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DEPARTMENT OF ENVIRONMENT  
ENVIRONMENTAL PROTECTION SERVICE  
PACIFIC REGION

REPLICATED WATER QUALITY  
SAMPLING IN MYRA CREEK,  
APRIL 16, 1982

Regional Program Report: 82 - 09

By

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1 INTRODUCTION

Detailed monitoring of Myra Creek was conducted by B.C. Research in June and July, 1981 (B.C. Research, 1981) and continued to 1982 (B.C. Research, 1982). These reports were prepared for the Buttle Lake Study Committee which receives its funding from Westmin Resources Ltd. The details as to why this committee was formed can be found in the above mentioned reports.

Some duplicate water samples had been analyzed by B.C. Research and the Provincial Waste Management Branch in the Phase I study. However, Environment Canada wished to look at the within sample variability in more detail. Further, the Study Committee wished to verify if there was any difference in heavy metals above and below Myra Creek Falls. That is, was there any significant inputs of heavy metals between the last sample site (M2) used by B.C. Research downstream of the mine and the entrance of Myra Creek to Buttle Lake. On April 16, 1982 the Environmental Protection Service of Environment Canada collected a series of replicated water samples at three sites on Myra Creek.

## 2 METHODS - Sample Collection Sites and Analysis

Three sample sites were used and are shown in Figure 1. Sites M1 and M2 are the same sites used by B.C. Research in their study. The third site (BF1) was located at the foot of the falls as Myra Creek enters Buttle Lake. At the time of sampling a small stream was entering Myra Creek approximately 10 meters downstream of M2. The rocks were heavily stained an orange red and duplicate water samples were taken at this site for total and dissolved metals.

In an effort to try and sample the same water mass above and below the falls, station BF1 was sampled 10 minutes after station M2.

For the three sites on Myra Creek (M1, M2, and BF1) replicated grab samples were collected using a modified version of a replicated grab sampler reported by Oguss and Erlebach (1976). The sampler holds six 1 liter sample bottles. Six 1 liter bottles were collected at each site for pH, conductivity, turbidity hardness, total residue and total dissolved residue. For these water quality samples two 1 liter bottles were composited into a 2 liter sample bottle thus making 3 replicas for each station.

For the heavy metal samples, each 1 liter sample bottle was used to fill two 250 ml bottles, one for total metals and the other for dissolved metals, thus making six replicated samples from each station. Also, for four of the 1 liter samples, a second set of 250 ml bottles were filled and two sets were sent to the Provincial Chemistry Laboratory and two sets were sent to the B.C. Research Laboratory. The samples for total heavy metals were preserved immediately with nitric acid to a pH of  $< 2$ . For the dissolved metal analysis  $\approx 100$  mls was filtered through a 0.45 micron cellulose nitrate filter using a 250 ml capacity Sartorius Membrane filter holder at the Quinsam Fish Hatchery. It was then preserved with nitric acid to a pH of  $< 2$ .

pH was measured in the creek at the time of sampling using a Western Scientific digital mini pH meter Model 49.

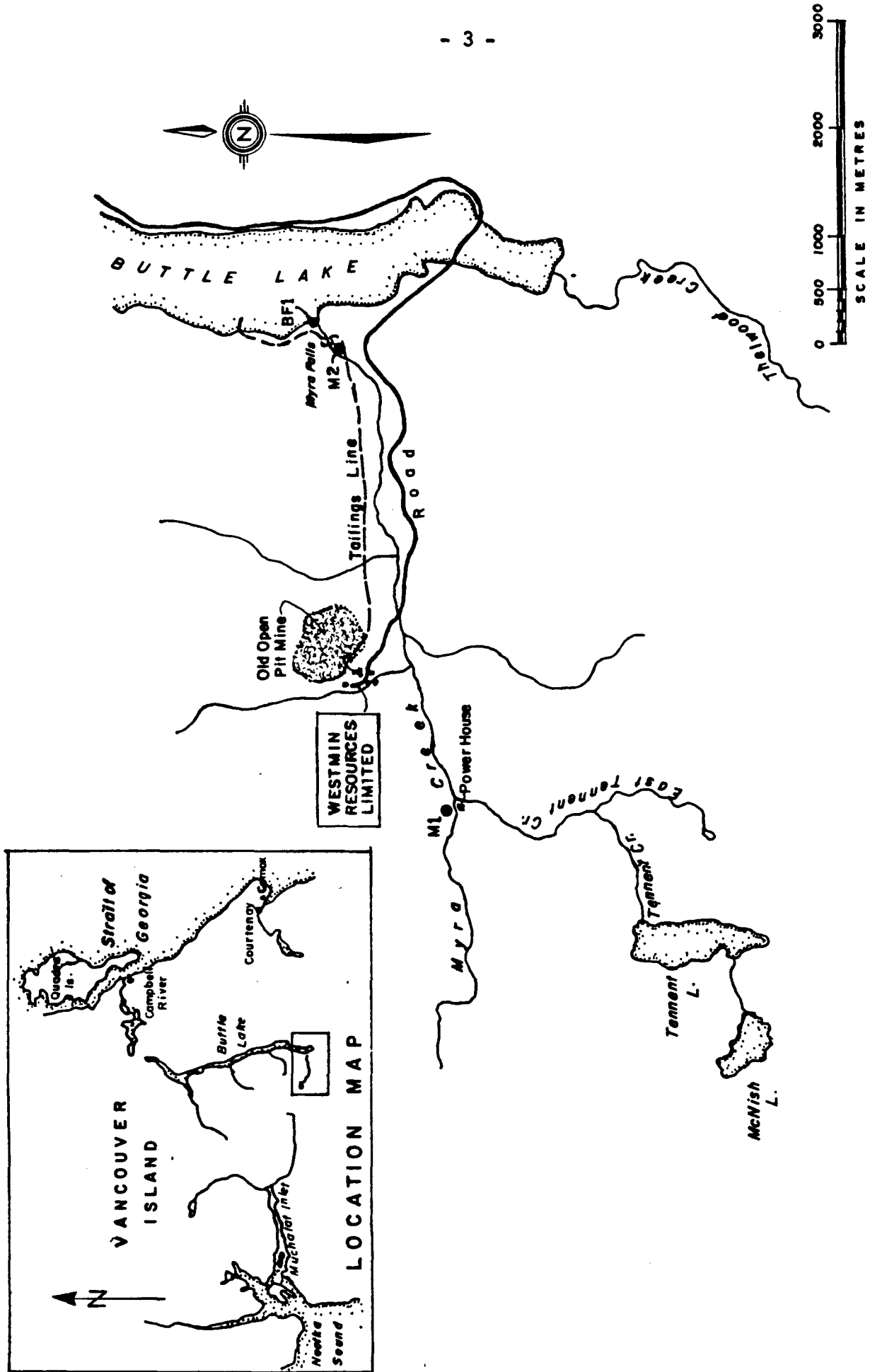


FIGURE 1 MYRA CREEK SAMPLE SITES

All samples were packed in wet ice and taken to the EPS warehouse in North Vancouver where they were stored in a walk-in cooler for the weekend. The samples were then delivered to the three laboratories on Monday, April 19, 1982. The samples for pH, turbidity and conductivity were done immediately while the residues were done on April 28, 1982.

For the heavy metal analysis at the Environmental Protection Service Laboratory, the samples were subjected to an ICAP scan (Inductively Coupled Argon Plasma) which is an automated Atomic Emission Spectrophotometer that gives a reading of 26 metals. For Cu, Pb, and Cd if the reading was below the ICAP detection limit, the samples were run again through the graphite furnace of the Atomic Absorption Spectrophotometer which has a lower detection limit.

The method for heavy metal analysis performed by B.C. Research is reported in the Phase I study (BCR 1981) and the method used by the Provincial Government is described in their lab manual (B.C. Ministry of Environment, 1976).



### 3 RESULTS AND DISCUSSION

#### 3.1 Physical Parameters

The replicated pH values were consistent for each station when analyzed at the EPS lab (Table 1). However the field determination of pH varied slightly at each station. Further tests conducted with this particular field instrument showed that it was not too accurate when it came to small differences in samples. Based on the lab analyses, the pH dropped by 0.6 between M1 and M2 and increased by 0.4 between M2 and BF1.

There was a significant difference in turbidity and conductivity between M1 and M2 but no difference between M2 and BF1 (Table 1).

Also, for residues, there was a very significant mean increase of 90 mg/l in total solids between M1 and M2 of which almost all was in the dissolved form. Again there was no significant difference above and below the falls.

#### 3.2 Heavy Metals

The main metals of concern in Myra Creek are zinc, copper, cadmium and possibly lead.

3.2.1 Copper. The replication for total copper at M1 was not very good. When the ICAP scan was run, three of the samples showed results of 0.014, 0.016 and 0.015, respectively and the other three samples were below the detection limit of 0.005 mg/l (Table 2). The latter three samples were then analyzed with the graphite furnace atomic absorption spectrophotometer (AAS) which gave readings of 0.005, 0.002 and 0.002 mg/l. Thus, the mean of the six samples is 0.009 mg/l with a standard deviation of 0.007. The dissolved metals were all below the AAS detection limit of 0.001 mg/l. B.C. Research results had a detection limit of 0.005 mg/l. The B.C. Provincial lab results were very similar to the EPS lab.

As expected, due to the contamination from the mine site, the copper levels at M2 increased greatly over background levels of M1 to mean

TABLE 1 WATER QUALITY PHYSICAL PARAMETERS OF MYRA CREEK AT THREE LOCATIONS ON APRIL 16, 1982

REPLICA	STATIONS					
	M1		M2		BF1	
	Field	Lab	Field	Lab	Field	Lab
<u>pH</u>						
1	6.9	7.4	6.6	6.8	6.7	7.2
2	6.9	7.4	6.7	6.8	7.0	7.2
3	7.0	7.4	-	6.8	-	7.2
<u>Turbidity (FTU)</u>						
1	L0.01		4.2		4.2	
2	L0.01		4.2		4.2	
3	L0.01		4.2		4.2	
<u>Conductivity (umhos/cm)</u>						
1	37.7		179		179	
2	37.7		179		179	
3	37.7		179		179	
<u>Residuals (mg/l)</u>						
	Total	Total Dissolved	Total	Total Dissolved	Total	Total Dissolved
1	33	33	119	119	124	115
2	28	28	119	118	122	115
3	30	30	122	118	121	114
$\bar{x}$	30	30	120	118	122	115
S.D.	2.5	2.5	1.7	0.6	1.5	0.6

TABLE 2 REPLICATED COPPER CONCENTRATIONS (mg/l) AT THREE LOCATIONS IN MYRA CREEK, APRIL 16, 1982

ICAP method unless otherwise indicated where

\* = AA

	STATION					
	M1		M2		BF1	
	Total	Dissolved	Total	Dissolved	Total	Dissolved
1	0.005*	LO.001*	0.209	0.126	0.229	0.064
2	0.014	LO.001*	0.228	0.126	0.226	0.076
3	0.002*	LO.001*	0.213	0.129	0.226	0.074
4	0.002*	LO.001*	0.219	0.127	0.223	0.081
5	0.016	LO.001*	0.216	0.127	0.218	0.062
6	<u>0.015</u>	<u>LO.001*</u>	<u>0.216</u>	<u>0.128</u>	<u>0.227</u>	<u>0.056</u>
$\bar{x}$	0.009	LO.001	0.217	0.127	0.225	0.069
S.D.	0.007	0.0	0.006	0.001	0.004	0.010

Anova

Level of Significance

Diss.	M2 vs BF - between stations	L.001
	- within samples	NS
Total	M2 vs BF - between stations	NS
	- within samples	NS

B.C. Research (split samples of replicas 1 and 2 above)

LO.0005	0.0005	0.21	0.12	0.21	0.07
LO.0005	LO.0005	0.20	0.12	0.21	0.07

B.C. Provincial Laboratory (split samples of replicas 3 and 4 above)

0.002	0.001	0.19	0.11	0.21	0.08
LO.001	LO.001	0.19	0.12	0.20	0.09

N.S. = not significant

values of 0.217 mg/l total and 0.127 mg/l dissolved. The difference between M2 and BF1 was not significant for total copper but was very significant ( $P < .001$ ) for dissolved copper with the mean concentration decreasing from 0.127 mg/l at M2 to 0.069 mg/l below the falls. This could be because of the increase of 0.4 in pH.

The B.C. Research results were the same as the EPS results at all sites.

3.2.2 Zinc. The within samples variability was not significant for all three stations ( $P < .05$ ) (Table 3). Also, there was not a significant difference between M2 and below the falls ( $P > .05$ ) for either total or dissolved zinc but as expected these two stations were very much higher than M1.

Of the samples submitted to B.C. Research from M1, the dissolved fraction was slightly higher than the total but their total values were less than the EPS mean total value even without the two values of 0.012 mg/l. The dissolved values agreed with the EPS lab results. At M2 and BF1 the mean total zinc values reported by the EPS lab were about 7-8% higher than B.C. Research but the dissolved values were very similar.

The dissolved values reported for M1 by both the EPS lab and the B.C. Research lab were below the detection limit of 0.005 mg/l reported by the Provincial lab.

3.2.3 Cadmium. For the determination of cadmium the within samples variation was not significant at all three stations ( $P > .05$ ) (Table 4). However, the differences between the control and M2 was highly significant as expected ( $P < .001$ ). The mean of the control was less than the detection limit of 0.001 mg/l while the mean total cadmium was 0.006 mg/l both above and below the falls. Further the cadmium was mostly in the dissolved form.

The detection limit B.C. Research was lower than EPS (0.0002 mg/l) and the Provincial Lab's detection limit was the highest at

TABLE 3 REPLICATED ZINC CONCENTRATIONS (mg/l) AT THREE LOCATIONS IN MYRA CREEK, APRIL 16, 1982

ICAP method

	STATION					
	M1		M2		BF1	
	Total	Dissolved	Total	Dissolved	Total	Dissolved
1	0.005	LO.002	1.80	1.72	1.97	1.72
2	0.006	LO.002	1.99	1.72	1.92	1.72
3	0.012	LO.002	1.86	1.74	1.95	1.71
4	0.007	LO.002	1.90	1.73	1.92	1.73
5	0.012	LO.002	1.93	1.71	1.89	1.68
6	<u>0.005</u>	<u>LO.002</u>	<u>1.89</u>	<u>1.73</u>	<u>1.96</u>	<u>1.68</u>
$\bar{x}$	0.008	LO.002	1.90	1.73	1.94	1.71
S.D.	0.003	0.0	0.064	0.01	0.030	0.022

Analysis of Variance

Total	M2 vs BF	- between stations	NS
		- within samples	NS
Diss.	M2 vs BF	- between stations	NS
		- within samples	NS

B.C. Research (split samples of replicas 1 and 2)

0.0025	0.0038	1.74	1.69	1.80	1.71
0.0018	0.0020	1.75	1.70	1.81	1.69

B.C. Provincial Laboratory (split samples of replicas 3 and 4 above)

LO.005	LO.005	1.70	1.65	1.75	1.65
LO.005	LO.005	1.75	1.65	1.75	1.70

TABLE 4 REPLICATED CADMIUM CONCENTRATIONS (mg/l) AT THREE LOCATIONS IN MYRA CREEK, APRIL 16, 1982

ICAP Method unless otherwise indicated  
where \* = AA

	STATION					
	M1		M2		BF1	
	Total	Dissolved	Total	Dissolved	Total	Dissolved
1	L0.001*	L0.001*	0.006	0.006	0.006	0.006
2	L0.001*	L0.001*	0.006	0.005	0.005	0.005
3	L0.001*	L0.001*	0.005	0.006	0.006	0.004
4	L0.001*	L0.001*	0.006	0.005	0.006	0.006
5	L0.001*	L0.001*	0.005	0.006	0.006	0.006
6	<u>L0.001*</u>	<u>L0.001*</u>	<u>0.006</u>	<u>0.005</u>	<u>0.007</u>	<u>0.005</u>
$\bar{x}$	L0.001	L0.001	0.006	0.006	0.006	0.005
S.D.	0.0	0.0	0.001	0.001	0.001	0.001

Analysis of Variance

Total M1 vs M2 - between stations <.001  
- within samples NS

B.C. Research (split samples of replicas 1 and 2 above)

L0.0002	L0.0002	0.0040	0.0037	0.0041	0.0036
L0.0002	L0.0002	0.0040	0.0035	0.0042	0.0036

B.C. Provincial Laboratory (split samples of replicas 3 and 4 above)

L0.005	L0.005	0.0050	0.0045	0.0055	0.0050
L0.005	L0.005	0.0055	0.0050	0.0050	0.0050

0.005 mg/l. For stations M2 and BF1 the Provincial lab results were very similar to the EPS lab results but B.C. Research's results were 0.001 to 0.002 mg/l lower.

3.2.4 Lead. The within sample variability was not significant except the one replica for total lead at M2 (0.03 mg/l) which was ten times higher than the rest of the samples (Table 5). This sample was only analyzed by the ICAP. At all sites the dissolved lead as analyzed by the EPS lab, was below the detection limit of 0.001 mg/l.

In tests of significance (with first replica of M2 omitted) between M1 and M2 the total values were significantly different but not between M1 and BF1. Also, M2 was significantly different than BF1. Thus, even though the total lead values are very small, the total lead mean value at M2 is significantly higher than either M1 or below the falls. This was also evident in the samples analyzed by both the B.C. Research and B.C. Provincial labs.

3.2.5 Other Heavy Metals. The heavy metals that were below the ICAP detection limit, with one exception, are listed in Table 6. There were two nickel readings (0.03 and 0.10 mg/l) below Myra Creek Falls that were above detection limit of 0.02 mg/l.

The other metals that were above detection limits are reported in Appendix I for interest. Those that were significantly higher than the control were barium, manganese, strontium, aluminum, iron, silica, magnesium, sodium and calcium. Only total barium showed a significant difference above and below the falls with mean values mean of 0.040 mg/l and 0.032 mg/l respectively.

3.2.6 Hardness. The mean total hardness increased from 15.6 mg/l at M1 to 71.5 mg/l at M2 with a slight decrease to 70.3 mg/l below the falls (Table 7).

TABLE 5 REPLICATED LEAD CONCENTRATIONS (mg/l) AT THREE LOCATIONS IN MYRA CREEK, APRIL 16, 1982

Method AA graphite furnace otherwise \* = ICAP

	STATION					
	M1		M2		BF1	
	Total	Dissolved	Total	Dissolved	Total	Dissolved
1	0.002	L0.001	0.030*	L0.001	0.003	L0.001
2	0.002	L0.001	0.004	L0.001	0.002	L0.001
3	0.002	L0.001	0.003	L0.001	0.001	L0.001
4	L0.001	L0.001	0.003	L0.001	0.002	L0.001
5	0.002	L0.001	0.003	L0.001	L0.001	L0.001
6	<u>0.002</u>	<u>L0.001</u>	<u>0.003</u>	<u>L0.001</u>	<u>L0.001</u>	<u>L0.001</u>
$\bar{x}$	0.002	L0.001	0.008	L0.001	0.002	L0.001
S.D.	0.0	0.0	0.011	0.0	0.001	0.0

Anova Table (Totals)

M1 vs M2 (without 1st replica)	- between stations	P <.005
	- within replicas	NS
M1 vs BF1	- between stations	NS
	- within replicas	NS
M2 vs BF1 (without 1st replica)	- between stations	P <.001
	- within replicas	NS

B.C. Research (split samples of replicas 1 and 2 above)

L0.001	L0.001	0.0055	L0.001	0.0035	L0.001
L0.001	0.0014	0.0059	L0.001	0.0035	L0.001

B.C. Provincial Laboratory (split samples of replicas 3 and 4 above)

0.002	L0.001	0.008	L0.001	0.004	L0.001
0.001	L0.001	0.009	L0.001	0.005	L0.001



TABLE 6 THE HEAVY METALS IN MYRA CREEK THAT WERE BELOW DETECTION LIMITS AT ALL THREE SAMPLE SITES

METAL	DETECTION LIMIT (mg/l)
Arsenic	L.05
Beryllium	L.001
Chromium	L.005
Mercury	L.05
Molybdenum	L.005
Nickel	L.02*
Phosphorus	L.05
Antimony	L.05
Selenium	L.05
Tin	L.05
Vanadium	L.01

\* 2 readings below the falls of total Ni of 0.03 and 0.1 mg/l.

TABLE 7 HARDNESS LEVELS (mg/l) AT THREE LOCATIONS IN MYRA CREEK,  
APRIL 16, 1982

Method ICAP

	STATION					
	M1		M2		BF1	
	Total	Ca, Mg	Total	Ca, Mg	Total	Ca, Mg
1	15.8	15.7	71.4	67.9	70.7	67.2
2	15.7	15.5	71.5	68.5	70.8	67.4
3	15.7	15.5	72.1	68.6	70.3	67.0
4	15.5	15.4	71.2	67.8	70.3	67.0
5	15.5	15.4	71.0	67.6	69.8	66.4
6	15.5	15.5	71.7	68.2	70.1	66.7
$\bar{x}$	15.6	15.5	71.5	68.1	70.3	67.0
S.D.	0.13	0.11	0.39	0.40	0.37	0.36

Anova

Total	M2 vs BF1 - between stations	P < .005
	- within replicas	NS
Ca, Mg	M2 vs BF1 - between stations	P < .001
	- within replicas	NS

4 CONTAMINATED STREAM BELOW M2

As stated earlier a small stream approximately 10 meters downstream of M2 was observed flowing into Myra Creek. The rocks were stained an orange-red (Fig. 2). The stream was high in copper (mean 3.670 mg/l total and 3.41 mg/l dissolved), cadmium (mean 0.063 mg/l total and 0.057 mg/l dissolved) and zinc (mean 14.0 mg/l total and 12.9 mg/l dissolved) (Table 8). Iron was 8.56 mg/l total and 3.04 mg/l dissolved. Total nickel was also detectable at 0.02 mg/l. Total hardness was 217 mg/l.



Figure 2. SMALL CONTAMINATED STREAM ENTERING MYRA CREEK APPROXIMATELY 10 METERS DOWNSTREAM OF M2.

TABLE 8 HEAVY METAL CONCENTRATION (mg/l) IN A SMALL STREAM ENTERING MYRA CREEK APPROXIMATELY 10 METERS BELOW M2

ICAP Method unless otherwise indicated where \* = AA

Replica	Copper		Lead		Cadmium	
	Total	Dissolved	Total*	Dissolved*	Total	Dissolved
1	3.62	3.40	0.001	LO.001	0.063	0.057
2	<u>3.57</u>	<u>3.42</u>	<u>LO.001</u>	<u>LO.001</u>	<u>0.062</u>	<u>0.056</u>
$\bar{x}$	3.60	3.41	LO.001	LO.001	0.063	0.057

Replica	Zinc		Iron		Nickel	
	Total	Dissolved	Total	Dissolved	Total	Dissolved
1	14.0	12.8	8.74	3.03	0.02	LO.02
2	<u>13.9</u>	<u>12.9</u>	<u>8.38</u>	<u>3.05</u>	<u>0.02</u>	<u>LO.02</u>
$\bar{x}$	14.0	12.9	8.56	3.04	0.02	LO.02

Replica	Hardness	
	Total	Ca, Mg
1	216	115
2	<u>218</u>	<u>116</u>
$\bar{x}$	217	116

5 CONCLUSIONS

1. The replicate grab samples analyzed by each lab were not significantly different. The total copper at M1 as analyzed by the EPS lab had a high standard deviation but the samples were analyzed by two different methods.
2. Dissolved copper was significantly lower at BF1 than at M2 above the falls. This could be due to a slightly higher pH below the falls. Total lead and total hardness were also lower below the falls than at M2.
3. At the time of sampling, there was a source of contamination entering Myra Creek between M2 and the beginning of the falls. The source of this contamination should be determined and steps taken to contain it.
4. Cu, Zn, Cd were all significantly greater at M2 and BF1 compared to M1. Pb was significantly greater at M2 compared to Ni but not a BF1 compared to M1.

6 REFERENCES

1. B.C. Research, 1981: Water Quality In The Thelwood and Myra Creek Drainages Phase 1. Project No. 1-12-493.
2. B.C. Research, 1982: Water Quality In The Thelwood and Myra Creek Drainages (Interim Report) Project No. 1-12-702.
3. B.C. Ministry of Environment, 1976: A Laboratory Manual for the Chemical Analysis of Waters, Wastewaters, Sediments and Biological Materials, 2nd edition.
4. Ogus, E., and W.E. Erlebach, 1976: Limitations of Single Water Samples in Representing Mean Water Quality. Environment Canada. Inland Waters Directorate Tech. Bull. No. 95.

APPENDIX 1

REPLICATED METAL CONCENTRATIONS AT THREE  
STATIONS IN MYRA CREEK, APRIL 16, 1982

METHOD OF ANALYSIS ICAP

Barium (mg/l)

---

STATION

---

Replica	<u>M1</u>		<u>M2</u>		<u>Below Falls</u>	
	Total	Dissolved	Total	Dissolved	Total	Dissolved
1	0.006	0.005	0.039	0.015	0.042	0.014
2	0.006	0.005	0.042	0.015	0.045	0.015
3	0.007	0.005	0.039	0.016	0.028	0.014
4	0.006	0.005	0.040	0.015	0.026	0.014
5	0.007	0.005	0.039	0.015	0.025	0.014
6	<u>0.006</u>	<u>0.005</u>	<u>0.040</u>	<u>0.016</u>	<u>0.026</u>	<u>0.014</u>
$\bar{x}$	0.005	0.005	0.040	0.015	0.032	0.014
S.D.	0.001	0.0	0.002	0.001	0.009	0.000

---



Cobalt (mg/l)

STATION						
Replica	M1		M2		Below Falls	
	Total	Dissolved	Total	Dissolved	Total	Dissolved
1	L0.005	L0.005	0.006	L0.005	0.005	L0.005
2	L0.005	L0.005	L0.005	L0.005	L0.005	L0.005
3	L0.005	L0.005	L0.005	L0.005	0.005	L0.005
4	L0.005	L0.005	0.007	L0.005	L0.005	L0.005
5	L0.005	L0.005	0.005	L0.005	L0.005	L0.005
6	<u>L0.005</u>	<u>L0.005</u>	<u>L0.005</u>	<u>L0.005</u>	<u>0.005</u>	<u>L0.005</u>
$\bar{x}$	L0.005	L0.005	0.006*	L0.005	0.005*	L0.005
S.D.	0.0	0.0	0.001	0.0	0.000	0.0

\*detection limit used to calculate mean.

Manganese (mg/l)

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STATION

---

Replica	M1		M2		Below Falls	
	Total	Dissolved	Total	Dissolved	Total	Dissolved
1	0.002	L0.001	0.364	0.354	0.388	0.356
2	0.002	L0.001	0.399	0.355	0.380	0.359
3	0.001	L0.001	0.370	0.359	0.385	0.356
4	0.001	L0.001	0.381	0.353	0.380	0.357
5	0.003	L0.001	0.375	0.353	0.372	0.353
6	<u>0.002</u>	<u>L0.001</u>	<u>0.376</u>	<u>0.356</u>	<u>0.379</u>	<u>0.355</u>
$\bar{x}$	0.002	L0.001	0.378	0.355	0.381	0.356
S.D.	0.001	0.0	0.012	0.002	0.006	0.002

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Strontium (mg/l)

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STATION

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Replica	<u>M1</u>		<u>M2</u>		<u>Below Falls</u>	
	Total	Dissolved	Total	Dissolved	Total	Dissolved
1	0.013	0.011	0.054	0.052	0.057	0.051
2	0.013	0.011	0.060	0.052	0.056	0.051
3	0.013	0.010	0.056	0.053	0.056	0.051
4	0.012	0.011	0.057	0.051	0.056	0.051
5	0.012	0.011	0.055	0.051	0.055	0.050
6	<u>0.013</u>	<u>0.010</u>	<u>0.057</u>	<u>0.052</u>	<u>0.056</u>	<u>0.050</u>
$\bar{x}$	0.013	0.011	0.057	0.052	0.056	0.051
S.D.	0.001	0.001	0.002	0.001	0.001	0.001

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Titanium (mg/l)

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STATION

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Replica	<u>M1</u>		<u>M2</u>		<u>Below Falls</u>	
	Total	Dissolved	Total	Dissolved	Total	Dissolved
1	0.004	L0.002	0.005	L0.002	0.005	L0.002
2	0.004	L0.002	0.005	L0.002	0.003	L0.002
3	0.005	L0.002	0.004	L0.002	0.004	L0.002
4	0.003	L0.002	0.005	L0.002	0.004	L0.002
5	0.004	L0.002	0.005	L0.002	0.003	L0.002
6	<u>0.003</u>	<u>L0.002</u>	<u>0.005</u>	<u>L0.002</u>	<u>0.004</u>	<u>L0.002</u>
$\bar{x}$	0.004	L0.002	0.005	L0.002	0.004	L0.002
S.D.	0.001	0.0	0.000	0.0	0.001	0.0

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Aluminum (mg/l)

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STATION

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Replica	<u>M1</u>		<u>M2</u>		<u>Below Falls</u>	
	Total	Dissolved	Total	Dissolved	Total	Dissolved
1	0.07	L0.05	1.49	L0.05	1.57	L0.05
2	0.07	L0.05	1.63	L0.05	1.52	L0.05
3	0.23*	L0.05	1.53	L0.05	1.56	L0.05
4	0.06	L0.05	1.58	L0.05	1.55	L0.05
5	0.08	L0.05	1.60	L0.05	1.53	L0.05
6	<u>0.09</u>	<u>L0.05</u>	<u>1.56</u>	<u>L0.05</u>	<u>1.55</u>	<u>L0.05</u>
$\bar{x}$	0.10	L0.05	1.56	L0.05	1.55	L0.05
S.D.	0.06	0.0	0.05	0.0	0.02	0.0

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\*data results suspect

Iron (mg/l)

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STATION

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Replica	<u>M1</u>		<u>M2</u>		<u>Below Falls</u>	
	Total	Dissolved	Total	Dissolved	Total	Dissolved
1	0.034	L0.005	0.204	L0.005	0.255	0.008
2	0.035	0.010	0.209	L0.005	0.250	L0.005
3	0.046	L0.005	0.200	0.009	0.242	L0.005
4	0.027	L0.005	0.213	L0.005	0.237	L0.005
5	0.035	L0.005	0.195	L0.005	0.232	L0.005
6	<u>0.026</u>	<u>L0.005</u>	<u>0.210</u>	<u>L0.005</u>	<u>0.231</u>	<u>L0.005</u>
$\bar{x}$	0.034	L0.005	0.205	0.006*	0.241	0.006*
S.D.	0.007	0.0	0.007	0.002	0.010	0.001

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\*detection limit used for calculation of mean

Silica (mg/l)

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STATION

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Replica	M1		M2		Below Falls	
	Total	Dissolved	Total	Dissolved	Total	Dissolved
1	1.4	1.1	2.3	2.0	2.4	2.0
2	1.4	1.1	2.4	2.0	2.3	2.0
3	1.7	1.1	2.3	2.0	2.4	2.0
4	1.5	1.1	2.3	2.0	2.2	2.0
5	1.3	1.1	2.4	2.0	2.3	2.0
6	<u>1.3</u>	<u>1.1</u>	<u>2.6</u>	<u>2.0</u>	<u>2.3</u>	<u>2.0</u>
$\bar{x}$	1.4	1.1	2.4	2.0	2.3	2.0
S.D.	0.2	0.0	0.1	0.0	0.1	0.0

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Magnesium (mg/l)

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STATION

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Replica	<u>M1</u>		<u>M2</u>		<u>Below Falls</u>	
	Total	Dissolved	Total	Dissolved	Total	Dissolved
1	0.3	0.2	3.8	3.7	4.0	3.7
2	0.2	0.2	4.2	3.7	3.9	3.7
3	0.3	0.2	3.9	3.8	4.0	3.7
4	0.2	0.2	4.0	3.7	4.0	3.7
5	0.3	0.2	4.1	3.7	3.9	3.7
6	<u>0.3</u>	<u>0.2</u>	<u>3.9</u>	<u>3.7</u>	<u>4.0</u>	<u>3.7</u>
x	0.3	0.2	4.0	3.7	4.0	3.7
S.D.	0.1	0.0	0.1	0.0	0.1	0.0

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Sodium (mg/l)

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STATION

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Replica	<u>M1</u>		<u>M2</u>		<u>Below Falls</u>	
	Total	Dissolved	Total	Dissolved	Total	Dissolved
1	0.9	0.7	1.8	1.7	2.0	1.7
2	1.0	0.7	2.0	1.7	1.8	1.7
3	2.1	0.7	1.9	1.7	2.0	1.6
4	0.8	0.7	1.9	1.7	1.9	1.7
5	0.9	0.7	2.1	1.7	1.9	1.7
6	<u>0.9</u>	<u>0.7</u>	<u>2.0</u>	<u>1.7</u>	<u>1.9</u>	<u>1.7</u>
$\bar{x}$	1.1	0.7	2.0	1.7	1.9	1.7
S.D.	0.49	0.0	0.12	0.0	0.08	0.0

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Calcium (mg/l)

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STATION

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Replica	<u>M1</u>		<u>M2</u>		<u>Below Falls</u>	
	Total	Dissolved	Total	Dissolved	Total	Dissolved
1	6.5	5.9	22.1	21.0	23.2	20.8
2	6.3	5.8	24.4	21.1	22.7	20.9
3	6.6	5.9	22.5	21.3	23.0	20.8
4	6.2	5.8	23.1	21.0	22.3	20.5
5	6.2	5.8	23.1	21.0	22.3	20.5
6	<u>6.4</u>	<u>5.8</u>	<u>23.0</u>	<u>21.1</u>	<u>22.7</u>	<u>20.7</u>
$\bar{x}$	6.4	5.8	23.0	21.1	22.8	20.8
S.D.	0.16	0.05	0.78	0.12	0.31	0.14

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