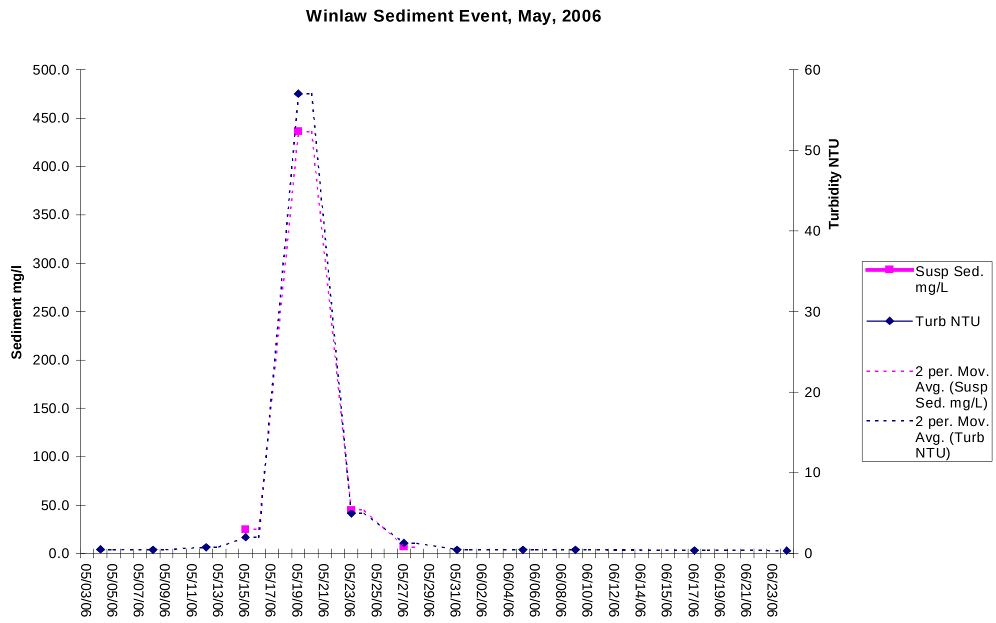
The Provincial Government standards for drinking water are 1 NTU.
Charts that shows turbidity vs. flow over these time periods gives another way to assess trends
Note occasional rises in Turbidity without corresponding increases in Flow.

Chart 4



Winlaw Water Monitoring Report 2006 – 2010, findings for turbidity & sediment cont.

Chart 5



The chart above illustrates the relation between sediment and turbidity during an event whereby a large amount of sediment passed through in a short time. Both turbidity and sediment rise quickly and fall off more slowly. The event showed very high sediment for the flow. It likely reflects an occurrence (slide) somewhere in the watershed. At 436 mg/l (57NTU), this was the highest sediment reading seen in 13 years of monitoring.

Findings for Water Temperature

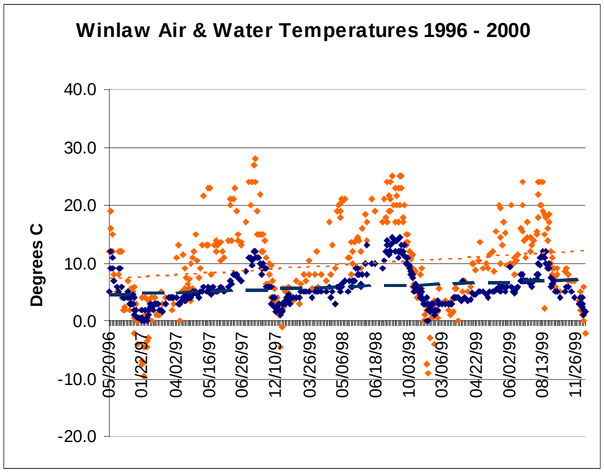
Historically, Winlaw's water temperature remains low in relation to rising air temperatures. Low temperatures are desirable for drinking water and aquatic life. The table below summarizes temperature readings:

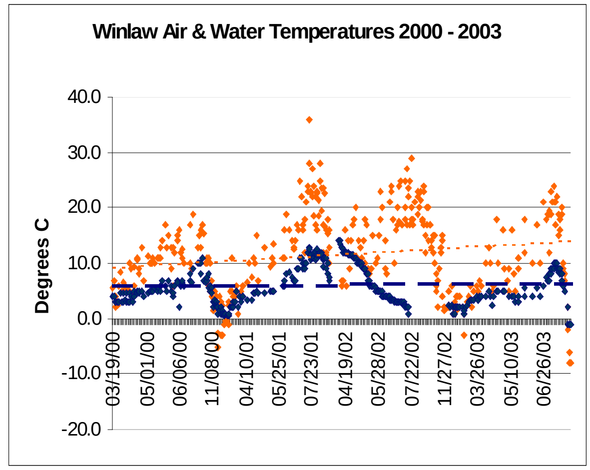
(Table 2) Years readings taken	Percentage less than 9ºC	Percentage greater than 13ºC	Number of Readings
1996 - 2002	83	2.3	560
2002 – June 2006	77	1.5	456
June 2006 - 2010	82	0.5	1349

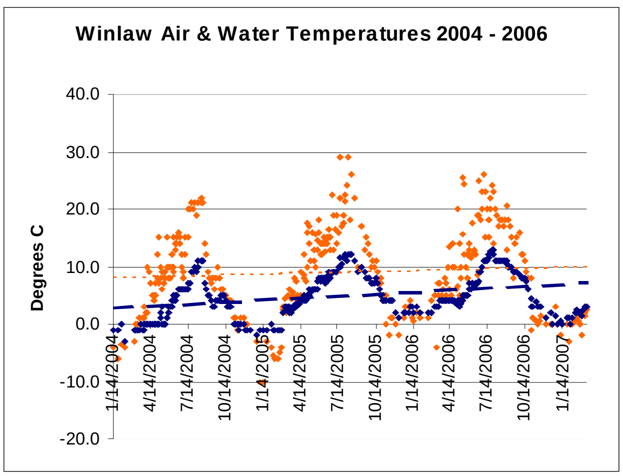
The recommended maximum for drinking water specified by the Provincial Govt. is 15°C. The highest reading observed on Winlaw over 10 years was 14.5°C. The charts for air and water temperatures below are from both manual and automated sensor readings taken over a 14 year period. Orange points are air readings and the blue points are water readings taken at the Winlaw Creek Gauge. The last chart below is daily mean taken from the automated sensor

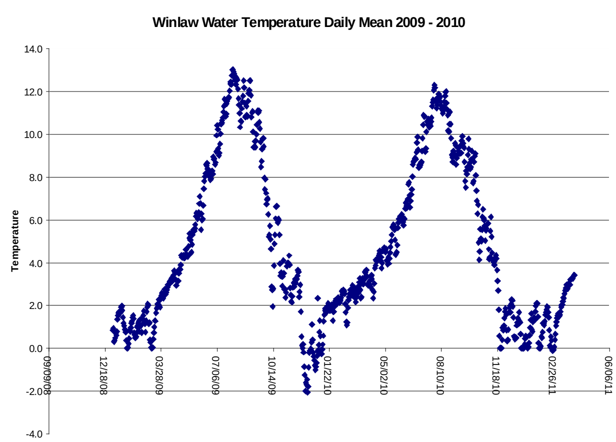
Winlaw Water Monitoring Report 2006 – 2010, Findings for Water Temperature cont.

Charts 6 – 9 Winlaw Water Temperature









Coliform Bacteria

Total coliform bacteria have been used as indicators of water quality related to human health for over 80 years. As a group, total coliform bacteria include many genera that are associated with decaying plant material and are not of necessarily of human or warm blooded animal origin. They can multiply on wood and ropes and can produce slimes inside pipes. (APHA 1989)

A sub-group of the coliform bacteria called “fecal coliforms” are cultured at 44.5°C. These bacteria are indicators of recent contamination from warm-blooded wildlife, domestic animals and/or human activity in a watershed and should be regarded as indicators of hazardous contamination. (Environmental Health Directorate 1977). Provincial Criteria have recently shifted to E.coli. However, fecal or thermotolerant bacteria are still considered for drinking water without treatment.

Studies done between 1996 and 2003 on Slocan River tributaries show fecal coliform count rises as water temperature increases and, in summer, main river water temperatures frequently rise above 20°C (SVWA 1996-2000). Fecal counts are low in winter when tributary volume and water temperature is low.

In spring, fecal coliform counts in tributaries have also been low despite an influx of water and turbid conditions. Again, this is likely due to cool water temperatures. (Winlaw Watershed Committee, 2001).

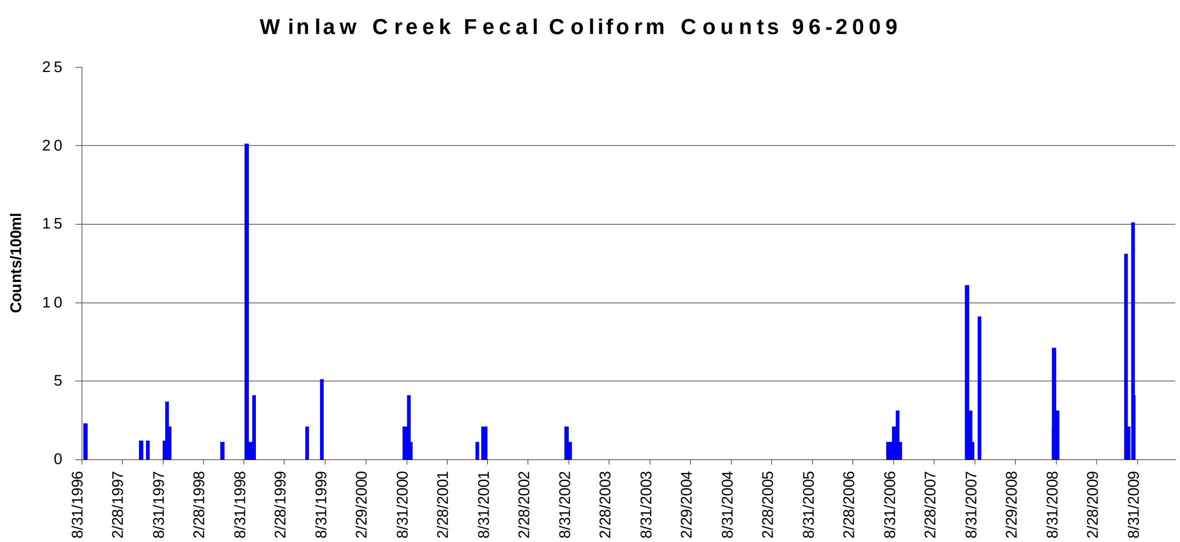
Historic Fecal (Thermotolerant) Counts in Winlaw Creek are given in the table below:

(Table 3) Years samples taken	Percentage of samples with no Fecal Coliforms	Average Count /100ml	Highest Count /100ml	Number of samples
1996 – 2001	71%	1	20	46
2002 – 2006	25%	2	3	12
2007 – 2011	25%	4	15	20

Samples were not collected between 2003 and 2005 or in 2010. Five samples were collected in 2011 and all were 0/100ml for fecal coliforms. The low count likely reflects low water temperature.

Provincial Criteria for drinking water specify that no fecal coliform bacteria should be present. The chart below shows the groups of 5 samples taken in Spring and/or Fall by year.

Chart 10



Metals

Spectrographic scans of low-level metals were performed on five water samples collected during spring and fall between 1996 and 1999. Low level metals were again tested in 2011.

Regarding results from 1996 – 1999 tests, the concentrations of metals in all the samples was low e.g. at least 10 times lower than the maximum recommended drinking water published by the Ministry of Environment except for aluminum at high flow.

Total aluminum levels exceeded criteria for aquatic life (0.5 mg/l dissolved aluminum) and drinking water (0.2 mg/l dissolved aluminum) on 1 to 3 samples during freshet in 1999. The highest levels on individual samples ranged from 0.3 to 0.5 mg/l total aluminum. However, the criteria are based on dissolved aluminum. Dissolved aluminum would have been lower than total aluminum, which was measured in the study. The results from tests done in 2011 were not available.

Benthic Invertebrates

Background

Aquatic biomonitoring measures changes in biological communities (for example, fish, benthic invertebrates, and algae) in order to assess the health of aquatic ecosystems. Biomonitoring is complementary to traditional physical and chemical monitoring. Biological monitoring can measure impacts of cumulative stressors including impacts from chemical interactions, contaminant pulses, or unknown contaminants that are difficult to capture with routine chemical sampling. Other stressors that may be captured by biological monitoring include the presence of exotic species, habitat degradation in the water body or surrounding land, climate change, and fluctuations in water quantity.

Reference Condition Approach

The method we use for Winlaw creek is called "CABIN"(Canadian Aquatic Benthic Invertebrate Network) It employs a Reference Condition Approach as the principal method for site assessments. RCA study design begins with the identification of a priority area or region of concern, based on hydrological (basin, sub-basin) or biogeographic (ecozone, ecoregion) boundaries. Reference sites are then selected where anthropogenic effects are minimal. A bioassessment model is developed from the reference site data. This model defines the range of biological communities that should be found at a site if the site is not affected by human activities. Potentially impaired (or test) sites are assessed against reference sites using the bioassessment model. The divergence between the benthic invertebrate communities at reference sites and a test site indicate the extent of impairment. The assessment of a test site is presented in an ordination plot. CABIN defines four assessment categories based on confidence ellipses around a group of reference communities: ***similar*** to reference, ***mildly divergent*** from reference, ***divergent*** from reference, and ***highly divergent*** from reference. (Reference: CABIN Website)

Invertebrates were monitored in Winaw Creek in 1998, 1999, 2006 and 2010. Findings from the studies done in 1998 and 1999 by Aquatic Resources showed that Winlaw Creek had the greatest abundance of macroinvertebrates of the four creeks studied. The creeks were Airy, Lemon, Bonanza. Winlaw also had the highest number of taxa and the ratio of the number of EPT/total taxa indicated "no impact". Samples collected typically had a healthy population of EPT (Ephemenoptera, Plecoptera and Tricoptera) taxa with ratings of slight to no impacts.

Current Findings:

The development of the reference model by Environment Canada for the Columbia last year gave us a standard by which to evaluate our data from 2006 and 2010. As can be seen by the charts 11 (2006) and 12 (2010) both sets of data fall within the 90% confidence ellipses and are designated as "unstressed". The probability of the samples falling into the designated group for year 2006 was 70.5% and for year 2010 was 69.6%. This means the samples were a good fit (fell well within) the reference site group.

Chart 11

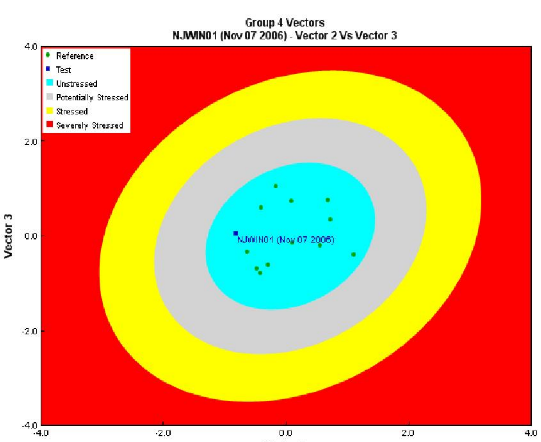
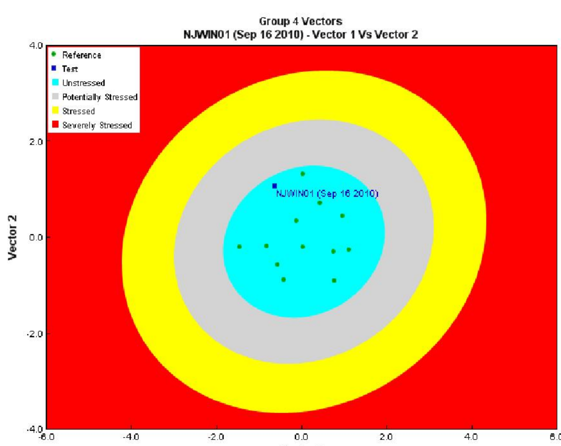


Chart 12



Photos

Winlaw Creek looking across at sample site

Winlaw Creek looking downstream at sample site

Winlaw typical substrate at sample site

Winlaw - Shanoon collecting invertebrate specimens

Metrics

Metric	2006	2010	Expected Range (EcoAnalysts)
%EPT	87.7%	73.0%	>20
Total no. EPT Individuals	1194	308	
No. of EPT Taxa	3	3	
% Dominant taxa	74.8%	29.2%	<30
Total Abundance	1361	422	
Total Number of Taxa	6	7	>30

The table above compares years 2006 and 2010. As can be seen, there were a lot more insects collected in 2006 than 2010, however, the number of EPT taxa was very close while the % Dominant taxa decreased (improved). This means there were more taxa in 2010. The striking thing about both years and characteristic of this creek is the large percentage of Ephemenoptera, Tricoptera & Plecoptera (EPT). E.g. 87.7% in 2006 and 73.0% in 2010. These species are considered intolerant to pollutants.

Water Chemistry

A Hach series 36 Water Ecology Test Kit was used during 1994 through 1995 to conduct eight series of water chemistry tests. The samples were taken throughout the year under different weather and water conditions. The tests in 2010 were done in Fall. The results are given below:

Year	Average pH		Average Acidity mg/l	Average Alkalinity mg/l	Average Hardness (mg/l CaCo3)	Dissolved Oxygen mg/l
1994-5	7.8		5.9	60.2	63.0	11.6
2010				54.7	63.0	11.0

The water can be characterized as slightly alkaline with low acidity, and low hardness.

Recommendations

This report is not intended to be a comprehensive analysis if the data. To accomplish this we would need to obtain rain data for past years as well as time, description and occurrence of other activities (logging, road building, etc.) in the watershed. Some options for the future of this program:

1. Continue monitoring Winlaw for the record and to serve as a historic comparison for other creeks in the valley past or future. For example, most of the creeks on the west side of Slocan ridge have similar flow regimes.

2. Work with other environmental groups in the valley & the RDCK to assess valley wide sensitive ecosystems using Streamkeepers SEI project mapping. Decide which creeks/streams/wetlands should be monitored in the Winlaw area and establish stations & protocol for collecting data.

3. Take a break from monitoring water altogether or monitor something else – vegetation patterns/changes, insects, birds.

References

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4. Slocan River Watershed Benthic Macroinvertebrate Assessment, 2000, AquaticResources Ltd

5. Water Survey Canada's website: http://scitech.pyr.ec.gc.ca/waterweb

6. Water quality guidelines from the Provincial Govt's website: http://www.env.gov.bc.ca/wat/wq/BCguidelines/approv_wq_guide/approved.html#1

7. CABIN website: http://cabin.cciw.ca/Main/cabin_about.asp?Lang=en-ca