

ENVIRONMENT CANADA
CONSERVATION AND PROTECTION
ENVIRONMENTAL PROTECTION SERVICE
PACIFIC AND YUKON REGION

WATER QUALITY MONITORING OF THE TSOLUN RIVER
WATER SHED AS INFLUENCED BY ACID MINE DRAINAGE
FROM ABANDONED COPPER MINE AT MOUNT WASHINGTON

Regional Data Report 86 - 08

by

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Introduction

The Mount Washington copper mine is situated on Vancouver Island about 40 km northwest of Courtenay. The mine, located on the north slope of Mount Washington, is drained by Pyrrhotite Creek and partially by McKay Creek at the headwater of the Tsolum River system. (Fig. 1).

The mine was abandoned in 1967 and the site ownership was turned back to the provincial crown. The mine continues to release acid water and high concentrations of heavy metals to the Tsolum River, an important river for coho, chum, and pink salmon.

The present study is the contribution of Environmental Protection Service of Environment Canada to the joint monitoring program of the Mount Washington mine problem. The objective of the study was to determine, during freshet, the distribution of the contaminant throughout the mine drainage area especially the mixing zone between Murex Creek and the Tsolum River.

Material and Methods

Flow measurements were taken at 11 different sites (fig. 1) with a Marsh-McBirney Model 201 Portable Water Current Meter. Measurements were performed on June 2, 1986 (Stations 5, 6 and 11), June 3, 1986 (Stations 7, 8, 9, 10), and on June 4, 1986 (Stations 1, 2, 3, 4, 5, 6). Depending on the stream width, three to ten discrete velocity measurements were taken at each transect for calculation of the discharge rate.

Conductivity and temperature were recorded in transects across the creeks with a Hydrolab digital 4041 indicator unit and 4021 sonde unit. The results of the conductivity transect were initially used to locate the plume of contaminated water in the receiving environment.

Water chemistry data were collected over June 3 and 4, 1984 at the 10 stations. A single grab sample was taken at each velocity measurement site of the transect. The following chemical parameters were analyzed: pH, SO₄, total residues, filterable residues, non filterable residues, alkalinity conductivity, total and dissolved metals. Hardness was determined from the dissolved metal sample. The samples for conductivity, alkalinity, pH, SO₄, total residues, filterable residues, and non filterable residues, were kept cool with ice until analysis. Dissolved metals were filtered the same day through a 0.45 micron cellulose nitrate membrane filter. Total and dissolved metals were preserved with nitric acid (0.5 ml/100 ml sample). The total organic carbon and total inorganic carbon samples were collected in glass jars and preserved with a few drops of concentrated HCl. Sediment samples were collected with a stainless steel syringe at 5 different sites (1, 3, 6, 7, 9) according to a method reported by Derksen, 1985. All samples were delivered to the Environmental Protection Service Laboratory in West Vancouver.

Inductively Coupled Argon Plasma (ICAP) atomic emission spectroscopy was used for the total and dissolved metal analysis and gave a reading of twenty-six metals. If the copper readings were below the ICAP detection limit, the samples were rerun on the graphite furnace of the atomic absorption spectrophotometer to obtain a lower detection limit.

Description of Sample Sites in the Mt. Washington Study Area

<u>Station</u>	<u>Location</u>	<u>Remarks</u>
1	Pyrrhotite Creek upstream of the Rossiter Mainline Bridge	turbid water, 3.6m wide, average velocity: 12cm/sec, large boulder. sediment sample
2	McKay Creek upstream of the Rossiter Mainline Bridge	solid bedrock, 3m wide, average velocity: 1.2m/sec, very shallow
3	Murex Creek upstream of the Rossiter Mainline Bridge	boulder and pockets of gravel, cascade, 4.5m wide, average velocity: 52cm/sec, stream in the shade, sediment sample.
4	Murex Creek, 100m, downstream of Pyrrhotite Creek.	boulder, no gravel, series of cascades, Creek 9.0 wide, average velocity: 58cm/sec
5	Murex Creek, 1200m downstream of Pyrrhotite Creek. Access through gravel pit on the west side of the Duncan Bay Mainline road	mainly boulder and cobbles, some gravel. 9m wide, average velocity: 44cm/sec
6	Murex Creek, 2500 downstream of Pyrrhotite Creek, upstream of Duncan Bay Mainline Bridge	mainly boulder and cobble, some gravel, 12m wide, average velocity: 40cm/sec, sediment sample
7	Tsolum River upstream Murex Creek upstream of the Duncan Bay Mainline Bridge	loose pebbles and gravel water with a brownish tint, 3.4m wide, average velocity: 1.0m/sec, sediment sample

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8	Tsolum River, 500m downstream of Murex Creek	rocky bottom with good gravel, bluffs on both sides of the river, shaded, 15m wide, average velocity:24cm/sec
9	Tsolum River, 1100m downstream of Murex Creek	cobbles, pebbles and gravel, 10.5m wide, average velocity:60cm/sec, sediment sample
10	Tsolum River, 6600m downstream of Murex Creek	cobbles, some gravel 24.5m wide average velocity:57cm/sec
11	Tsolum River 9800m downstream of Murex Creek, upstream of the Farham Road bridge	solidified clay bottom, 13m wide, average velocity:62cm/sec

SUMMARY OF RESULTS FROM MOUNT WASHINGTON

Station 1
Pyrrhotite creek
June 4, 1986 4:30 PM
T.Discharge : 0.144 m3/sec
X Tot. Cu : 0.927 mg/l
X Diss. Cu : 0.882 mg/l
Load. T.Cu : 11.53 Kg/day
Load. D.Cu : 10.97 Kg/day

Station 2
McKay creek
June 4, 1986 4:00 PM
T.Discharge : 0.497 m3/sec
X Tot. Cu : 0.010 mg/l
X Diss. Cu : 0.009 mg/l
Load. T.Cu : 0.43 Kg/day
Load. D.Cu : 0.39 Kg/day

Station 3
Murex creek upstream of Pyrrhotite
June 4, 1986 3:00 PM
T.Discharge : 0.762 m3/sec
X Tot. Cu : 0.005 mg/l
X Diss. Cu : 0.005 mg/l
Load. T.Cu : 0.33 Kg/day
Load. D.Cu : 0.33 Kg/day

Station 4
Murex creek, 100 m downstream
June 4, 1986 12:00 PM
T.Discharge : 1.655 m3/sec
X Tot. Cu : 0.131 mg/l
X Diss. Cu : 0.120 mg/l
Load. T.Cu : 18.73 Kg/day
Load. D.Cu : 17.16 Kg/day

Station 5
Murex creek, 1200 m downstream
June 4, 1986 10:00 AM
T.Discharge : 1.620 m3/sec
X Tot. Cu : 0.154 mg/l
X Diss. Cu : 0.137 mg/l
Load. T.Cu : 21.49 Kg/day
Load. D.Cu : 19.19 Kg/day

Station 6
Murex creek, 2500 m downstream
June 3, 1986 7:30 PM S.gauge: 0.87
T.Discharge : 2.090 m3/sec
X Tot. Cu : 0.085 mg/l
X Diss. Cu : 0.076 mg/l
Load. T.Cu : 15.42 Kg/day
Load. D.Cu : 13.72 Kg/day

Station 7
Tsolum river above Murex creek
June 4, 1986 8:30 AM
T.Discharge : 0.307 m3/sec
X Tot. Cu : 0.002 mg/l
X Diss. Cu : 0.001 mg/l
Load. T.Cu : 0.05 Kg/day
Load. D.Cu : 0.03 Kg/day

Station 8
Tsolum river, 500 m downstream
June 3, 1986 5:15 PM
T.Discharge : 1.854 m3/sec
X Tot. Cu : 0.077 mg/l
X Diss. Cu : 0.068 mg/l
Load. T.Cu : 12.32 Kg/day
Load. D.Cu : 10.83 Kg/day

Station 9
Tsolum river, 1100 m downstream
June 3, 1986 11:30 AM
T.Discharge : 2.149 m3/sec
X Tot. Cu : 0.088 mg/l
X Diss. Cu : 0.078 mg/l
Load. T.Cu : 16.30 Kg/day
Load. D.Cu : 14.63 Kg/day

Station 10
Tsolum river, 6600 m downstream
June 3, 1986 8:15 AM
T.Discharge : 2.794 m3/sec
X Tot. Cu : 0.044 mg/l
X Diss. Cu : 0.039 mg/l
Load. T.Cu : 10.41 Kg/day
Load. D.Cu : 9.34 Kg/day

EXTRA SAMPLING

Station 6
Murex creek, 2500 m downstream
June 2, 1986 5:00 PM
T.Discharge : 1.849 m3/sec

Station 7
Tsolum river above Murex creek
June 2, 1986 6:00 PM
T.Discharge : 0.32 m3/sec

Station 11
Tsolum river, 9800 m downstream
June 2, 1986 7:00 PM
T.Discharge : 3.08 m3/sec

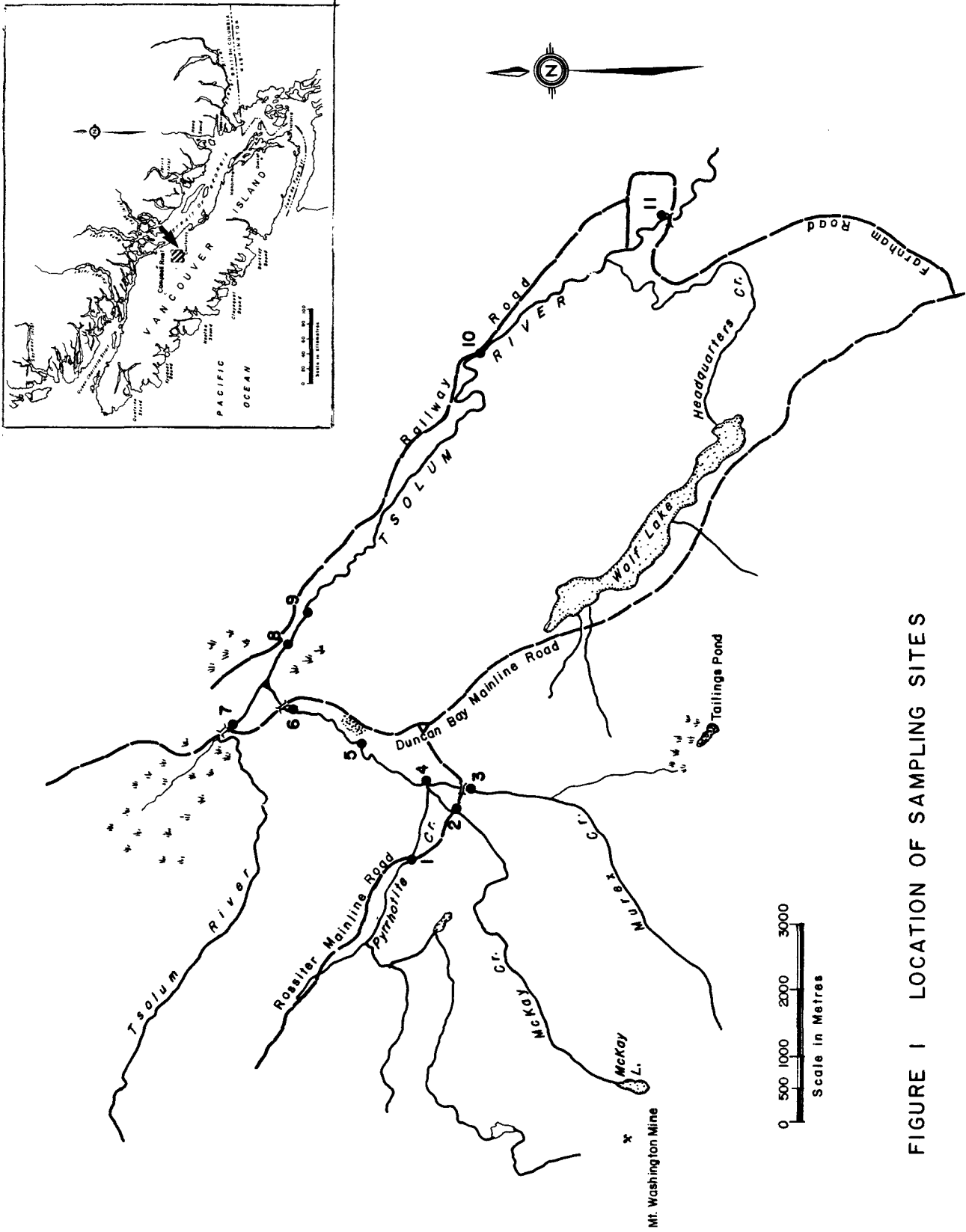
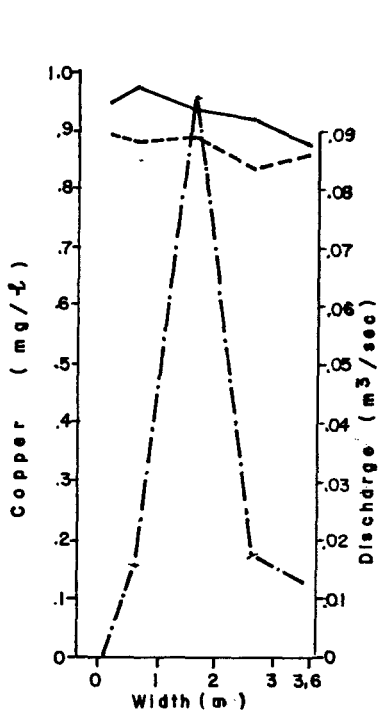
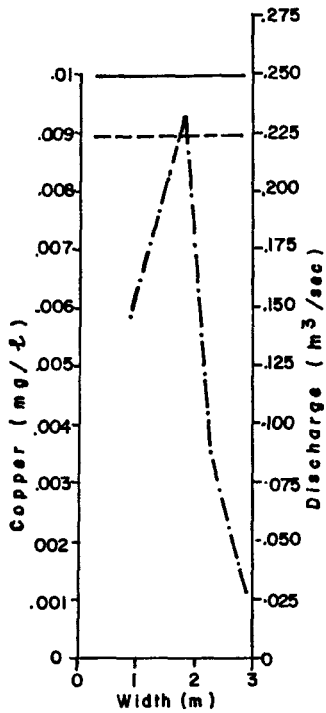


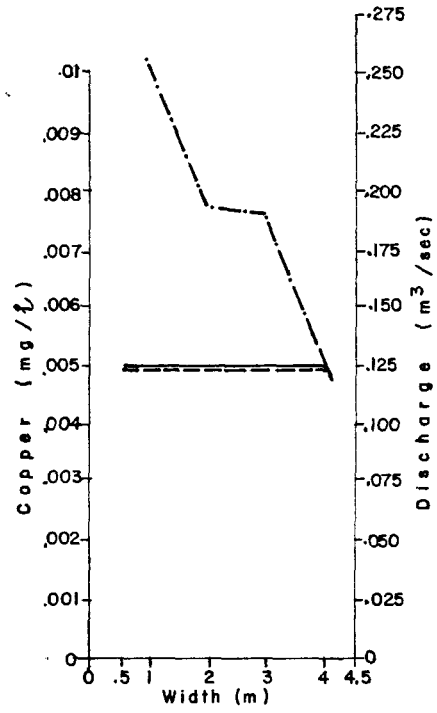
FIGURE 1 LOCATION OF SAMPLING SITES



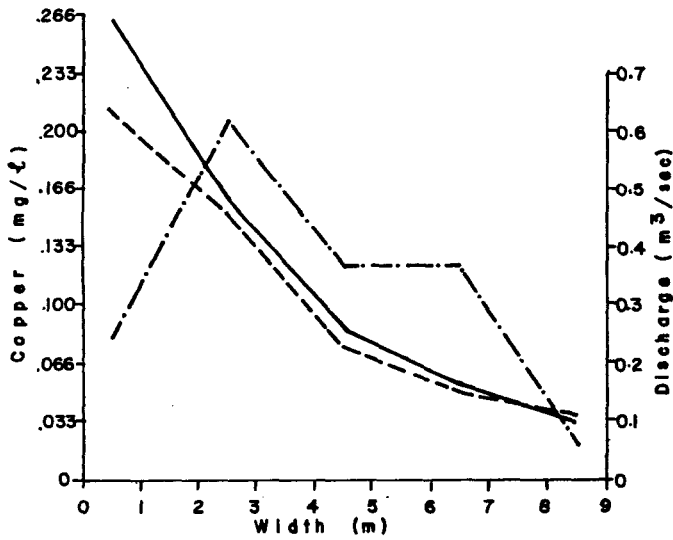
**PYRRHOTITE CREEK
STATION 1**



**McKAY CREEK
STATION 2**

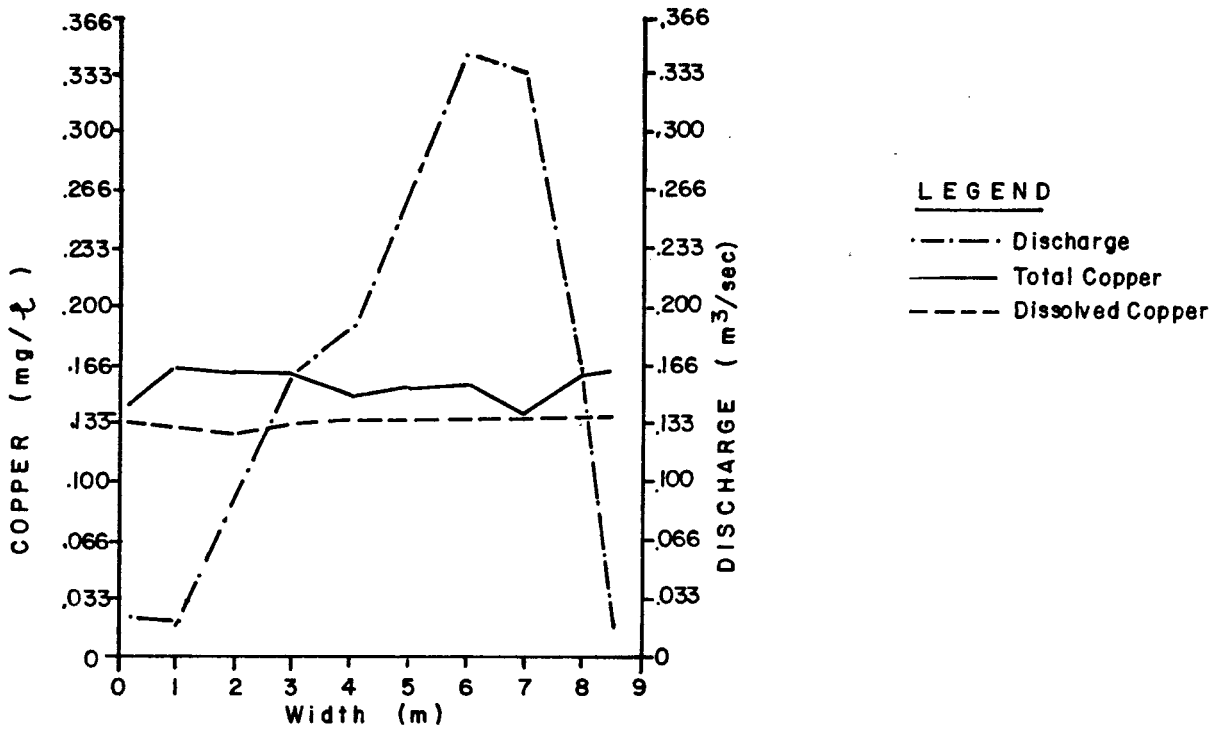


**MUREX CREEK ABOVE
PYRRHOTITE CREEK
STATION 3**

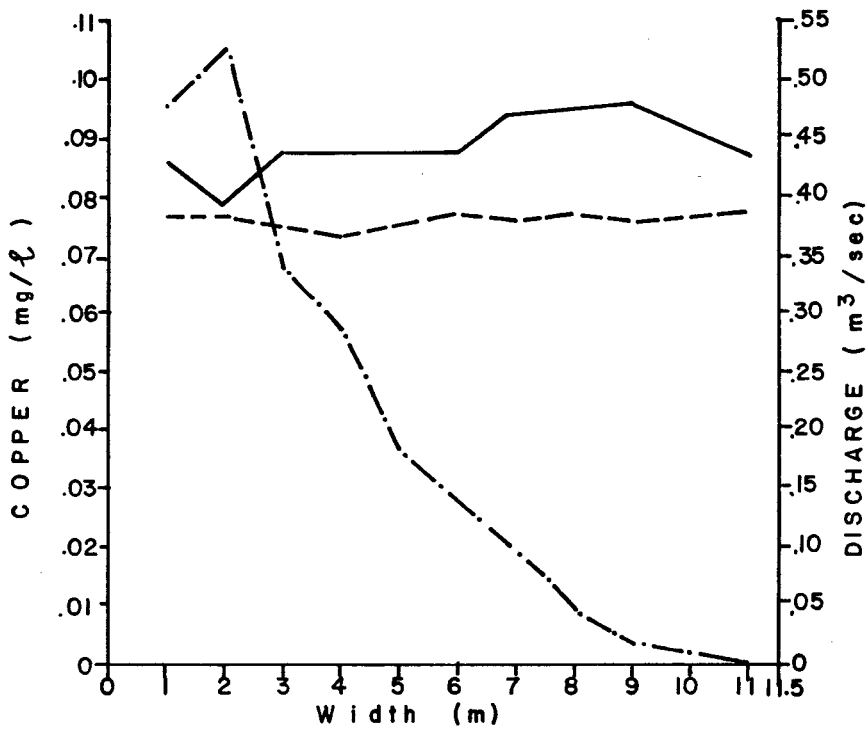


**MUREX CREEK, 100 METRES DOWNSTREAM
STATION 4**

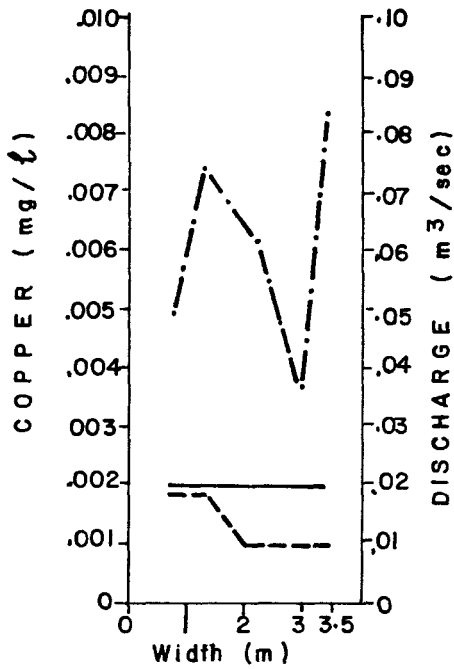
LEGEND
 - · - · Discharge
 — Total Copper
 - - - Dissolved Copper



**MUREX CREEK, 1200 METRES DOWNSTREAM
(GRAVEL PIT) - STATION 5**



**MUREX CREEK, 2500 METRES DOWNSTREAM
(DUNCAN BAY MAINLINE) - STATION 6**

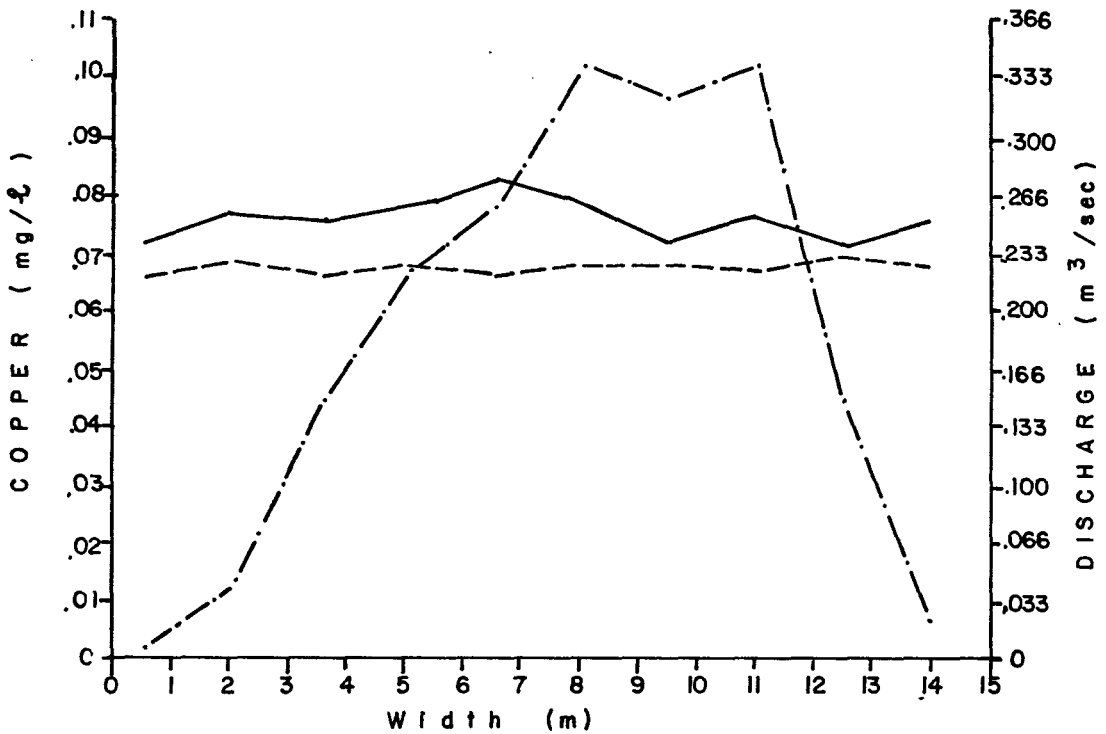


LEGEND

- · - · - Discharge
- Total Copper
- - - Dissolved Copper

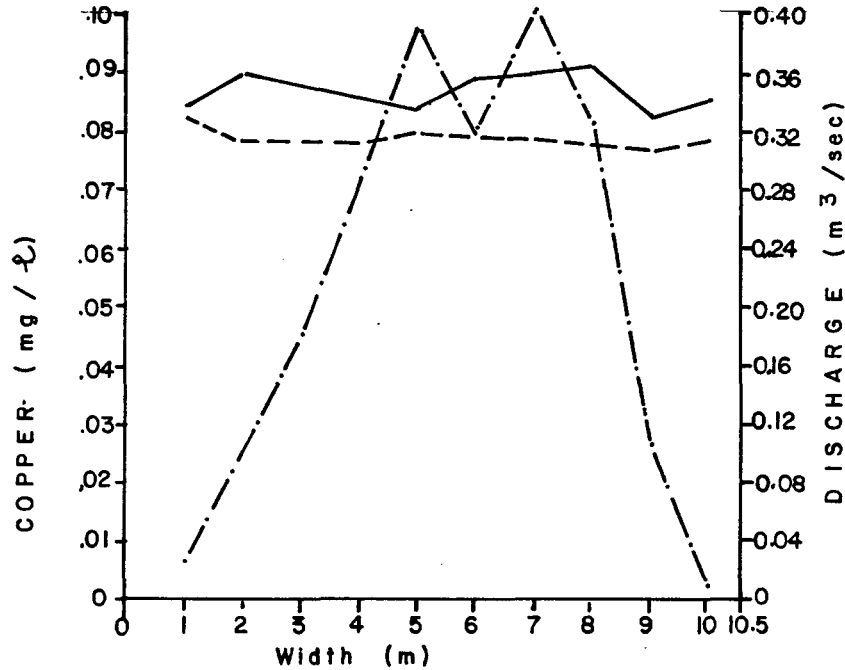
TSOLUM RIVER ABOVE MUREX CREEK

STATION 7



TSOLUM RIVER, 500 METRES DOWNSTREAM

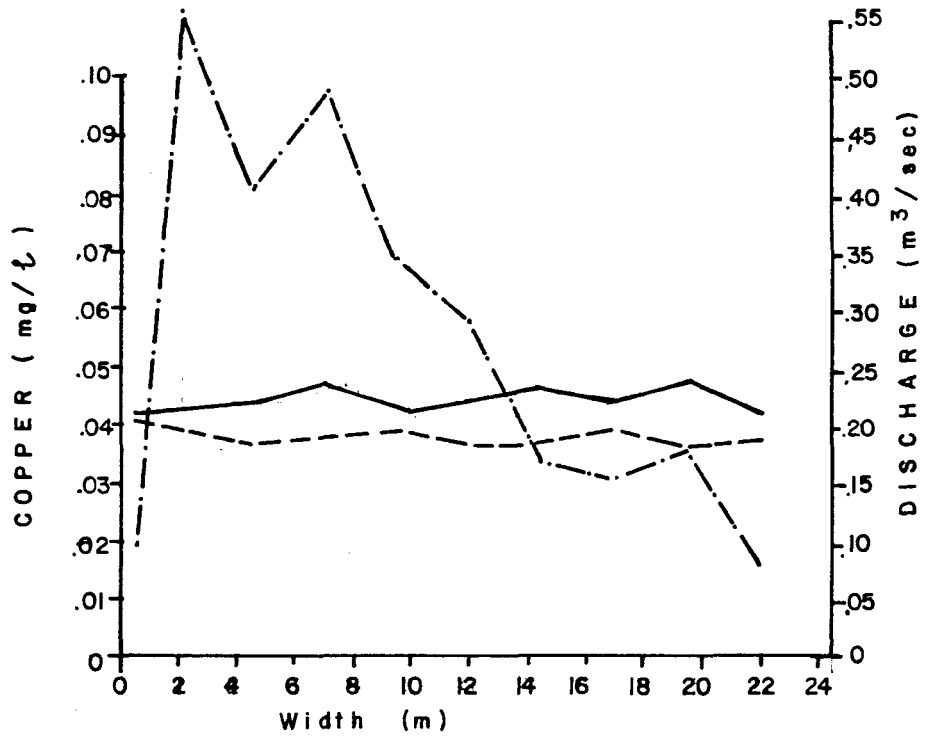
STATION 8



TSOLUM RIVER, 1100 METRES DOWNSTREAM
STATION 9

LEGEND

- · - · - Discharge
- Total Copper
- - - Dissolved Copper



TSOLUM RIVER, 6600 METRES DOWNSTREAM
STATION 10

RESULTS FOR MCJANT WASHINGTON SAMPLES
June 3-4, 1966

Station Number	Station Location	Lateral Distance (m)	AL		RL		CA		CU		FE		MG		MN		NA		SR		ZN		HARDNESS	
			TOTICP MG/L	DISICP MG/L	TOTICP MG/L	DISICP MG/L	TOTICP MG/L	DISICP MG/L	TOTICP MG/L	DISICP MG/L	TOTICP MG/L	DISICP MG/L	TOTICP MG/L	DISICP MG/L	TOTICP MG/L	DISICP MG/L	TOTICP MG/L	DISICP MG/L	TOTICP MG/L	DISICP MG/L	TOTICP MG/L	DISICP MG/L	Ca + Mg MG/L	TOTAL MG/L
Station 1	L. Bank Pyrrhotite u/s Murex R. Bank	0.1	0.43	0.05	4.1	4.1	0.547	0.895	0.037	0.056	0.8	0.7	0.078	0.079	0.5	0.4	0.010	0.009	0.009	0.009	0.030	0.027	13.20	13.70
		0.6	0.45	0.05	4.1	4.1	0.568	0.862	0.092	0.065	0.8	0.7	0.079	0.080	0.5	0.5	0.009	0.009	0.009	0.009	0.030	0.027	13.38	13.92
		1.6	0.41	0.05	4.1	4.1	0.930	0.893	0.057	0.067	0.8	0.7	0.078	0.080	0.5	0.5	0.010	0.009	0.009	0.009	0.030	0.028	13.40	13.90
Station 2	L. Bank Pyrrhotite u/s Murex R. Bank	2.6	0.41	0.05	4.2	4.2	0.916	0.843	0.058	0.056	0.8	0.8	0.078	0.078	0.5	0.5	0.010	0.009	0.009	0.009	0.028	0.028	13.60	14.10
		3.6	0.44	0.05	4.3	4.2	0.879	0.864	0.052	0.054	0.8	0.8	0.076	0.079	0.5	0.5	0.010	0.009	0.009	0.009	0.030	0.029	13.90	14.40
		0.2	0.11	0.08	3.0	3.0	0.010	0.009	0.042	0.014	0.6	0.6	0.002	0.002	0.4	0.5	0.011	0.012	0.012	0.012	0.002	0.002	3.90	10.40
Station 3	L. Bank Murex u/s Pyrrhotite R. Bank	1.0	0.14	0.07	3.0	3.0	0.010	0.009	0.054	0.013	0.6	0.6	0.002	0.002	0.4	0.5	0.011	0.011	0.011	0.011	0.002	0.002	9.73	10.28
		2.8	0.13	0.05	3.0	3.0	0.010	0.009	0.051	0.012	0.6	0.5	0.002	0.002	0.4	0.4	0.011	0.011	0.011	0.011	0.002	0.002	9.66	9.99
		0.5	0.05	0.05	1.7	1.7	0.005	0.005	0.052	0.011	0.2	0.2	0.002	0.001	0.5	0.5	0.008	0.009	0.008	0.009	0.002	0.002	5.00	5.18
Station 4	L. Bank Murex 100 m d/s Pyrrhotite R. Bank	1.0	0.06	0.05	1.7	1.7	0.005	0.005	0.050	0.013	0.2	0.2	0.002	0.001	0.6	0.5	0.007	0.008	0.007	0.008	0.002	0.002	5.06	5.28
		2.0	0.08	0.05	1.8	1.8	0.005	0.005	0.057	0.013	0.2	0.2	0.002	0.001	0.6	0.6	0.008	0.008	0.008	0.008	0.002	0.002	5.17	5.45
		3.0	0.10	0.05	1.8	1.8	0.005	0.005	0.053	0.014	0.2	0.2	0.002	0.001	0.6	0.5	0.008	0.008	0.008	0.008	0.002	0.002	5.25	5.54
Station 5	L. Bank Murex 2500 m d/s Pyrrhotite R. Bank	4.0	0.11	0.05	1.8	1.8	0.005	0.005	0.056	0.014	0.2	0.2	0.002	0.001	0.6	0.6	0.008	0.008	0.008	0.008	0.002	0.002	5.33	5.66
		0.5	0.17	0.08	2.8	2.8	0.253	0.215	0.051	0.022	0.5	0.5	0.020	0.019	0.5	0.5	0.009	0.009	0.009	0.009	0.007	0.006	8.66	9.40
		2.5	0.14	0.05	2.5	2.5	0.161	0.155	0.049	0.016	0.4	0.4	0.014	0.014	0.5	0.5	0.010	0.008	0.008	0.008	0.005	0.003	7.90	8.16
Station 6	L. Bank Murex 2500 m d/s Pyrrhotite R. Bank	4.5	0.10	0.05	2.4	2.4	0.087	0.079	0.047	0.015	0.4	0.3	0.009	0.009	0.5	0.5	0.009	0.009	0.009	0.009	0.004	0.004	7.25	7.46
		6.5	0.12	0.05	2.3	2.3	0.052	0.051	0.045	0.013	0.4	0.3	0.005	0.005	0.5	0.5	0.010	0.008	0.008	0.008	0.002	0.002	7.03	7.31
		8.5	0.09	0.05	2.2	2.2	0.033	0.037	0.039	0.012	0.3	0.3	0.004	0.004	0.5	0.5	0.010	0.008	0.008	0.008	0.002	0.002	6.96	7.13
Station 7	L. Bank Murex 2500 m d/s Pyrrhotite R. Bank	0.2	0.17	0.09	2.8	2.8	0.144	0.137	0.055	0.020	0.5	0.5	0.012	0.012	0.6	0.6	0.011	0.009	0.009	0.009	0.005	0.005	8.66	9.42
		1.0	0.15	0.07	2.8	2.8	0.166	0.131	0.062	0.018	0.5	0.4	0.013	0.011	0.6	0.6	0.011	0.009	0.009	0.009	0.005	0.005	8.52	8.97
		2.0	0.14	0.07	2.7	2.7	0.163	0.129	0.047	0.019	0.5	0.4	0.013	0.011	0.6	0.6	0.011	0.009	0.009	0.009	0.005	0.005	8.60	9.07
Station 7	L. Bank Murex 2500 m d/s Pyrrhotite R. Bank	3.0	0.12	0.05	2.7	2.7	0.164	0.135	0.054	0.015	0.4	0.4	0.013	0.012	0.5	0.5	0.009	0.009	0.009	0.009	0.006	0.006	8.32	8.67
		4.0	0.11	0.05	2.8	2.8	0.149	0.137	0.056	0.019	0.5	0.4	0.011	0.011	0.6	0.6	0.010	0.009	0.009	0.009	0.005	0.005	8.79	9.19
		5.0	0.11	0.05	2.7	2.7	0.154	0.138	0.056	0.017	0.5	0.5	0.013	0.012	0.6	0.6	0.011	0.009	0.009	0.009	0.004	0.004	8.66	8.99
Station 7	L. Bank Murex 2500 m d/s Pyrrhotite R. Bank	6.0	0.13	0.05	2.7	2.7	0.158	0.138	0.051	0.021	0.4	0.5	0.013	0.012	0.5	0.5	0.010	0.009	0.009	0.009	0.004	0.004	8.73	9.15
		7.0	0.13	0.05	2.7	2.7	0.140	0.139	0.056	0.019	0.5	0.4	0.012	0.012	0.5	0.5	0.010	0.009	0.009	0.009	0.004	0.004	8.69	9.20
		8.0	0.15	0.09	2.8	2.8	0.159	0.138	0.056	0.020	0.5	0.5	0.013	0.012	0.6	0.6	0.011	0.009	0.009	0.009	0.004	0.004	8.92	9.48
Station 7	L. Bank Murex 2500 m d/s Pyrrhotite R. Bank	0.5	0.13	0.09	2.8	2.8	0.162	0.137	0.045	0.019	0.5	0.5	0.013	0.012	0.6	0.6	0.011	0.009	0.009	0.009	0.005	0.005	8.61	9.36
		1.0	0.12	0.06	2.4	2.4	0.086	0.077	0.049	0.013	0.4	0.4	0.007	0.006	0.7	0.6	0.009	0.009	0.009	0.009	0.003	0.003	7.59	7.95
		2.0	0.12	0.05	2.4	2.4	0.079	0.077	0.050	0.013	0.4	0.4	0.007	0.007	0.6	0.6	0.008	0.008	0.008	0.008	0.003	0.003	7.50	7.82
Station 7	L. Bank Murex 2500 m d/s Pyrrhotite R. Bank	3.0	0.12	0.05	2.4	2.4	0.088	0.075	0.050	0.013	0.4	0.3	0.008	0.007	0.5	0.5	0.009	0.008	0.008	0.008	0.003	0.003	7.39	7.67
		4.0	0.14	0.06	2.4	2.4	0.087	0.073	0.054	0.013	0.4	0.3	0.008	0.007	0.5	0.5	0.008	0.008	0.008	0.008	0.003	0.003	7.32	7.67
		5.0	0.10	0.05	2.4	2.4	0.087	0.076	0.050	0.013	0.5	0.4	0.008	0.008	0.6	0.5	0.009	0.008	0.008	0.008	0.003	0.003	7.64	7.95
Station 7	L. Bank Murex 2500 m d/s Pyrrhotite R. Bank	6.0	0.08	0.05	2.4	2.4	0.087	0.077	0.050	0.012	0.4	0.4	0.008	0.008	0.7	0.5	0.009	0.008	0.008	0.008	0.003	0.003	7.42	7.66
		7.0	0.08	0.05	2.4	2.4	0.094	0.076	0.046	0.012	0.4	0.4	0.008	0.008	0.6	0.5	0.010	0.008	0.008	0.008	0.003	0.003	7.52	7.78
		8.0	0.07	0.05	2.4	2.4	0.095	0.077	0.048	0.012	0.4	0.4	0.008	0.008	0.6	0.6	0.010	0.009	0.009	0.009	0.005	0.005	7.66	7.92
Station 7	L. Bank Murex 2500 m d/s Pyrrhotite R. Bank	9.0	0.12	0.07	2.5	2.4	0.096	0.076	0.055	0.014	0.4	0.4	0.008	0.007	0.6	0.6	0.009	0.009	0.009	0.009	0.004	0.004	7.73	8.15
		11.0	0.15	0.08	2.5	2.5	0.087	0.077	0.059	0.015	0.4	0.4	0.008	0.007	0.6	0.6	0.009	0.008	0.008	0.008	0.004	0.004	7.62	8.31
		0.7	0.06	0.05	4.5	4.5	0.082	0.082	0.469	0.061	1.3	1.3	0.030	0.025	1.5	1.5	0.012	0.012	0.012	0.012	0.002	0.002	16.70	17.50
Station 7	L. Bank Murex 2500 m d/s Pyrrhotite R. Bank	1.3	0.06	0.05	4.6	4.6	0.082	0.082	0.466	0.059	1.3	1.3	0.030	0.025	1.5	1.5	0.012	0.012	0.012	0.012	0.002	0.002	16.70	17.52
		2.1	0.09	0.05	4.5	4.5	0.082	0.081	0.458	0.054	1.3	1.3	0.031	0.023	1.5	1.5	0.013	0.013	0.013	0.013	0.002	0.002	16.30	17.00
		2.9	0.07	0.05	4.5	4.5	0.082	0.081	0.443	0.056	1.3	1.3	0.030	0.023	1.5	1.5	0.013	0.013	0.013	0.013	0.002	0.002	16.50	17.30
Station 7	L. Bank Murex 2500 m d/s Pyrrhotite R. Bank	3.4	0.15	0.05	4.6	4.6	0.082	0.081	0.464	0.073	1.3	1.3	0.030	0.024	1.5	1.5	0.013	0.013	0.013	0.013	0.002	0.002	16.50	17.20

RESULTS FOR MOUNT WASHINGTON SAMPLES
June 3-4, 1986

Station Number	Station Location	Lateral Distance (m)	AL		CA		CU		FE		MG		MN		NA		SR		ZN		HARDNESS		
			TOTIP MG/L	DISIOP MG/L	TOTIP MG/L	DISIOP MG/L	TOTIP MG/L	DISIOP MG/L	TOTIP MG/L	DISIOP MG/L	TOTIP MG/L	DISIOP MG/L	TOTIP MG/L	DISIOP MG/L	TOTIP MG/L	DISIOP MG/L	TOTIP MG/L	DISIOP MG/L	TOTIP MG/L	DISIOP MG/L	Ca #	PE	TOTIP
L. Bank		0.5	0.05	0.05	2.8	2.8	0.072	0.072	0.026	0.102	0.049	0.7	0.6	0.010	0.010	0.9	1.3	0.009	0.009	0.003	0.002	9.21	9.46
		2.0	0.05	0.05	2.8	2.8	0.077	0.077	0.058	0.058	2.253	0.6	0.6	0.010	0.010	0.6	0.8	0.009	0.009	0.003	0.002	9.34	9.77
		3.5	0.05	0.05	2.8	2.8	0.076	0.076	0.067	0.051	0.051	0.6	0.6	0.010	0.010	0.7	0.7	0.009	0.009	0.003	0.002	9.36	9.78
		5.0	0.05	0.05	2.9	2.9	0.078	0.068	0.100	0.051	0.051	0.6	0.6	0.011	0.010	0.8	0.6	0.009	0.009	0.003	0.002	9.53	9.95
		6.5	0.05	0.05	2.9	2.9	0.083	0.066	0.103	0.051	0.051	0.6	0.6	0.011	0.010	0.8	0.8	0.009	0.009	0.004	0.002	9.60	10.10
		8.0	0.07	0.05	2.9	2.9	0.079	0.068	0.099	0.054	0.054	0.6	0.6	0.010	0.010	0.8	0.6	0.009	0.009	0.002	0.002	9.63	10.00
		9.5	0.10	0.05	2.9	2.9	0.072	0.068	0.105	0.053	0.053	0.6	0.6	0.010	0.010	0.8	0.8	0.009	0.009	0.003	0.002	9.55	10.12
		11.0	0.12	0.05	2.9	2.9	0.077	0.067	0.107	0.053	0.053	0.6	0.6	0.011	0.010	0.8	0.7	0.009	0.009	0.003	0.002	9.59	10.22
		12.5	0.10	0.05	2.9	2.9	0.071	0.070	0.099	0.052	0.052	0.6	0.6	0.010	0.010	0.7	0.7	0.009	0.009	0.002	0.002	9.47	10.00
		14.0	0.17	0.08	2.9	2.9	0.076	0.068	0.107	0.053	0.053	0.6	0.6	0.011	0.010	0.7	0.8	0.009	0.009	0.003	0.002	9.52	10.10
L. Bank		1.0	0.09	0.06	3.0	3.0	0.084	0.084	0.082	0.124	0.056	0.6	0.6	0.013	0.013	0.9	0.9	0.010	0.010	0.002	0.015	9.79	10.30
		2.0	0.07	0.06	3.1	3.1	0.082	0.079	0.101	0.054	0.054	0.6	0.6	0.011	0.011	0.9	0.8	0.011	0.011	0.002	0.011	9.69	10.20
		3.0	0.13	0.06	3.0	3.0	0.089	0.079	0.106	0.053	0.053	0.6	0.6	0.011	0.011	0.8	0.8	0.011	0.011	0.002	0.002	9.78	10.20
		4.0	0.15	0.07	3.0	3.0	0.086	0.078	0.105	0.055	0.055	0.6	0.6	0.012	0.011	0.8	0.8	0.011	0.011	0.002	0.002	9.84	10.40
		5.0	0.15	0.08	3.0	3.0	0.084	0.080	0.117	0.055	0.055	0.6	0.6	0.012	0.012	0.8	0.8	0.010	0.010	0.002	0.002	9.98	10.60
		6.0	0.12	0.07	2.9	2.9	0.089	0.079	0.129	0.053	0.053	0.6	0.6	0.012	0.012	0.8	0.9	0.011	0.011	0.002	0.002	10.30	11.40
		7.0	0.16	0.07	3.0	3.0	0.090	0.079	0.113	0.055	0.055	0.7	0.6	0.012	0.011	0.8	0.8	0.011	0.011	0.002	0.002	9.89	10.40
		8.0	0.16	0.05	3.0	3.0	0.091	0.078	0.129	0.055	0.055	0.7	0.6	0.012	0.011	0.8	0.8	0.011	0.011	0.002	0.002	9.82	10.30
		9.0	0.20	0.05	3.0	3.0	0.083	0.077	0.110	0.055	0.055	0.7	0.6	0.011	0.011	0.9	0.9	0.011	0.011	0.002	0.002	9.63	10.00
		10.0	0.16	0.05	3.0	3.0	0.085	0.078	0.112	0.052	0.052	0.7	0.6	0.012	0.011	0.8	0.8	0.011	0.011	0.002	0.002	9.65	10.00
L. Bank		0.5	0.11	0.06	3.2	3.2	0.042	0.041	0.120	0.155	0.155	0.6	0.7	0.009	0.011	0.9	1.0	0.012	0.012	0.002	0.004	11.00	11.50
		1.5	0.10	0.05	3.0	3.0	0.043	0.039	0.116	0.064	0.064	0.6	0.6	0.009	0.008	0.9	0.9	0.011	0.011	0.002	0.002	10.10	10.50
		4.2	0.09	0.05	3.0	3.0	0.044	0.037	0.116	0.063	0.063	0.6	0.6	0.008	0.008	0.9	0.9	0.011	0.011	0.002	0.002	10.20	10.70
		6.9	0.10	0.06	3.1	3.1	0.047	0.038	0.115	0.064	0.064	0.6	0.6	0.009	0.009	0.9	0.9	0.010	0.010	0.002	0.002	10.20	10.70
		9.4	0.08	0.07	3.0	3.0	0.042	0.039	0.113	0.062	0.062	0.6	0.6	0.008	0.008	0.9	1.0	0.010	0.010	0.002	0.002	9.97	10.50
		11.9	0.07	0.06	3.1	3.1	0.043	0.037	0.110	0.061	0.061	0.6	0.6	0.009	0.009	0.9	0.9	0.011	0.011	0.002	0.002	10.10	10.60
		14.4	0.08	0.05	3.0	3.0	0.046	0.037	0.115	0.060	0.060	0.6	0.6	0.009	0.008	1.1	1.2	0.010	0.010	0.002	0.002	9.63	10.20
		17.9	0.09	0.05	3.0	3.0	0.044	0.040	0.117	0.060	0.060	0.6	0.6	0.009	0.009	0.9	0.9	0.010	0.010	0.002	0.002	9.90	10.10
		19.4	0.14	0.05	3.0	3.0	0.047	0.037	0.120	0.056	0.056	0.7	0.6	0.009	0.009	0.9	0.9	0.010	0.010	0.002	0.002	9.58	9.83
		22.0	0.14	0.05	3.0	3.0	0.041	0.038	0.120	0.059	0.059	0.7	0.6	0.009	0.009	0.9	0.9	0.011	0.011	0.002	0.002	9.50	10.10

RESULTS FOR POINT WBS-INSTON SAMPLES
June 3-4, 1986

Station Number	Station Location	Lateral Distance (m)	ALK MG/L	COND UMHO/C	PH REL-DL	SO4 MG/L	TR MG/L	FR MG/L	NFR MG/L	TIC MG/L	TDC MG/L	TOC MG/L
Station 1	Murex R-Bank	0.5	2.0	44	5.7	13	33	33	15	1	2	
		1.6	2.0	45	5.7	12	31	31	15	1	3	
		2.6	1.0	44	5.8	13	31	31	26	6	1	
		3.6	1.0	46	5.4	11	33	24	24	9	1	
Station 2	L-Bank McKay R-Bank	0.2	2.9	28	6.3	6	25	25	15	1	2	
		1.8	2.9	26	6.3	6	17	17	15	1	2	
		2.8	2.9	28	6.2	6	26	26	15	1	2	
		0.5	3.9	16	6.4	1	8	8	15	1	2	
Station 3	Murex u/s of Pyrrhotite R-Bank	1.0	4.9	16	6.7	1	20	20	15	1	2	
		2.0	3.9	16	6.6	2	22	22	15	1	2	
		3.0	4.9	16	6.5	1	16	16	15	1	2	
		4.0	3.9	28	6.4	1	21	21	16	7	1	2
Station 4	L-Bank Murex 100 m d/s Pyrrhotite R-Bank	0.5	3.9	27	6.6	3	29	24	5	1	3	
		2.5	3.9	25	6.6	3	20	20	15	1	2	
		4.5	3.9	23	6.6	4	21	21	15	1	2	
		8.5	3.9	22	6.5	1	21	21	15	1	2	
Station 5	Murex 1000 m d/s of Pyrrhotite R-Bank	0.2	4.9	26	6.6	4	26	18	8	1	2	
		1.0	4.9	26	6.7	3	20	20	15	1	2	
		2.0	3.9	26	6.7	3	25	25	15	1	2	
		3.0	4.9	26	6.7	3	21	21	15	1	2	
Station 6	Murex 2500 m c/s Pyrrhotite R-Bank	4.0	3.9	26	6.6	4	23	23	15	1	2	
		5.0	3.9	26	6.7	3	23	23	15	1	2	
		6.0	3.9	26	6.6	3	23	13	10	1	2	
		7.0	3.9	26	6.6	1	24	19	5	1	2	
Station 7	L-Bank Isolim u/s of Murex R-Bank	8.0	3.9	26	6.6	5	20	20	15	1	2	
		8.5	3.9	26	6.6	5	22	17	8	1	2	
		1.0	4.9	23	6.8	5	27	27	15	1	2	
		2.0	3.9	23	6.7	4	20	20	15	1	2	
Station 8	Murex 2500 m c/s Pyrrhotite R-Bank	3.0	4.4	23	6.7	4	24	24	15	1	2	
		4.0	4.4	23	6.7	4	26	26	15	1	2	
		5.0	4.9	23	6.8	4	30	30	15	1	2	
		6.0	4.9	23	6.8	4	18	18	15	1	2	
Station 9	Murex 2500 m c/s Pyrrhotite R-Bank	7.0	4.9	24	6.8	2	18	18	15	1	2	
		8.0	4.9	23	6.7	2	21	21	15	1	2	
		9.0	4.9	24	6.7	2	22	22	15	1	2	
		11.0	4.9	24	6.7	2	26	26	15	1	2	
Station 10	L-Bank Isolim u/s of Murex R-Bank	0.7	17	41	6.7	11	38	33	6	4	5	
		1.3	18	41	6.8	11	40	40	15	4	5	
		2.1	18	41	6.8	11	36	36	15	4	5	
		2.9	18	41	6.8	1	36	36	15	4	5	
Station 11	Murex R-Bank	3.4	18	41	6.8	1	41	41	15	4	5	
		4.1	18	41	6.8	1	41	41	15	4	5	

RESULTS FOR MOUNT WASHINGTON SAMPLES
June 3-4, 1986

Station Number	Station Location	Lateral Distance (m)	ALK MG/L	COND μ MHO/C	PH REL.U.	SD4 MG/L	TR MG/L	FR MG/L	NFR MG/L	TIC MG/L	TDC MG/L
Station 8	500 m d/s of Murex	0.5	6.8	28	28	7.0	2	24	21	5	
		2.0	6.8	27	27	7.0	4	26	26	15	2
		3.5	6.8	27	27	6.9	4	23	23	15	
		5.0	6.8	27	27	6.9	4	30	30	15	2
		6.5	6.8	27	27	6.9	4	29	29	15	
Station 9	1100 m d/s of Murex	8.0	6.8	27	27	6.9	5	26	26	15	2
		9.5	6.3	27	27	6.9	(1)	24	24	15	
		11.0	5.9	27	27	6.9	4	25	25	15	2
		12.5	5.9	27	27	6.9	4	23	23	15	
		14.0	5.9	27	27	6.9	4	33	33	15	2
Station 10	6000 m d/s of Murex	1.0	6.8	28	28	7.0	4	25	25	15	2
		2.0	6.3	31	31	6.9	4	30	30	15	
		3.0	5.9	28	28	6.8	4	27	27	15	2
		4.0	6.8	29	29	6.8	4	26	26	15	
		5.0	6.8	29	29	6.9	4	25	25	15	2
Station 10	6000 m d/s of Murex	6.0	6.8	28	28	7.0	4	28	28	15	1
		7.0	6.8	28	28	6.8	1	27	27	15	
		8.0	6.8	28	28	6.9	(1)	20	20	6	2
		9.0	7.3	28	28	6.9	4	14	14	15	2
		10.0	6.8	29	29	6.8	4	22	22	15	
Station 10	6000 m d/s of Murex	0.4	7.8	29	29	6.7	4	29	24	15	
		1.9	7.8	29	29	6.8	4	26	26	15	2
		4.2	7.8	29	29	6.9	(1)	23	23	15	
		6.9	7.8	29	29	6.9	3	23	23	17	2
		9.4	6.8	29	29	6.8	(1)	24	24	15	
Station 10	6000 m d/s of Murex	11.9	7.8	29	29	6.9	(1)	21	21	15	3
		14.4	7.8	29	29	6.9	3	24	24	15	
		17.9	6.8	29	29	6.9	2	26	26	15	2
		19.4	7.8	30	30	7.0	1	18	18	15	
		22.0	7.8	30	30	7.0	3	20	20	15	2

FIELD TEMPERATURE AND SPECIFIC CONDUCTIVITY

Lateral			Lateral				
STATION	Distance (m)	Temperature Celsius	Conductivity umhos/cm	STATION	Distance (m)	Temperature Celsius	Conductivity umhos/cm
Station 1	0.1	14.1	42.9	Station 7	0.7	14.1	38.5
Pyrrhotite	0.5	14.2	43.1	Tsolum	1.3	14.1	38.7
w/s of	1.6	14.2	43.1	w/s of	2.1	14.2	38.8
Murex	2.6	14.2	43.1	Murex	2.9	14.2	38.9
June 4	3.6	14.2	43.1	June 4	3.4	14.2	38.9
Station 2	0.2	10.4	22.9	Station 8	0.5	15.2	22.0
McKay	0.7	10.4	22.9	Tsolum	2.0	15.2	22.0
w/s of	1.8	10.4	22.9	500 m	3.5	15.1	21.8
Pyrrhotite	2.2	10.4	22.9	d/s of	5.0	15.1	21.8
June 4	2.8	10.4	22.9	Murex	6.5	15.1	21.8
Station 3	0.5	9.4	11.0	June 3	8.0	15.1	21.8
Murex	1.0	9.4	11.0	June 3	9.5	15.1	21.8
w/s of	2.0	9.4	11.0	June 3	11.0	15.1	21.8
Pyrrhotite	3.0	9.4	11.0	June 3	12.5	15.1	21.8
June 4	4.0	9.4	11.0	June 3	14.0	15.1	21.8
Station 4	0.5	10.2	22.3	Station 9	1.0	12.0	22.9
Murex	2.5	9.9	19.9	Tsolum	2.0	11.9	23.0
100 m d/s	4.5	9.6	17.5	1100 m	3.0	11.9	23.0
Pyrrhotite	6.5	9.4	16.3	d/s of	4.0	11.9	23.0
June 4	8.5	9.4	15.7	Murex	5.0	11.9	23.0
Station 5	0.2	9.7	20.6	June 3	6.0	11.8	23.0
Murex	1	9.7	20.6	June 3	7.0	11.8	23.3
1200 m	2	9.7	20.6	June 3	8.0	11.7	23.0
d/s of	3	9.7	20.9	June 3	9.0	11.7	23.0
Pyrrhotite	4	9.7	20.9	June 3	10.0	11.7	22.8
June 4	5	9.7	20.9	Station 10	0.4	11.1	23.5
June 4	6	9.7	21.2	Tsolum	1.9	11.1	23.5
June 4	7	9.7	21.2	6600 m	4.2	11.1	23.5
June 4	8	9.7	21.2	d/s of	6.9	11.1	23.5
June 4	8.5	9.7	21.2	Murex	9.4	11.1	23.5
Station 6	1	13.5	17.5	June 3	11.9	11.1	23.5
Murex	2	13.5	17.9	June 3	14.4	11.1	23.5
2500 m	3	13.4	17.7	June 3	17.9	11.1	23.5
d/s of	4	13.4	17.5	June 3	19.4	11.1	23.7
Pyrrhotite	5	13.4	17.3	June 3	22.0	11.2	23.7
June 3	6	13.4	17.3				
June 3	7	13.4	17.5				
June 3	8	13.4	17.3				
June 3	9	13.5	17.2				
June 3	11	13.6	17.2				

FIELD TEMPERATURE AND SPECIFIC CONDUCTIVITY

STATION	Lateral			Lateral			
	Distance (m)	Temperature Celsius	Conductivity umhos/cm	Distance (m)	Temperature Celsius	Conductivity umhos/cm	
Station 6	1.5	14.2	18.5	Station 11	0.4	15.8	25.6
Murex	2.5	14.2	18.5	Tsolium	1.4	15.8	25.6
u/s	3.5	14.2	18.5	2800 m	2.4	15.8	25.6
Tsolium	4.5	14.2	18.5	d/s Murex	3.4	15.8	25.6
June 2	5.5	14.3	18.5	June 2	4.4	15.8	25.6
	6.5	14.3	18.7		5.4	15.8	25.6
	7.5	14.3	18.9		6.4	15.8	25.6
	8.5	14.3	18.9		7.4	15.8	25.6
	9.5	14.4	18.9		8.4	15.8	25.6
	10.5	14.6	18.8		9.4	15.8	25.6
Station 7	0.1	16.8	36.3		10.4	15.8	25.6
Tsolium	0.5	16.7	35.9		11.9	15.8	25.6
u/s	1.1	16.6	35.4				
Murex	1.6	16.6	35.3				
June 2	2.1	16.6	35.3				
	2.6	16.6	35.0				
	3.1	16.6	34.6				

Complexing capacity of receiving waters (Estimation)

Station	X TOC mg/l	Complexing capacity umole of Cu	umole of tot. Cu	umole of diss. Cu	umole of labile tot. Cu	umole of labile diss. Cu	Labile Tot. Cu ug/l	Labile Diss. Cu ug/l
Station 1 Pyrrhotite creek	2.6	0.60	14.6	13.89	14.00	13.29	889.56	844.40
Station 2 McKay creek	2.0	0.46	0.157	0.14	-0.30	-0.32	0.00	0.00
Station 3 Murex u/s Pyrrhotite	2.0	0.46	0.078	0.08	-0.38	-0.38	0.00	0.00
Station 4 Murex 100 m d/s Pyrrhotite	2.3	0.53	1.87	1.84	1.34	1.31	85.14	83.20
Station 5 Murex 1200 m d/s Pyrrhotite	2.0	0.46	2.45	2.12	1.99	1.66	126.44	105.50
Station 6 Murex 2500 m d/s Pyrrhotite	2.0	0.46	1.39	1.19	0.93	0.73	59.09	46.40
Station 7 Tsolum u/s Murex	5.0	1.16	0.02	0.02	-1.14	-1.14	0.00	0.00
Station 8 Tsolum 500 m d/s Murex	1.8	0.40	1.197	1.05	0.79	0.65	50.19	41.30
Station 9 Tsolum 1100 m d/s Murex	1.4	0.32	1.369	1.23	1.04	0.91	66.08	57.80
Station 10 Tsolum 6600 m d/s Murex	2.2	0.50	0.69	0.60	0.19	0.10	12.12	6.40

Note :
 - Chau and Wong (1975) determined that 7.08mg/l DOC complexed 1.64 um Cu/L
 - TOC correspond to the total humic acid content in fresh water, which is a ligand to copper
 - Estimation of the complexing capacity in the streams are based on Chau and Wong's calculations

Sediment results for Mt. Washington
June 5 1986

Station Number	Sample Number	LF.15 %	LR.15 %	TM.15 6	SEDGF A6 U6/6	SEDICP AL U6/6	SEDICP AS U6/6	SEDICP BA U6/6	SEDICP BE U6/6	SEDICP CA U6/6	SEDICP CD U6/6	SEDICP CO U6/6	SEDICP CR U6/6	SEDICP CU U6/6	SEDICP FE U6/6	SEMG HG U6/6	SEDICP HG U6/6	SEDICP MN U6/6	SEDICP MO U6/6
1	right	55.5	34.5	1.73	0.32	43000	40	39.9	1.3	19000	1.5	51.3	127	1740	60300	0.073	16100	1250	6.8
	centre	56.4	43.6	3.91	0.46	54000	102	39.7	1.7	14100	2.7	70.3	85.6	4450	61200	0.076	15000	1450	6.8
	left	62.9	37.1	2.14	0.53	52300	110	41.6	1.5	14000	2.2	62.6	106	3470	62100	0.075	15600	1210	6.8
3	right	70.4	29.6	9.25	0.60	35600	94	56.4	0.4	10300	0.3	20.8	68.5	296	51400	0.055	9290	806	6.8
	centre	79.3	20.7	2.44	0.61	32900	120	54.4	0.3	8360	0.3	29.5	85.1	355	44700	0.069	8340	657	6.8
	left	43.6	56.4	9.47	0.60	37500	87	61.4	0.4	9180	0.7	32.6	74.1	340	49600	0.061	9930	781	6.9
6	right	34.8	65.2	13.8	0.51	30900	118	54.2	0.5	10800	1.1	39.3	60.1	1190	51000	0.101	10600	838	6.8
	centre	51.7	48.3	6.76	0.50	33300	142	57	0.5	9710	0.8	36.3	86.2	1130	51000	0.066	10400	802	6.8
	left	40.6	59.4	10.7	0.52	36900	102	56.6	0.5	11100	0.4	35.9	67.6	863	52300	0.066	10100	811	6.8
7	right	9.8	90.2	29.4	0.24	33000	08	74.6	1.4	21700	0.7	24	58.9	142	52700	0.061	11800	844	6.8
	centre	20.1	79.9	12	0.28	34300	08	40.2	1.4	20200	1.1	23.1	64.4	172	50100	0.061	11800	1110	6.8
	left	12.2	87.8	16.6	0.19	32500	08	32.9	1.4	21400	1.1	20.2	71.4	152	51200	0.056	11300	740	6.8
9	right	20.5	79.5	22.8	0.37	36100	82	60.8	0.9	14900	0.3	25.2	71.2	568	56700	0.056	10700	1110	6.8
	centre	19.4	80.6	17.7	0.43	32900	96	80.6	0.6	13300	0.3	25.8	66	667	51000	0.078	10100	843	6.8
	left	32.5	67.5	18.5	0.35	30200	70	125	0.8	14400	0.3	25.6	60.4	377	50000	0.068	9590	751	6.8

