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DEPARTMENT OF ENVIRONMENT
ENVIRONMENTAL PROTECTION SERVICE
PACIFIC AND YUKON REGION

A DATA REPORT ON WATER QUALITY OF THE RECEIVING WATERS OF THE AREA AROUND THE PROPOSED QUINSAM COAL DEVELOPMENT

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES (Continued)

1. INTRODUCTION

In 1983, Quinsam Coal Ltd. (Brinco Mining Ltd. and Weldwood of Canada Ltd.) has been conducting baseline environmental monitoring to provide information in addition to that presented in the Stage II Assessment Report of June, 1981. In order to have comparison data, EPS in June, 1983 conducted a physical, chemical and biological survey of the lakes and streams in the proposed development area. Abnormally high mercury levels were found in the lake sediments therefore additional sediment sampling was carried out in August and September. The results from these surveys are included in the Addendum to this report. The following is a data report of the physical and chemical results. The biological results will be made available when all analyses have been completed.

2. STUDY AREA

A description of the sample sites is contained in Table 1 and shown on the map in Figure 1.

TABLE 1 LIST OF EPS SAMPLE SITES AT THE QUINSAM COAL DEVELOPMENT SITE

STATION #	LAKE
A	Middle Quinsam Lake
B	Long Lake
C	Noname Lake
D	Gooseneck Lake

STATION #	CREEKS AND RIVERS
1	Quinsam River upstream of Argonaut Road Bridge
2	Flume (Culvert) Creek at Argonaut Road crossing
3	Noname Lake outlet
4	Long Lake outlet
5	Middle Quinsam Lake outlet
6	Iron River just upstream of Quinsam River
7	Quinsam River upstream of Highway 28 bridge
8	Campbell River upstream Quinsam River at Elk Falls Park
9	Argonaut Mine Pit Water

Gooseneck Lake serves as the control lake while Station 1 on the Quinsam River serves as the river control site.

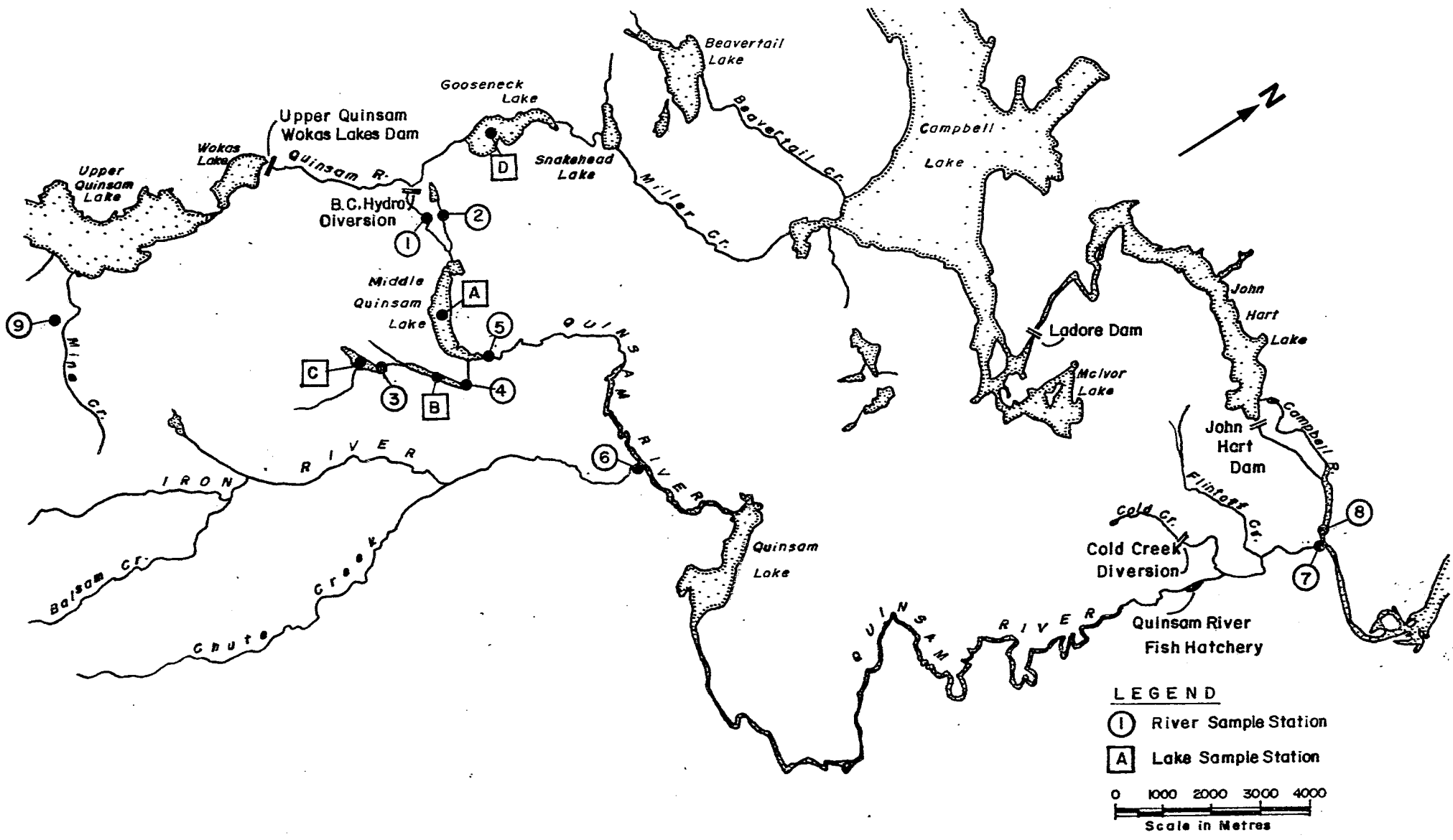

FIGURE 1 QUINSAM DRAINAGE BASIN SHOWING SAMPLE SITE LOCATIONS

3. METHODS AND MATERIALS

3.1 Water Chemistry

Triplicate grab samples were collected at all creek and river stations (1-8). Two grab samples were collected from the surface of the Argonaut Mine pit water.

For the lake sampling, station locations were used using geographic markers and a model FM-21 Furuno Echo Sounder. Water samples were collected at four depths within the water column with the aid of six liter Van-Dorn water bottles. Table 2 gives the details of the parameters, the field methods, sample preparation and analysis. All water samples were kept cool on wet ice until delivered to the respective laboratories.

3.2 Sediment Sampling

Sediment samples were only collected at 2 sites in the Quinsam River, upstream and downstream of Middle Quinsam Lake (Stations 1 and 5). Six replicates of the fine sediments were collected at each site with a large syringe. The details of this method are in Appendix 1.

Triplicate lake sediments were taken with a Phlager corer with a 3.8 cm diameter plastic insert. The top 8-10 cm of cores were extruded into paper bags and then placed in whirlpac bags and frozen on dry ice.

TABLE 2 SUMMARY OF PARAMETERS SAMPLED AND LABORATORY USED

PARAMETER	FIELD PREPARATION AND LABORATORY
Total Phosphorus	EPS/DOE Lab
Total Dissolved P.	Filtered through .45 micron sartorius filter in field and sent to EPS/DOE Lab
Nitrate	EPS/DOE Lab and IWD Lab
Nitrite	EPS/DOE Lab and IWD Lab
Nitrate-Nitrite	IWD Lab
Ammonia	IWD Lab and EPS/DOE Lab
Total Diss. Nitrogen	IWD Lab
Particulate Nitrogen	Filtered through roasted GF-F
Particulate Carbon	Whatman glass fibre filter and sent to IWD Lab
pH	Measured in field using a Brinkman Model E 288 pH meter
Turbidity	EPS/DOE Lab
Temperature	Measured in field (Hydrolab 4000)
Alkalinity	EPS/DOE Lab
Conductivity	Measured in field (Hydrolab 4000)
Dissolved Oxygen	In field added manganous sulphate solution and alkaline-iodide azide solution and Winkler titration method within 24 hours
Residues	EPS/DOE Lab
Phenol	EPS/DOE Lab
Total Sulphate	EPS/DOE Lab
Oil/Grease	EPS/DOE Lab
Heavy Metals in Water	Total preserved with nitric acid dissolved field filtered through 0.045 micron cellulose nitrate filter in a Satorious filter holder and preserved with nitric acid - EPS/DOE Lab
Heavy Metals in Sediment	Frozen on dry ice and sent to EPS/DOE Lab
Mercury in water	Total preserved with potassium dichromate-nitric acid
Chlorophyll a and Phaeopigments	Filtered thorugh a Whatman GFC glass-fibre filter and shipped frozen to laboratory

EPS/DOE - Environmental Protection Service/Fisheries and Oceans Lab in West Vancouver (See Lab Manual, 1976 for method of determination).

IWD - Inland Waters Directorate in North Vancouver (See Inland Waters Directorate, 1974, for methods of determination).

4.1 Creek and River Physical and Chemical Results

Table 3.1 - Station 1
Table 3.2 - Station 2
Table 3.3 - Station 3
Table 3.4 - Station 4
Table 3.5 - Station 5
Table 3.6 - Station 6
Table 3.7 - Station 7
Table 3.8 - Station 8

TABLE 3.1 QUINSAM COAL SURVEY - WATER QUALITY
STATION 1, QUINSAM RIVER AT ARGONAUT ROAD BRIDGE (June 23, 1983)

PARAMETER	SAMPLE #1	SAMPLE #2	SAMPLE #3
Temperature (°C)	15.8	15.8	15.8
Conductivity (uS/cm)	31	31	31
pH	7.90	7.85	7.90
Dissolved Oxygen (mg/l)	8.85	9.05	8.95
Hardness - total (mg/l)	19.1	19.0	19.7
Turbidity (FTU)	0.1	0.1	0.1
Solids (mg/l) - dissolved	36	39	27
- suspended	< 5	< 5	< 5
- total	36	39	27
Phenol (mg/l)	< 0.02	< 0.02	< 0.02
Oil/Grease (mg/l)	3	2	2
Sulphate (mg/l)	2.9	3.3	3.3
Phosphorous - total (mg/l)	0.010	0.010	0.011
- total dissolved	0.007	0.007	0.007
Nitrite (mg/l)	< 0.005	< 0.005	< 0.005
Nitrate (mg/l)	0.02	0.02	0.02
Ammonia (mg/l)	< 0.005	0.008	0.008
Nitrate/Nitrite (mg/l)*	0.034	0.032	0.036
Ammonia (mg/l)*	0.021	0.020	0.010
Total Dissolved Nitrogen (mg/l)*	0.085	0.090	0.069
Particulate Nitrogen (mg/l)*	< 0.010	0.006	< 0.010
Particulate Carbon (mg/l)*	0.143	0.164	0.193

*Analyzed by Inland Waters Directorate Laboratory

TABLE 3.2 QUINSAM COAL SURVEY - WATER QUALITY
STATION 2, FLUME (CULVERT) CREEK (June 23, 1983)

PARAMETER	SAMPLE #1	SAMPLE #2	SAMPLE #3
Temperature (°C)	16.4	16.4	16.4
Conductivity (uS/cm)	38	38	38
pH	7.60	7.60	7.60
Dissolved Oxygen (mg/l)	7.55	7.10	7.90
Hardness - total (mg/l)	21.9	21.9	21.5
Turbidity (FTU)	0.2	0.1	0.1
Solids (mg/l) - dissolved	29	30	32
- suspended	10	< 5	< 5
- total	39	30	32
Phenol (mg/l)	< 0.02	< 0.02	< 0.02
Oil/Grease (mg/l)	2	2	2
Sulphate (mg/l)	2.6	3.3	2.7
Phosphorous - total (mg/l)	0.012	0.012	0.013
- total dissolved	0.049**	0.008	0.008
Nitrite (mg/l)	< 0.005	< 0.005	< 0.005
Nitrate (mg/l)	0.02	0.02	0.02
Ammonia (mg/l)	0.005	< 0.005	< 0.005
Nitrate/Nitrite (mg/l)*	0.032	0.018	0.020
Ammonia (mg/l)*	0.020	0.007	0.014
Total Dissolved Nitrogen (mg/l)*	0.080	0.078	0.087
Particulate Nitrogen (mg/l)*	< 0.010	< 0.010	0.008
Particulate Carbon (mg/l)*	0.101	0.277	0.188

*Analyzed by Inland Waters Directorate Laboratory
**possible contamination of sample

TABLE 3.3 QUINSAM COAL SURVEY - WATER QUALITY
STATION 3, NONAME LAKE OUTLET (June 22, 1983)

PARAMETER	SAMPLE #1	SAMPLE #2	SAMPLE #3
Temperature (°C)	18.8	18.7	18.7
Conductivity (uS/cm)	24	22	22
pH	7.75	7.70	7.75
Dissolved Oxygen (mg/l)	8.90	8.95	9.10
Hardness - total (mg/l)	11.9	12.0	11.8
Turbidity (FTU)	0.2	0.2	0.1
Solids (mg/l) - dissolved	12	18	26
- suspended	7	6	< 5
- total	19	24	26
Phenol (mg/l)	< 0.02	< 0.02	< 0.02
Oil/Grease (mg/l)	2	2	< 2
Sulphate (mg/l)	2.3	2.2	2.1
Phosphorous - total (mg/l)	0.012	0.013	0.012
- total dissolved	0.018**	0.007	0.007
Nitrite (mg/l)	< 0.005	< 0.005	< 0.005
Nitrate (mg/l)	0.01	0.01	0.01
Ammonia (mg/l)	0.005	< 0.005	< 0.005
Nitrate/Nitrite (mg/l)*	0.013	0.025	0.026
Ammonia (mg/l)*	0.014	0.042	0.016
Total Dissolved Nitrogen (mg/l)*	0.101	0.115	0.112
Particulate Nitrogen (mg/l)*	0.018	0.019	0.017
Particulate Carbon (mg/l)*	0.307	0.469	0.345

*Analyzed by Inland Waters Directorate Laboratory
**possible contamination of sample

TABLE 3.4 QUINSAM COAL SURVEY - WATER QUALITY
STATION 4, LONG LAKE OUTLET (June 23, 1983)

PARAMETER	SAMPLE #1	SAMPLE #2	SAMPLE #3
Temperature (°C)	16	16	16
Conductivity (uS/cm)	18	18	18
pH	7.85	7.82	7.95
Dissolved Oxygen (mg/l)	8.20	8.20	8.10
Hardness - total (mg/l)	12.4	12.3	11.9
Turbidity (FTU)	0.1	0.1	0.1
Solids (mg/l) - dissolved	34	38	34
- suspended	< 5	< 5	< 5
- total	34	38	34
Phenol (mg/l)	< 0.02	< 0.02	< 0.02
Oil/Grease (mg/l)	3	2	2
Sulphate (mg/l)	2.1	3.9	2.9
Phosphorous - total (mg/l)	0.013	0.014	0.011
- total dissolved	0.009	0.008	0.007
Nitrite (mg/l)	< 0.005	< 0.005	< 0.005
Nitrate (mg/l)	0.02	0.02	0.02
Ammonia (mg/l)	0.008	0.008	0.008
Nitrate/Nitrite (mg/l)*	0.024	0.023	0.028
Ammonia (mg/l)*	0.021	0.053	0.021
Total Dissolved Nitrogen (mg/l)*	0.098	0.105	0.110
Particulate Nitrogen (mg/l)*	0.013	0.017	0.016
Particulate Carbon (mg/l)*	0.255	0.343	0.287

*Analyzed by Inland Waters Directorate Laboratory

TABLE 3.5 QUINSAM COAL SURVEY - WATER QUALITY
STATION 5, MIDDLE QUINSAM LAKE OUTLET (June 22, 1983)

PARAMETER	SAMPLE #1	SAMPLE #2	SAMPLE #3
Temperature (°C)	18.5	18.5	18.5
Conductivity (uS/cm)	36	36	36
pH	7.88	7.85	7.80
Dissolved Oxygen (mg/l)	8.95	9.00	8.85
Hardness - total (mg/l)	19.9	19.8	19.9
Turbidity (FTU)	0.1	0.1	0.1
Solids (mg/l) - dissolved	29	32	29
- suspended	< 5	< 5	< 5
- total	29	32	29
Phenol (mg/l)	< 0.02	< 0.02	< 0.02
Oil/Grease (mg/l)	2	< 2	2
Sulphate (mg/l)	2.1	2.9	2.5
Phosphorous - total (mg/l)	0.011	0.011	0.012
- total dissolved	0.008	0.007	0.006
Nitrite (mg/l)	< 0.005	< 0.005	< 0.005
Nitrate (mg/l)	0.01	0.01	0.01
Ammonia (mg/l)	0.006	0.005	0.006
Nitrate/Nitrite (mg/l)*	0.021	0.016	0.018
Ammonia (mg/l)*	0.018	0.011	0.016
Total Dissolved Nitrogen (mg/l)*	0.085	0.078	0.084
Particulate Nitrogen (mg/l)*	0.011	0.008	< 0.010
Particulate Carbon (mg/l)*	0.283	0.229	0.273

*Analyzed by Inland Waters Directorate Laboratory

TABLE 3.6 QUINSAM COAL SURVEY - WATER QUALITY
STATION 6, IRON RIVER - Upstream of Quinsam River (June 21, 1983)

PARAMETER	SAMPLE #1	SAMPLE #2	SAMPLE #3
Temperature (°C)	-	-	-
Conductivity (uS/cm)	-	-	-
pH	-	-	-
Dissolved Oxygen (mg/l)	-	-	-
Hardness - total (mg/l)	30.3	30.2	30.1
Turbidity (FTU)	0.1	0.1	0.1
Solids (mg/l) - dissolved	48	53	42
- suspended	< 5	< 5	< 5
- total	48	53	42
Phenol (mg/l)	-	-	-
Oil/Grease (mg/l)	-	-	-
Sulphate (mg/l)	3.5	3.7	3.4
Phosphorous - total (mg/l)	-	-	-
- total dissolved	-	-	-
Nitrite (mg/l)	< 0.005	< 0.005	< 0.005
Nitrate (mg/l)	0.02	0.02	0.02
Ammonia (mg/l)	< 0.005	< 0.005	< 0.005
Nitrate/Nitrite (mg/l)*	-	-	-
Ammonia (mg/l)*	-	-	-
Total Dissolved Nitrogen (mg/l)*	-	-	-
Particulate Nitrogen (mg/l)*	-	-	-
Particulate Carbon (mg/l)*	-	-	-

*Analyzed by Inland Waters Directorate Laboratory

TABLE 3.7 QUINSAM COAL SURVEY - WATER QUALITY
STATION 7, QUINSAM RIVER U/S HWY 28 (June 24, 1983)

PARAMETER	SAMPLE #1	SAMPLE #2	SAMPLE #3
Temperature (°C)	13.6	13.6	13.6
Conductivity (uS/cm)	104	104	103
pH	7.40	7.65	7.70
Dissolved Oxygen (mg/l)	10.35	10.40	9.90
Hardness - total (mg/l)	35.6	34.6	35.4
Turbidity (FTU)	0.2	0.2	0.2
Solids (mg/l) - dissolved	49	57	55
- suspended	6	< 5	5
- total	57	57	60
Phenol (mg/l)	< 0.02	< 0.02	< 0.02
Oil/Grease (mg/l)	2	2	2
Sulphate (mg/l)	3.5	3.4	3.6
Phosphorous - total (mg/l)	0.023	0.023	0.022
- total dissolved	0.019	0.020	0.017
Nitrite (mg/l)	< 0.005	< 0.005	< 0.005
Nitrate (mg/l)	0.03	0.03	0.03
Ammonia (mg/l)	0.014	0.014	0.014
Nitrate/Nitrite (mg/l)*	0.055	0.063	0.043
Ammonia (mg/l)*	0.011	0.340**	0.016
Total Dissolved Nitrogen (mg/l)*	0.101	0.327**	0.105
Particulate Nitrogen (mg/l)*	0.014	< 0.010	< 0.010
Particulate Carbon (mg/l)*	0.330	0.262	0.225

*Analyzed by Inland Waters Directorate Laboratory
**possible contamination of sample

TABLE 3.8 QUINSAM COAL SURVEY - WATER QUALITY
STATION 8, CAMPBELL RIVER U/S QUINSAM RIVER (June 24, 1983)

PARAMETER	SAMPLE #1	SAMPLE #2	SAMPLE #3
Temperature (°C)	13.8	13.8	13.8
Conductivity (uS/cm)	39	39	39
pH	7.45	7.25	7.30
Dissolved Oxygen (mg/l)	-	-	-
Hardness - total (mg/l)	20.2	20.3	20.0
Turbidity (FTU)	0.1	0.1	0.1
Solids (mg/l) - dissolved	34	31	31
- suspended	< 5	< 5	< 5
- total	34	31	31
Phenol (mg/l)	-	-	-
Oil/Grease (mg/l)	-	-	-
Sulphate (mg/l)	4.3	4.1	4.2
Phosphorous - total (mg/l)	-	-	-
- total dissolved	-	-	-
Nitrite (mg/l)	< 0.005	< 0.005	< 0.005
Nitrate (mg/l)	0.02	0.02	0.02
Ammonia (mg/l)	0.006	0.006	0.006
Nitrate/Nitrite (mg/l)*	-	-	-
Ammonia (mg/l)*	-	-	-
Total Dissolved Nitrogen (mg/l)*	-	-	-
Particulate Nitrogen (mg/l)*	-	-	-
Particulate Carbon (mg/l)*	-	-	-

*Analyzed by Inland Waters Directorate Laboratory

4.2 Creek and River Heavy Metals in Water

TABLE 4.1 QUINSAM COAL SURVEY - WATER QUALITY
STATION 1, QUINSAM RIVER AT ARGONAUT RD. BRIDGE
Total and Dissolved Metals (mg/l)
(June 23, 1983)

	Sample 1		Sample 2		Sample 3	
	Total	Dissolved	Total	Dissolved	Total	Dissolved
As	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
B	< 0.001	0.024	< 0.001	0.024	< 0.001	0.012
Ba	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Be	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Cd	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Co	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cr	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cu	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Hg	< 0.0001	-	< 0.0001	-	< 0.0001	-
Mn	0.001	< 0.001	0.001	< 0.001	0.001	< 0.001
Mo	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Ni	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
P	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pb	0.017	< 0.001	0.001	< 0.001	0.001	< 0.001
Sb	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Se	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Sn	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Sr	0.01	0.01	0.01	0.01	0.01	0.011
Ti	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
V	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Zn	0.006	0.009	0.003	0.006	< 0.002	0.005
Al	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fe	0.021	0.008	0.025	0.006	0.023	0.008
Si	1.50	1.60	1.50	1.60	1.50	1.60
Ca	6.60	6.50	6.60	6.50	6.60	6.70
Mg	0.70	0.70	0.70	0.70	0.70	0.70
Na	0.60	0.60	0.60	0.60	0.60	0.60

TABLE 4.2 QUINSAM COAL SURVEY - WATER QUALITY
STATION 2, FLUME (CULVERT) CREEK
Total and Dissolved Metals (mg/l)
(June 23, 1983)

	Sample 1		Sample 2		Sample 3	
	Total	Dissolved	Total	Dissolved	Total	Dissolved
As	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
B	< 0.001	0.012	< 0.001	0.012	< 0.001	0.024
Ba	0.005	0.005	0.005	0.005	0.005	0.005
Be	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Cd	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Co	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cr	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cu	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Hg	< 0.0001	-	< 0.0001	-	< 0.0001	-
Mn	0.006	0.005	0.006	0.005	0.006	0.005
Mo	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Ni	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
P	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pb	< 0.001	< 0.001	0.001	< 0.001	0.002	< 0.001
Sb	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Se	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Sn	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Sr	0.017	0.018	0.018	0.018	0.017	0.018
Ti	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
V	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Zn	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Al	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fe	0.101	0.057	0.111	0.057	0.118	0.055
Si	1.70	1.80	1.70	1.80	1.70	1.80
Ca	7.00	7.20	7.10	7.20	7.10	7.10
Mg	0.90	0.90	0.90	0.90	0.90	0.90
Na	1.00	1.00	0.90	1.10	0.90	1.00

TABLE 4.3 QUINSAM COAL SURVEY - WATER QUALITY
STATION 3, NONAME LAKE OUTLET
Total and Dissolved Metals (mg/l)
(June 22, 1983)

	Sample 1		Sample 2		Sample 3	
	Total	Dissolved	Total	Dissolved	Total	Dissolved
As	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
B	< 0.001	0.012	< 0.001	0.012	< 0.001	0.012
Ba	0.001	0.001	0.001	< 0.001	0.001	< 0.001
Be	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Cd	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Co	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cr	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cu	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Hg	< 0.0001	-	< 0.0001	-	< 0.0001	-
Mn	0.018	0.003	0.008	0.003	0.008	0.003
Mo	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Ni	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
P	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pb	< 0.001	< 0.001	0.002	< 0.001	< 0.001	< 0.001
Sb	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Se	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Sn	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Sr	0.01	0.01	0.011	0.01	0.01	0.01
Ti	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
V	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Zn	< 0.002	0.003	< 0.002	< 0.002	< 0.002	0.005
Al	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fe	0.135	0.037	0.082	0.037	0.224	0.038
Si	2.30	2.30	2.20	2.30	2.20	2.30
Ca	3.40	3.50	3.40	3.50	3.30	3.50
Mg	0.80	0.80	0.80	0.80	0.80	0.70
Na	1.00	1.00	1.00	1.00	1.00	1.00

TABLE 4.4 QUINSAM COAL SURVEY - WATER QUALITY
STATION 4, LONG LAKE OUTLET
Total and Dissolved Metals (mg/l)
(June 23, 1983)

	Sample 1		Sample 2		Sample 3	
	Total	Dissolved	Total	Dissolved	Total	Dissolved
As	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
B	< 0.001	0.03	< 0.001	0.03	< 0.001	0.03
Ba	0.002	0.002	0.002	0.002	0.002	0.002
Be	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Cd	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Co	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cr	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cu	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Hg	< 0.0001	-	< 0.0001	-	< 0.0001	-
Mn	0.011	0.004	0.01	0.004	0.011	0.004
Mo	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Ni	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
P	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pb	0.002	< 0.001	0.001	< 0.001	0.001	< 0.001
Sb	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Se	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Sn	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Sr	0.012	0.013	0.012	0.013	0.012	0.012
Ti	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
V	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Zn	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Al	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fe	0.071	0.029	0.057	0.03	0.063	0.03
Si	2.10	2.30	2.10	2.30	2.20	2.30
Ca	3.50	3.70	3.50	3.70	3.70	3.60
Mg	0.70	0.70	0.70	0.70	0.70	0.70
Na	1.20	1.20	1.20	1.20	1.30	1.20

TABLE 4.5 QUINSAM COAL SURVEY - WATER QUALITY
STATION 5, MIDDLE QUINSAM LAKE OUTLET
Total and Dissolved Metals (mg/l)
(June 22, 1983)

	Sample 1		Sample 2		Sample 3	
	Total	Dissolved	Total	Dissolved	Total	Dissolved
As	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
B	< 0.001	0.012	< 0.001	0.012	< 0.001	0.012
Ba	0.001	< 0.001	0.001	0.001	0.001	0.001
Be	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Cd	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Co	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cr	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cu	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Hg	< 0.0001	-	< 0.0001	-	< 0.0001	-
Mn	0.008	0.005	0.007	0.005	0.008	0.004
Mo	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Ni	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
P	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pb	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Sb	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Se	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Sn	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Sr	0.012	0.013	0.012	0.013	0.012	0.013
Ti	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
V	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Zn	< 0.002	0.003	< 0.002	0.002	< 0.002	< 0.002
Al	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fe	0.049	0.021	0.047	0.02	0.05	0.021
Si	1.30	1.40	1.30	1.40	1.30	1.40
Ca	6.40	6.70	6.40	6.60	6.40	6.70
Mg	0.80	0.70	0.80	0.70	0.80	0.70
Na	0.90	0.90	0.90	0.90	0.90	0.90

TABLE 4.6 QUINSAM COAL SURVEY - WATER QUALITY
STATION 6, IRON RIVER*
Total and Dissolved Metals (mg/l)
(June 22, 1983)

	Sample 1		Sample 2		Sample 3	
	Total	Dissolved	Total	Dissolved	Total	Dissolved
As	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
B	< 0.001	0.03	< 0.001	0.03	< 0.001	0.012
Ba	0.005	0.005	0.004	0.005	0.005	0.005
Be	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Cd	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Co	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cr	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cu	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Hg	< 0.0001	-	< 0.0001	-	< 0.0001	-
Mn	0.005	0.005	0.006	0.005	0.006	0.005
Mo	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Ni	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
P	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pb	< 0.001	< 0.001	0.001	< 0.001	0.002	< 0.001
Sb	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Se	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Sn	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Sr	0.03	0.033	0.03	0.033	0.03	0.032
Ti	< 0.002	< 0.002	< 0.002	0.002	0.002	< 0.002
V	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Zn	< 0.002	0.002	< 0.002	< 0.002	< 0.002	0.004
Al	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fe	0.046	0.03	0.044	0.029	0.059	0.029
Si	2.10	2.30	2.10	2.30	2.10	2.30
Ca	10.30	10.80	10.40	10.70	10.40	10.70
Mg	0.80	0.80	0.80	0.80	0.80	0.80
Na	1.10	1.10	1.10	1.10	1.10	1.20

*Samples collected by Brian Lukyn, Quinsam Hatchery

TABLE 4.7 QUINSAM COAL SURVEY - WATER QUALITY
STATION 7, QUINSAM RIVER AT HIGHWAY 28
Total and Dissolved Metals (mg/l)
(June 24, 1983)

	Sample 1		Sample 2		Sample 3	
	Total	Dissolved	Total	Dissolved	Total	Dissolved
As	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
B	< 0.001	0.036	< 0.001	0.036	< 0.001	0.018
Ba	0.002	0.002	0.002	0.001	0.002	0.002
Be	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Cd	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Co	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cr	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cu	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Hg	< 0.0001	-	< 0.0001	-	< 0.0001	-
Mn	0.007	0.005	0.008	0.004	0.007	0.005
Mo	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Ni	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
P	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pb	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Sb	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Se	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Sn	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Sr	0.022	0.023	0.022	0.023	0.022	0.023
Ti	0.005	< 0.002	0.005	< 0.002	0.005	0.002
V	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Zn	< 0.002	< 0.002	< 0.002	< 0.002	0.002	0.003
Al	0.07	< 0.05	0.06	< 0.05	0.06	< 0.05
Fe	0.159	0.065	0.201	0.064	0.155	0.063
Si	3.6	3.7	3.6	3.8	3.6	3.8
Ca	10.90	10.80	10.90	10.50	11.00	10.70
Mg	2.20	2.10	2.20	2.00	2.20	2.10
Na	2.20	2.30	2.20	2.20	2.30	2.20

TABLE 4.8 QUINSAM COAL SURVEY - WATER QUALITY
STATION 8, CAMPBELL RIVER AT CAMPBELL RIVER UPSTREAM OF QUINSAM RIVER
Total and Dissolved Metals (mg/l)
(June 24, 1983)

	Sample 1		Sample 2		Sample 3	
	Total	Dissolved	Total	Dissolved	Total	Dissolved
As	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
B	< 0.001	0.036	< 0.001	0.036	< 0.001	< 0.001
Ba	0.016	0.017	0.017	0.016	0.017	0.016
Be	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Cd	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Co	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cr	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cu	0.001	< 0.001	0.001	0.001	0.002	0.001
Hg	< 0.0001	-	< 0.0001	-	< 0.0001	-
Mn	0.005	0.004	0.005	0.003	0.006	0.003
Mo	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Ni	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
P	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pb	0.001	< 0.001	0.001	< 0.001	< 0.001	< 0.001
Sb	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Se	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Sn	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Sr	0.01	0.01	0.01	0.01	0.01	0.01
Ti	< 0.002	0.004	0.002	< 0.002	0.002	< 0.002
V	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Zn	0.032	0.032	0.031	0.03	0.032	0.031
Al	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fe	0.035	0.022	0.056	0.019	0.057	0.019
Si	1.60	1.70	1.60	1.70	1.60	1.70
Ca	7.10	6.80	7.10	6.80	7.10	6.70
Mg	0.80	0.80	0.80	0.80	0.80	0.80
Na	0.70	0.80	0.80	0.80	0.80	0.80

4.3 Heavy Metals in the Fine Sediments of Quinsam River above and below Middle Quinsam Lake

Table 5.1 - Station 1

Table 5.2 - Station 5

TABLE 5.1 HEAVY METAL CONCENTRATION, PARTICLE SIZE DISTRIBUTION AND VOLUME OF INTERGRAVEL FINE SEDIMENTS FOR QUINSAM RIVER UPSTREAM OF MIDDLE QUINSAM LAKE (STATION 1) June, 1983

METAL*	REPLICA 1	2	3	4
Hg**	0.13	0.11	0.15	0.09
As	< 8.0	< 8.0	< 8.0	< 8.0
Ba	75.3	68.9	69.3	85.1
Be	0.3	0.3	0.4	< 0.2
Cd	0.5	0.7	0.5	0.7
Co	13.1	15.3	13.0	14.4
Cr	65.2	46.1	65.8	87.1
Cu	83.0	84.2	84.7	93.1
Mn	1210	944	1360	894
Mo	< 0.8	< 0.8	< 0.8	1.6
Ni	32.0	23.0	32.0	47.0
P	639	572	662	647
Pb	5.0	4.0	7.0	< 3.0
Sn	6.0	10.0	8.0	7.0
Sr	66.8	66.0	61.2	77.7
Ti	3490	3590	3220	3600
V	134.0	131.0	122.0	132.0
Zn	62.5	57.3	66.6	63.4
Al	29400	28800	28800	34300
Fe	47000	41800	50400	36200
Si	4110	4360	3930	4390
Ca	26000	23700	30200	19000
Mg	6600	6890	6540	8240
Na	730	790	700	930

*ICAP, < 0.15 mm fraction, as ug/g (ppm)
**Hg (flameless atomic absorption)

Portion of total Sample (%)				
< .15 mm	76.6	82.5	74.1	71.4
> .15 mm	23.4	17.5	25.9	28.6
Portion of total Sample (weight:g)				
< .15 mm	12.7	12.4	12.4	13.3
> .15 mm	3.9	2.6	4.3	5.4
Sample Volume: ml				
total liq. & settleable	850	1230	1210	1190
total settleable	100	53	125	160

TABLE 5.2 HEAVY METAL CONCENTRATION, PARTICLE SIZE DISTRIBUTION AND VOLUME OF INTERGRAVEL FINE SEDIMENTS FOR QUINSAM RIVER DOWNSTREAM OF MIDDLE QUINSAM LAKE (STATION 5) June, 1983

METAL*	REPLICA 1	2	3	4
Hg**	0.28	0.24	0.16	0.15
As	9.0	< 8.0	< 8.0	11.0
Ba	122.0	121.0	83.1	89.5
Be	0.2	0.3	0.4	0.3
Cd	0.7	0.6	0.6	0.5
Co	13.5	13.7	12.5	10.4
Cr	52.1	66.7	46.5	54.8
Cu	67.2	64.0	81.2	79.5
Mn	1970	1870	1070	2150
Mo	< 0.8	< 0.8	< 0.8	< 0.8
Ni	24.0	28.0	19.0	21.0
P	763	712	881	896
Pb	17.0	15.0	8.0	5.0
Sn	5.0	3.0	7.0	7.0
Sr	112.0	117.0	70.1	67.7
Ti	2370	2550	3000	2810
V	114.0	130.0	127.0	134.0
Zn	97.5	103.0	73.6	71.5
Al	37600	36000	36600	34500
Fe	35300	38400	35000	37700
Si	7950	7240	4760	5380
Ca	17100	17300	13200	13000
Mg	8730	9000	7190	7010
Na	500	460	480	510
Portion of total Sample (%)				
< .15 mm	63.5	63.0	47.3	26.1
> .15 mm	36.5	37.0	52.7	73.9
Portion of total Sample (weight:g)				
< .15 mm	11.0	10.8	13.1	0.7
> .15 mm	6.3	6.3	14.6	1.9
Sample Volume: ml				
total liq. & settleable	800	1275	1220	1235
total settleable	55	24	88	45

*ICAP, < 0.15 mm fraction, as ug/g (ppm)
**Hg (flameless atomic absorption)

4.4 Lake Physical and Chemical Results

Table 6.1 - Temperature and Conductivity Profiles
Table 6.2 - Station A
Table 6.3 - Station B
Table 6.4 - Station C
Table 6.5 - Station D

TABLE 6.1 TEMPERATURE AND CONDUCTIVITY PROFILES - QUINSAM COAL SURVEY - June, 1983

A. MIDDLE QUINSAM LAKE			B. LONG LAKE			C. NONAME LAKE			A. GOOSENECK LAKE		
Depth (m)	T° (C°)	Conductivity (uS/cm)	Depth (m)	T° (C°)	Conductivity (uS/cm)	Depth (m)	T° (C°)	Conductivity (uS/cm)	Depth (m)	T° (C°)	Conductivity (uS/cm)
Surface	17.3	55	Surface	17.8	34	Surface	17.3	18	Surface	16.2	54
1	17.3	55	1	17.6	34	1	17.3	18	1	16.2	54
2	17.3	55	2	17.3	33	2	17.2	18	2	16.2	54
3	17.3	55	3	17.3	24	3	17.1	17	3	16.1	54
4	17.3	55	4	17.2	25	4	16.7	17	4	16.1	53
5	17.3	55	5	11.8	18	5	13.0	11	5	16.1	53
6	16.7	55	6	8.8	18	6	9.7	9	6	14.6	51
7	12.8	49	7	7.3	16	7	8.0	8	7	11.5	47
8	10.4	48	8	6.8	14	8	7.0	7	8	8.8	46
9	9.5	48	9	6.6	14	9	6.8	7	9	7.5	46
10	8.9	49	10	6.4	12	10	6.7	6	10	6.8	46
11	8.2	51	11	6.3	11	11	6.6	6	11	6.3	46
12	8.0	52	12	6.2	9	12	6.5	5	12	6.1	45
13	8.0	52	13	6.1	9	13	6.4	5	13	5.9	45
			14	6.0	10	14	6.2	5	14	5.8	45
			15	5.9	10	15	6.2	5	15	5.8	45
			16	5.9	9				16	5.7	45
			17	5.8	9				17	5.6	44
			18	5.7	9						

TABLE 6.2 QUINSAM COAL SURVEY - WATER QUALITY
STATION A, MIDDLE QUINSAM LAKE (June 24, 1983)

PARAMETER	1 meter	5 meters	9 meters	10 meters
pH	7.80	7.95	7.28	7.05
Dissolved Oxygen (mg/l)	9.00	8.90	9.55	8.75
Hardness - total (mg/l)	20.4	20.3	17.5	17.5
Turbidity (FTU)	0.2	0.2	0.2	0.2
Solids (mg/l) - dissolved	32	52	25	36
- suspended	< 5.0	< 5.0	< 5.0	< 5.0
- total	32	52	25	36
Phenol (mg/l)	< 0.02	< 0.02	< 0.02	< 0.02
Oil/Grease (mg/l)	3	< 2	< 2	< 2
Sulphate (mg/l)	3.1	3.1	3.3	3.2
Phosphorous - total (mg/l)	0.016	0.013	0.015	0.014
- total dissolved	0.009	0.009	0.009	0.009
Nitrite (mg/l)	< 0.005	< 0.005	< 0.005	< 0.005
Nitrate (mg/l)	0.02	0.02	0.02	0.02
Ammonia (mg/l)	0.007	0.008	0.010	0.013
Nitrate/Nitrite (mg/l)*	0.017	0.014	0.010	0.020
Ammonia (mg/l)*	0.012	0.012	0.004	0.015
Total Dissolved Nitrogen (mg/l)*	0.098	0.075	0.077	0.080
Particulate Nitrogen (mg/l)*	0.011	0.013	< 0.010	< 0.010
Particulate Carbon (mg/l)*	0.266	0.238	0.188	0.165
Secchi Disk reading - 9.5 meters				

*Analyzed by Inland Waters Directorate Laboratory

TABLE 6.3 QUINSAM COAL SURVEY - WATER QUALITY
STATION B, LONG LAKE (June 22, 1983)

PARAMETER	1 meter	4 meters	8 meters	15 meters
pH	7.85	7.80	7.50	7.20
Dissolved Oxygen (mg/l)	8.10	8.55	9.20	8.30
Hardness - total (mg/l)	11.40	11.60	9.71	9.71
Turbidity (FTU)	0.10	0.10	0.10	0.10
Solids (mg/l) - dissolved	30	33	31	29
- suspended	< 5.0	< 5.0	< 5.0	< 5.0
- total	30	33	31	29
Phenol (mg/l)	< 0.02	< 0.02	< 0.02	< 0.02
Oil/Grease (mg/l)	< 2	2	2	2
Sulphate (mg/l)	1.5	2.3	2.3	1.8
Phosphorous - total (mg/l)	0.014	0.012	0.015	0.012
- total dissolved	0.009	0.007	0.008	0.017
Nitrite (mg/l)	< 0.005	< 0.005	< 0.005	< 0.005
Nitrate (mg/l)	0.02	0.02	0.02	0.02
Ammonia (mg/l)	0.006	0.006	0.006	0.010
Nitrate/Nitrite (mg/l)*	0.030	0.012	0.015	0.022
Ammonia (mg/l)*	0.018	0.015	0.013	0.025
Total Dissolved Nitrogen (mg/l)*	0.117	0.094	0.068	0.069
Particulate Nitrogen (mg/l)*	0.024	0.024	0.016	< 0.010
Particulate Carbon (mg/l)*	0.564	0.375	0.413	0.334
Secchi Disk reading 5.5 meters				

*Analyzed by Inland Waters Directorate Laboratory

TABLE 6.4 QUINSAM COAL SURVEY - WATER QUALITY
STATION C, NONAME LAKE (June 21, 1983)

PARAMETER	1 meter	3 meters	8 meters	9 meters
pH	7.3	7.1	6.5	7.0
Dissolved Oxygen (mg/l)	8.70	8.75	9.00	8.30
Hardness - total (mg/l)	12.20	12.20	9.81	10.2
Turbidity (FTU)	0.2	0.2	0.2	0.2
Solids (mg/l) - dissolved	32	37	27	19
- suspended	< 5.0	< 5.0	< 5.0	< 5.0
- total	32	37	27	19
Phenol (mg/l)	< 0.02	< 0.02	< 0.02	< 0.02
Oil/Grease (mg/l)	2	3	3	3
Sulphate (mg/l)	2.9	2.9	2.3	2.7
Phosphorous - total (mg/l)	0.011	0.011	0.011	0.012
- total dissolved	0.007	0.022**	0.008	0.008
Nitrite (mg/l)	< 0.005	< 0.005	< 0.005	< 0.005
Nitrate (mg/l)	0.01	0.01	0.01	0.01
Ammonia (mg/l)	< 0.005	0.006	0.007	0.020
Nitrate/Nitrite (mg/l)*	0.033	0.014	0.020	0.026
Ammonia (mg/l)*	0.013	0.022	0.006	0.032
Total Dissolved Nitrogen (mg/l)*	0.115	0.105	0.095	0.085
Particulate Nitrogen (mg/l)*	0.020	0.015	0.010	0.006
Particulate Carbon (mg/l)*	0.277	0.324	0.220	0.238
Secchi Disk reading 7 meters				

*Analyzed by Inland Waters Directorate Laboratory
**possible contamination of sample

TABLE 6.5 QUINSAM COAL SURVEY - WATER QUALITY
STATION D, GOOSENECK LAKE (June 25, 1983)

PARAMETER	1 meter	5 meters	10 meters	14 meters
pH	7.45	7.30	7.15	6.95
Dissolved Oxygen (mg/l)	9.50	8.70	10.55	9.55
Hardness - total (mg/l)	19.1	19.8	20.3	18.7
Turbidity (FTU)	0.2	0.2	0.2	0.2
Solids (mg/l) - dissolved	40	37	42	42
- suspended	< 5.0	< 5.0	< 5.0	< 5.0
- total	40	37	42	42
Phenol (mg/l)	< 0.02	< 0.02	< 0.02	< 0.02
Oil/Grease (mg/l)	< 2	2	< 2	< 2
Sulphate (mg/l)	2.9	3.3	3.3	3.1
Phosphorous - total (mg/l)	0.012	0.012	0.014	0.015
- total dissolved	0.008	0.009	0.009	0.011
Nitrite (mg/l)	< 0.005	< 0.005	< 0.005	< 0.005
Nitrate (mg/l)	0.02	0.02	0.02	0.02
Ammonia (mg/l)	0.006	0.006	0.008	0.008
Nitrate/Nitrite (mg/l)*	0.014	0.013	0.010	0.021
Ammonia (mg/l)*	0.003	0.012	0.010	0.011
Total Dissolved Nitrogen (mg/l)*	0.067	0.059	0.060	0.080
Particulate Nitrogen (mg/l)*	< 0.010	0.007	< 0.010	< 0.010
Particulate Carbon (mg/l)*	0.209	0.215	0.173	0.178
Secchi Disk reading 9 meters				

*Analyzed by Inland Waters Directorate Laboratory

4.5 Heavy Metals in the Lake Water Column

Table 7.1 - Station A
Table 7.2 - Station B
Table 7.3 - Station C
Table 7.4 - Station D

TABLE 7.1 QUINSAM COAL SURVEY - WATER QUALITY
STATION A, MIDDLE QUINSAM LAKE
Total and Dissolved Metals (mg/l)
(June 24, 1983)

	1 meter		5 meters		9 meters		10 meters	
	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
As	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
B	< 0.001	0.024	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.012
Ba	0.001	< 0.001	< 0.001	< 0.001	0.001	0.001	0.001	0.002
Be	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Cd	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Co	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cr	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cu	< 0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Hg	< 0.0001	-	< 0.0001	-	< 0.0001	-	< 0.0001	-
Mn	0.006	0.002	0.006	0.002	0.009	0.007	0.011	0.01
Mo	< 0.005	< 0.005	< 0.005	< 0.005	0.006	< 0.005	< 0.005	< 0.005
Ni	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
P	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pb	< 0.001	< 0.001	0.001	< 0.001	0.002	< 0.001	0.001	< 0.001
Sb	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Se	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Sn	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.01
Sr	0.012	0.013	0.012	0.013	0.011	0.012	0.011	0.012
Ti	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
V	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Zn	0.002	0.004	< 0.002	0.002	< 0.002	0.002	< 0.002	0.004
Al	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fe	0.042	0.014	0.052	0.015	0.047	0.019	0.056	0.028
Si	1.30	1.40	1.30	1.40	1.60	1.70	1.60	1.70
Ca	6.70	6.80	6.60	6.80	5.70	5.90	5.70	5.80
Mg	0.8	0.80	0.70	0.80	0.70	0.70	0.60	0.70
Na	0.9	0.90	0.90	0.90	1.10	1.20	1.30	1.40

TABLE 7.2 QUINSAM COAL SURVEY - WATER QUALITY
STATION B, LONG LAKE
Total and Dissolved Metals (mg/l)
(June 22, 1983)

	1 meter		4 meters		8 meters		15 meters	
	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
As	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
B	< 0.001	0.03	< 0.001	0.03	< 0.001	0.03	< 0.001	0.03
Ba	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Be	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Cd	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Co	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cr	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cu	< 0.001	0.001	< 0.001	0.002	< 0.001	< 0.001	0.001	0.002
Hg	< 0.0001	-	< 0.0001	-	< 0.0001	< 0.0001	< 0.0001	-
Mn	0.005	0.001	0.005	0.002	0.003	0.002	0.004	0.004
Mo	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Ni	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
P	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pb	< 0.001	< 0.001	< 0.001	< 0.001	0.002	< 0.001	0.001	0.001
Sb	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Se	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Sn	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Sr	0.012	0.012	0.011	0.012	0.009	0.01	0.009	0.009
Ti	< 0.002	0.004	< 0.002	0.004	< 0.002	0.003	< 0.002	0.004
V	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Zn	< 0.002	0.004	< 0.002	0.008	< 0.002	0.003	< 0.002	0.011
Al	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.05	< 0.05	< 0.05
Fe	0.065	0.024	0.041	0.026	0.06	0.028	0.086	0.05
Si	2.20	2.40	2.20	2.40	2.40	2.40	2.40	2.60
Ca	3.50	3.50	3.40	3.50	2.80	2.90	2.80	2.90
Mg	0.70	0.60	0.70	0.70	0.60	0.60	0.60	0.60
Na	1.20	1.20	1.20	1.20	0.90	1.00	0.90	1.00

TABLE 7.3 QUINSAM COAL SURVEY - WATER QUALITY
STATION C, NONAME LAKE
Total and Dissolved Metals (mg/l)
(June 21, 1983)

	1 meter		3 meters		8 meters		11 meters	
	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
As	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
B	0.033	0.012	0.02	0.012	< 0.001	0.012	< 0.001	0.012
Ba	< 0.001	< 0.001	0.001	< 0.001	0.001	< 0.001	0.001	< 0.001
Be	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Cd	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Co	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cr	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cu	< 0.001	< 0.001	0.003	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Hg	< 0.0001	-	< 0.0001	-	< 0.0001	-	< 0.0001	-
Mn	0.004	< 0.001	0.009	0.001	0.004	0.002	0.005	0.004
Mo	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Ni	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
P	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pb	0.001	< 0.001	0.007	< 0.001	0.002	< 0.001	0.001	< 0.001
Sb	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Se	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Sn	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Sr	0.01	0.011	0.01	0.011	0.008	0.008	0.008	0.008
Ti	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
V	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Zn	0.002	0.003	0.012	0.004	0.002	0.005	0.004	0.009
Al	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.05	< 0.05	< 0.05
Fe	0.076	0.034	0.083	0.035	0.096	0.072	0.0141	0.087
Si	2.20	2.40	2.20	2.40	2.30	2.5	2.40	2.60
Ca	3.40	3.60	3.50	3.60	2.70	2.8	2.70	2.90
Mg	0.80	0.80	0.80	0.80	0.60	0.60	0.60	0.60
Na	1.00	1.00	1.00	1.00	0.80	0.80	0.80	0.90

TABLE 7.4 QUINSAM COAL SURVEY - WATER QUALITY
STATION D, GOOSENECK LAKE
Total and Dissolved Metals (mg/l)
(June 25, 1983)

	1 meter		5 meters		10 meters		14 meters	
	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
As	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
B	< 0.001	0.024	< 0.001	< 0.001	< 0.001	0.012	< 0.001	< 0.001
Ba	< 0.001	< 0.001	< 0.001	< 0.001	0.001	0.001	0.001	0.001
Be	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Cd	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Co	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cr	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cu	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Hg	< 0.0001	-	< 0.0001	-	< 0.0001	-	< 0.0001	-
Mn	0.003	0.001	0.003	0.001	0.003	0.008	0.004	0.001
Mo	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Ni	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
P	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pb	0.001	< 0.001	0.002	< 0.001	0.001	< 0.001	0.002	< 0.001
Sb	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Se	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Sn	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Sr	0.01	0.011	0.01	0.011	0.01	0.011	0.01	0.011
Ti	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
V	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Zn	< 0.002	0.003	< 0.002	< 0.002	< 0.002	0.003	< 0.002	< 0.002
Al	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fe	0.025	0.015	0.024	0.013	0.023	1.04	0.059	0.012
Si	1.50	1.60	1.50	1.50	1.50	1.60	1.70	1.80
Ca	6.60	6.50	6.60	6.80	6.10	6.30	6.20	6.30
Mg	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
Na	0.60	0.60	0.60	0.60	0.70	0.70	0.70	0.70

4.6 Heavy Metals in Lake Sediments

Table 8.1

TABLE 8.1 QUINSAM COAL SURVEY - HEAVY METAL LEVELS IN LAKE SEDIMENTS (ug/g), JUNE, 1983

	As	Ba	Be	Cd	Co	Cr	Cu	Mn	Mo	Ni	P	Pb
C. Noname Lake	< 8.0	28.7	< 0.2	0.31	11.5	20.0	32.5	1330	< 0.8	7.0	706	3.8
(June 21)	< 8.0	33.5	< 0.2	0.35	9.5	22.7	43.0	800	< 0.8	15.0	1040	3.7
	11.0	32.8	< 0.2	0.26	7.9	18.9	37.9	1420	< 0.8	9.0	874	5.0
B. Long Lake	63.0	133.0	< 0.2	0.33	24.9	23.7	54.5	2310	< 0.8	3.0	2130	2.5
(June 22)	13.0	53.5	< 0.2	0.38	7.3	16.3	34.7	552	< 0.8	6.0	1120	2.7
	48.0	112.0	< 0.2	0.32	23.9	25.9	53.9	1820	< 0.8	4.0	2070	2.0
A. Middle Quinsam	46.0	91.7	0.3	0.90	22.0	42.7	211.0	656	< 0.8	25.0	726	3.0
Lake	< 0.8	31.8	< 0.2	0.38	8.3	25.8	87.7	241	< 0.8	65.0	553	2.8
(June 24)	24.0	78.4	0.5	0.90	21.2	38.7	168.0	612	< 0.8	23.0	723	2.9
D. Gooseneck Lake	< 8.0	58.6	< 0.2	0.22	6.4	14.2	30.9	271	3.1	6.0	683	3.0
(June 25)	< 8.0	56.1	< 0.2	0.29	6.4	13.7	31.3	271	1.6	40.0	767	5.0
	< 8.0	56.9	< 0.2	0.23	6.4	15.0	30.6	264	1.8	7.0	904	4.0

Continued...

TABLE 8.1 QUINSAM COAL SURVEY - HEAVY METAL LEVELS IN LAKE SEDIMENTS (ug/g), JUNE, 1983
(Continued)

	Sn	Sr	Ti	V	Zn	Al	Fe	Si	Ca	Mg	Na	Hg
C. Noname Lake	< 2.0	18.9	372	79.0	61.7	13400	30600	8790	4200	1580	240	16.0
(June 21)	3.0	19.2	420	91.0	66.7	14500	24500	7720	4480	1920	240	8.47
	< 2.0	19.0	352	80.0	61.8	13200	30000	7990	4090	1560	490	13.3
B. Long Lake	< 2.0	25.9	455	109.0	78.9	17500	101000	6250	5050	1520	290	57.5
(June 22)	< 2.0	17.3	307	77.0	48.9	12200	17400	7290	3600	1020	210	6.3
	< 2.0	24.7	547	121.0	79.2	17800	93700	6590	5220	1750	320	62.7
A. Middle Quinsam	2.0	70.2	4050	168.0	87.2	34000	49600	5620	18100	12800	1200	53.0
Lake	< 2.0	28.7	618	63.0	40.0	14200	14100	10500	8850	2930	500	21.0
(June 24)	< 2.0	59.8	4080	152.0	79.7	31700	45600	7210	17400	12400	1080	34.4
D. Gooseneck Lake	< 2.0	11.9	378	49.0	27.8	11600	7630	8890	3690	1130	260	3.9
(June 25)	< 2.0	11.3	371	43.0	27.9	12000	7590	6130	3620	1080	410	4.1
	< 2.0	11.7	420	49.0	27.5	12200	8120	4930	3790	1200	200	4.8

4.7 Water Quality of Argonaut Mine Pit Water

Table 9.1 - Physical Chemical Results

Table 9.2 - Heavy Metals

TABLE 9.1 QUINSAM COAL SURVEY - WATER QUALITY
STATION 9, ARGONAUT MINE PIT WATER (June 24, 1983).

PARAMETER	SAMPLE #1	SAMPLE #2
Temperature (°C)	-	-
Conductivity (uS/cm)	-	-
pH	8.65	8.45
Dissolved Oxygen (mg/l)	-	-
Hardness - total (mg/l)	97.1	96.9
Turbidity (FTU)	0.1	0.1
Solids (mg/l) - dissolved	127	129
- suspended	5	< 5
- total	132	129
Phenol (mg/l)	-	-
Oil/Grease (mg/l)	-	-
Sulphate (mg/l)	22.5	22.5
Phosphorous - total (mg/l)	-	-
- total dissolved	-	-
Nitrite (mg/l)	< 0.005	< 0.005
Nitrate (mg/l)	0.02	0.02
Ammonia (mg/l)	0.007	0.007
Nitrate/Nitrite (mg/l)*	-	-
Ammonia (mg/l)*	-	-
Total Dissolved Nitrogen (mg/l)*	-	-
Particulate Nitrogen (mg/l)*	-	-
Particulate Carbon (mg/l)*	-	-

*Analyzed by Inland Waters Directorate Laboratory

TABLE 9.2 QUINSAM COAL SURVEY - WATER QUALITY
STATION 9. ARGONAUT MINE PIT WATER
Total and Dissolved Metals (mg/l)
(June 24, 1983)

	Sample 1		Sample 2	
	Total	Dissolved	Total	Dissolved
As	< 0.05	< 0.05	< 0.05	< 0.05
B	0.013	0.036	0.039	0.036
Ba	< 0.001	< 0.001	< 0.001	< 0.001
Be	< 0.001	< 0.001	< 0.001	< 0.001
Cd	< 0.0005	< 0.0005	< 0.0005	< 0.0005
Co	< 0.005	< 0.005	< 0.005	< 0.005
Cr	< 0.005	< 0.005	< 0.005	< 0.005
Cu	< 0.001	< 0.001	0.001	< 0.001
Hg	< 0.0001	-	< 0.0001	-
Mn	0.002	0.001	0.002	0.001
Mo	0.012	0.011	0.013	0.011
Ni	< 0.02	< 0.02	< 0.02	< 0.02
P	< 0.05	< 0.05	< 0.05	< 0.05
Pb	< 0.001	< 0.001	0.002	< 0.001
Sb	< 0.05	< 0.05	< 0.05	< 0.05
Se	< 0.05	< 0.05	< 0.05	< 0.05
Sn	< 0.01	< 0.01	< 0.01	< 0.01
Sr	0.053	0.057	0.053	0.057
Ti	< 0.002	< 0.002	< 0.002	< 0.002
V	< 0.01	< 0.01	< 0.01	< 0.01
Zn	0.002	0.003	< 0.002	< 0.002
Al	< 0.05	< 0.05	< 0.05	< 0.05
Fe	< 0.005	< 0.005	0.017	< 0.005
Si	2.80	3.00	2.80	3.00
Ca	35.1	35.70	35.00	35.60
Mg	1.90	1.90	2.00	1.90
Na	1.10	1.10	1.10	1.10

APPENDIX I

The method of using a stainless steel syringe of the collection of fine sediments is outlined in detail in an unpublished report by George Derksen of the Environmental Protection Service, Pacific Region. However, for information, some of the methodology is outlined here.

Samples were evacuated into 2-litre polethylene sample bottles. Using Imhoff cones the sample was settled for one hour to obtain the final sample. The total volume of sample was recorded as well as the volume of settled material. The water in the cone was decanted and then the sediment put into a soil-bag and the soil-bag into a whirl pac (invert cone, pull plug, using distilled water rinse any residual sediment into the sample bag). Upon consultation with Paul Kluckner (EPS-DFO Laboratory) it was decided to use the contents of two syringe samples to make up one replicate.

For the Quinsam Coal project, for each station, six replicates were taken (each composed of two syringe samples). Four of the replicates were sieved to the < .15 mm fraction for metal analysis, the percent of the total sample < .15 mm and $\geq$ .15 mm was also determined. Two samples were used for particle size analysis (0.15 mm sieve included in the series in order to calculate the portion of that fraction) and from these samples the total volatile fraction (organic content) of the < .15 mm and $\geq$ .15 mm fractions was also determined.

ADDENDUM

Additional Sediment Sampling

The sediment samples taken from the four lakes in June, 1983 showed unusually high concentrations of mercury (3.9-62.7 ppm). The EPS-DFO Chemistry Laboratory re-analysed the samples and the high mercury concentrations were confirmed. No possible sources of contamination in the laboratory or in the field could be found. Assuming the elevated mercury levels were real, a second sampling trip to Middle Quinsam, Long Lake and Noname Lake was conducted. The second set of sediment cores, taken from the original site and two other sites in each lake, indicated mercury values of 0.19-0.73 ppm.

The relatively large difference in mercury levels between the first and second sediment sites prompted a third trip to Long Lake (where the highest levels were found) and ten more cores were taken. The third set of samples confirmed the lower mercury concentrations (0.34-0.65 ppm).

Sampling Procedure

The second set of sediment cores were collected August 17-18, 1983 from Noname Lake, Long Lake and Middle Quinsam Lake. Triplicate core samples were taken from three sites in each lake using a Phlager corer with individual plastic inserts. The cores were immediately frozen on dry ice and delivered to the EPS-DFO Chemistry Laboratory in West Vancouver.

At the laboratory, the frozen core samples were removed from the plastic tubes and cut into three inch sections. A stainless steel knife was used to cut about one quarter inch into the core, which was then broken by hand (rubber gloves were worn). Since the core lengths varied from six to fifteen inches, the number of sections per core varied accordingly. The ten sediment cores taken from Long Lake on September 21, 1983 were handled in the same manner as above.

August, 1983

The heavy metal concentration results from each lake site (3 cores per site) were reported for each core section depth i.e. 0-3 inches, 4-6 inches, 7-9 inches, 10-12 inches and 13-15 inches. As the core lengths varied, the number of sections per core varied accordingly. To avoid tabulating individual metal concentrations, mean and standard deviation calculations were performed on the 2 or 3 replicates per core depth at each sampling site. (See Table 10.1). The lake site descriptions are:

Noname Lake

Site #1 - midlake, off mouth of Waterfall Creek
Site #2 - at west end
Site #3 - at east end, off lake outlet

Long Lake

Site #1 - at west end, off lake inlet
Site #2 - midlake
Site #3 - at east end, off lake outlet

Middle Quinsam Lake

Site #1 - at west end, off campsite
Site #2 - midlake
Site #3 - at east end narrows

September, 1983

Of the ten sediment core samples taken from Long Lake (at site #3), four depth segments per core were indentified (0-3 inches, 4-6 inches, 7-9 inches, 10-12 inches). Mean and standard deviation calculations were performed on the heavy metal concentration results from the individual core depths. (See Table 10.2).

Heavy Metals in Lake Sediment Cores

Table 10.1 - Middle Quinsam, Long, Noname Lakes (Aug./83)

Table 10.2 - Long Lake (Sept./83)

TABLE 10.1 QUINSAM COAL SURVEY - HEAVY METAL LEVELS IN LAKE SEDIMENTS (ug/g), AUGUST, 1983

LAKE	CORE (in.)	n	ARSENIC		BARIUM		COBALT		CHROMIUM	
			$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
NONAME LAKE										
site #1	0-3	3	10.67	4.62	44.83	7.54	12.93	2.86	31.40	1.23
	4-6	3	8.99	1.73	37.13	5.78	15.40	2.88	35.37	1.16
	7-9	3	12.33	6.66	38.73	7.94	15.03	2.90	34.60	1.25
site #2	0-3	3	16.00	4.58	46.93	0.68	11.20	0.89	20.60	0.50
	4-6	3	9.00	1.00	29.50	1.68	7.47	1.70	18.30	0.36
site #3	0-3	3	21.00	2.65	48.27	5.10	8.40	4.23	24.50	4.72
	4-6	3	8.99	1.73	38.00	10.01	8.90	1.40	25.77	4.50
	7-9	2	< 8.00	0.00	27.00	7.21	8.60	0.42	20.80	2.26
LONG LAKE										
site #1	0-3	3	56.00	16.70	83.27	10.76	12.97	1.78	21.93	0.74
	4-6	3	15.67	2.31	75.93	4.45	15.17	1.99	24.23	0.91
	7-9	3	11.67	3.06	70.27	5.13	13.23	2.32	23.80	0.62
site #2	0-3	3	278.00	13.08	243.20	224.48	23.43	11.83	25.37	2.61
	4-6	3	72.33	15.50	153.10	69.85	26.03	8.08	36.60	0.46
	7-9	3	50.67	4.51	161.33	46.20	24.07	3.34	33.73	1.71
site #3	0-3	3	1012.67	93.22	995.00	167.26	15.23	0.57	21.97	2.49
	4-6	3	268.33	92.55	490.00	150.52	22.80	3.99	21.83	2.06
	7-9	3	139.33	11.59	312.00	60.00	21.37	4.12	20.90	0.66
	10-12	2	120.00	8.49	365.50	17.68	21.35	3.04	24.55	1.20
MIDDLE QUINSAM										
site #1	0-3	3	16.67	2.52	86.63	9.14	13.87	0.38	30.83	1.50
	4-6	3	9.00	1.73	50.60	4.45	10.50	1.42	28.07	0.45
	7-9	3	8.33	0.58	31.40	1.21	9.00	1.81	26.10	0.70
	10-12	3	< 8.00	0.00	29.87	0.93	9.93	1.82	25.70	0.69
site #2	0-3	3	10.33	2.08	71.13	6.52	13.20	2.27	28.77	0.90
	4-6	3	< 8.00	0.00	49.20	3.08	11.53	2.97	26.77	1.12
	7-9	3	< 8.00	0.00	32.77	1.03	7.07	1.50	25.07	0.15
	10-12	3	< 8.00	0.00	35.83	1.76	9.37	3.32	27.50	1.59
site #3	0-3	3	10.67	2.31	69.20	10.48	8.10	3.24	26.60	0.53
	4-6	3	< 32.67*	26.1	41.60	7.79	9.87	8.24	29.30	1.54
	7-9	3	10.33	2.52	27.77	4.68	6.80	1.59	27.70	2.07
	10-12	3	< 16.00*	12.17	29.73	3.78	10.63	5.54	29.50	2.18
	13-15	3	< 12.00*	6.93	26.17	2.51	5.73	1.25	27.67	1.46

* - Less than detection values used in calculation of mean

.../cont.

TABLE 10.1 QUINSAM COAL SURVEY - HEAVY METAL LEVELS IN LAKE SEDIMENTS (ug/g), AUGUST, 1983 (Cont.)

LAKE	CORE (in.)	n	COPPER		MANGANESE		MOLYBDENUM		NICKEL	
			$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
NONAME LAKE										
site #1	0-3	3	59.43	1.08	594	57.6	1.07	0.25	14.33	1.53
	4-6	3	62.53	1.42	446	94.4	1.63	1.12	15.77	2.52
	7-9	3	63.13	8.75	398	65.6	1.67	0.75	15.00	3.61
site #2	0-3	3	35.70	3.53	1427	185.6	2.17	0.57	5.33	1.53
	4-6	3	29.67	1.85	484	29.7	3.47	0.21	5.00	1.00
site #3	0-3	3	48.73	13.54	1700	572.6	6.10	1.91	4.00	1.00
	4-6	3	51.13	9.49	537	60.2	2.93	0.91	8.33	2.31
	7-9	2	40.05	4.17	381	59.4	2.70	0.28	7.00	0.00
LONG LAKE										
site #1	0-3	3	42.90	3.03	1642	714.9	6.73	3.90	5.33	1.53
	4-6	3	48.10	1.75	592	67.7	3.33	1.46	10.00	1.00
	7-9	3	45.20	0.46	526	58.4	3.53	0.45	8.67	1.53
site #2	0-3	3	51.67	5.88	1280	1124.6	26.03	1.40	< 3.00	0.00
	4-6	3	78.17	3.95	1760	540.1	14.90	4.94	6.00	2.65
	7-9	3	68.20	5.28	1371	477.8	9.33	1.86	10.33	2.08
site #3	0-3	3	32.00	8.57	< 0.2	0.0	86.03	41.56	< 3.00	0.00
	4-6	3	41.13	7.41	145	250.5	11.80	9.53	< 3.00	0.00
	7-9	3	32.20	1.44	< 0.2	0.0	5.17	2.89	< 3.00	0.00
	10-12	2	43.70	12.02	< 0.2	0.0	11.00	5.94	< 3.00	0.00
MIDDLE QUINSAM										
site #1	0-3	3	80.33	7.41	524	672.3	1.83	0.29	13.33	3.21
	4-6	3	73.67	13.90	791	48.5	3.00	0.36	9.00	2.00
	7-9	3	67.63	11.38	571	32.5	2.53	0.55	8.67	1.53
	10-12	3	58.47	0.81	470	14.5	2.07	0.84	8.00	1.00
site #2	0-3	3	76.50	2.86	798	136.0	2.30	0.70	11.67	1.53
	4-6	3	68.27	5.03	569	28.8	2.70	0.36	12.00	7.00
	7-9	3	60.40	1.57	425	11.5	2.33	0.47	7.00	1.73
	10-12	3	73.00	9.57	445	28.2	2.93	0.67	10.00	1.00
site #3	0-3	3	74.83	9.00	1352	771.8	4.57	2.00	7.33	3.21
	4-6	3	83.73	19.62	556	23.6	< 4.60*	1.51	< 12.00*	7.21
	7-9	3	80.40	10.91	405	102.7	4.67	0.49	7.67	0.58
	10-12	3	72.23	2.93	360	49.3	4.47	1.36	< 8.33*	1.53
	13-15	3	88.23	13.79	299	0.6	4.47	0.57	7.33	3.51

* Less than detection values used in calculation of mean

.../cont.

TABLE 10.1 QUINSAM COAL SURVEY - HEAVY METAL LEVELS IN LAKE SEDIMENTS (ug/g), AUGUST, 1983 (Cont.)

LAKE	CORE (in.)	n	PHOSPHOROUS $\bar{x}$	PHOSPHOROUS S.D.	LEAD $\bar{x}$	LEAD S.D.	STRONTIUM $\bar{x}$	STRONTIUM S.D.	TITANIUM $\bar{x}$	TITANIUM S.D.
NONAME LAKE										
site #1	0-3	3	1316.7	192.2	5.33	2.08	23.4	1.61	565.7	105.5
	4-6	3	1703.3	125.8	< 3.00	0.001	21.0	2.10	545.7	52.4
	7-9	3	1536.7	118.5	< 3.00	0.00	22.1	2.02	658.7	120.5
site #2	0-3	3	1300.0	20.0	3.33	0.58	25.6	0.75	1066.7	5.8
	4-6	3	1240.0	30.0	< 3.00	0.00	22.2	0.32	841.3	46.2
site #3	0-3	3	2013.3	567.7	3.67	0.58	23.5	1.24	590.3	90.6
	4-6	3	1823.3	400.7	< 3.00	0.00	22.6	2.61	587.7	136.7
	7-9	2	989.0	185.3	< 3.00	0.00	22.1	1.84	491.5	70.0
LONG LAKE										
site #1	0-3	3	1440.0	45.8	5.00	3.46	33.0	0.67	906.0	21.8
	4-6	3	1306.7	80.2	< 3.00	0.00	36.3	2.01	1223.3	104.1
	7-9	3	1296.7	124.4	< 3.00	0.00	34.9	0.90	1260.0	108.2
site #2	0-3	3	2613.3	220.1	16.33	4.16	26.8	1.47	513.67	43.1
	4-6	3	3550.0	569.3	3.67	1.56	30.0	0.87	756.67	31.7
	7-9	3	2150.0	281.6	< 3.00	0.00	25.5	2.06	526.0	67.4
site #3	0-3	3	4823.3	535.3	26.67	4.93	43.0	13.89	352.0	15.4
	4-6	3	3840.0	969.4	6.00	2.00	21.6	1.70	417.3	74.1
	7-9	3	3236.7	459.4	3.67	1.56	18.6	0.50	456.3	13.5
	10-12	2	3085.0	601.0	5.00	0.00	20.1	1.20	487.5	30.4
MIDDLE QUINSAM										
site #1	0-3	3	917.0	6.6	8.33	0.58	46.7	4.63	1760.0	286.2
	4-6	3	969.3	13.3	4.33	1.53	35.7	1.31	1156.7	89.6
	7-9	3	956.0	6.1	< 3.00	0.00	28.6	0.75	860.7	73.4
	10-12	3	996.3	15.8	< 3.00	0.00	30.9	1.18	892.0	109.2
site #2	0-3	3	895.0	10.6	11.67	2.52	38.7	3.27	1373.3	176.2
	4-6	3	770.0	13.5	6.67	2.08	32.8	3.06	1018.7	139.7
	7-9	3	740.3	22.9	< 3.00	0.00	25.4	0.55	738.3	32.5
	10-12	3	881.0	48.5	< 3.00	0.00	28.7	0.61	831.7	38.0
Site #3	0-3	3	912.7	61.4	13.67	1.15	31.9	1.77	1011.7	58.0
	4-6	3	813.0	93.5	< 11.00*	8.54	31.4	5.12	775.3	81.4
	7-9	3	670.3	37.7	< 3.67*	1.15	23.5	4.37	658.3	120.4
	10-12	3	744.0	101.7	< 5.67*	3.79	27.1	4.92	766.0	50.1
	13-15	3	810.3	20.6	< 4.33*	2.31	26.7	1.93	740.3	93.8

* - Less than detection values used in calculation mean

.../cont.

TABLE 10.1 QUINSAM COAL SURVEY - HEAVY METAL LEVELS IN LAKE SEDIMENTS (ug/g), AUGUST, 1983 (Cont.)

LAKE	CORE (in.)	n	VANADIUM		ZINC		ALUMINIUM		IRON	
			$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
NONAME LAKE										
site #1	0-3	3	116.0	7.94	86.2	4.20	20400	1307.7	40133	6552
	4-6	3	123.0	11.14	89.2	5.07	20800	721.1	43400	5902
	7-9	3	128.0	11.14	88.8	1.54	21433	850.5	40267	2075
site #2	0-3	3	95.0	1.73	61.9	2.65	16633	208.2	36800	1229
	4-6	3	77.0	1.73	53.0	2.21	14967	378.6	22433	1069
site #3	0-3	3	116.3	22.81	69.6	9.25	16500	2740.4	55100	15780
	4-6	3	110.3	24.58	68.5	10.74	16867	2516.6	33367	7869
	7-9	2	97.0	1.41	56.6	6.51	13600	1838.5	20150	3465
LONG LAKE										
site #1	0-3	3	106.0	1.00	70.4	1.68	19467	404.1	45700	4521
	4-6	3	108.7	2.52	70.2	1.74	22866	873.7	30833	1102
	7-9	3	108.0	1.00	67.6	0.32	22333	321.5	28867	416
site #2	0-3	3	139.0	19.52	79.5	1.91	18800	2551.5	155400*	1400
	4-6	3	181.0	9.54	95.4	3.15	26200	264.6	87800	13164
	7-9	3	159.0	10.44	87.9	3.35	22533	1274.1	57200	8155
site #3	0-3	3	88.3	7.57	74.1	3.05	12867	493.3	134700*	2842
	4-6	3	122.0	10.39	81.8	4.04	18500	2007.5	157100*	1315
	7-9	3	119.7	5.03	76.0	4.64	18267	1464.0	159000*	100
	10-12	2	127.5	9.19	81.5	7.71	18900	1697.1	136000	8485
MIDDLE QUINSAM										
site #1	0-3	3	105.0	4.58	69.9	5.33	25433	1800.9	40600	2646
	4-6	3	97.0	1.73	56.4	5.85	21233	665.8	33367	950
	7-9	3	86.7	1.53	44.3	1.44	18300	458.3	26667	1115
	10-12	3	88.0	2.65	43.5	0.46	18367	776.7	24833	1124
site #2	0-3	3	99.7	3.51	68.6	2.93	23367	1289.7	31933	1079
	4-6	3	93.7	1.15	53.9	2.57	19967	971.3	30600	700
	7-9	3	82.7	4.04	40.9	0.87	16867	57.7	25733	404
	10-12	3	89.7	6.11	46.7	2.19	17900	458.3	25800	1375
site #3	0-3	3	88.0	2.65	62.4	3.70	18933	550.8	37800	5453
	4-6	3	89.3	1.15	53.4	12.96	18133	1150.4	30300	700
	7-9	3	86.3	5.03	40.8	5.34	16000	1400.0	25300	2691
	10-12	3	86.7	6.43	43.2	5.02	16733	929.2	24533	1710
	13-15	3	85.0	4.00	46.8	8.55	16000	800.0	21967	1301

*sample concentration greater than range of ICAP (Further dilution of sediment sample required)

.../cont.

TABLE 10.1 QUINSAM COAL SURVEY - HEAVY METAL LEVELS IN LAKE SEDIMENTS (ug/g), AUGUST, 1983 (cont.)

LAKE	CORE (in.)	n	SILICON		CALCIUM		MAGNESIUM		SODIUM	
			$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
NONAME LAKE										
site #1	0-3	3	6190	486	5027	197	3033	321	206.7	20.8
	4-6	3	7520	375	4763	577	3093	206	196.7	5.8
	7-9	3	6897	1207	4997	539	3327	180	260.0	36.1
site #2	0-3	3	4637	361	6143	176	2543	64	376.7	41.6
	4-6	3	4927	145	5353	68	2177	70	366.7	11.5
site #3	0-3	3	5393	104	5343	471	1730	252	316.7	37.9
	4-6	3	5187	659	5213	583	1940	426	336.7	40.4
	7-9	2	5420	113	4960	269	1740	269	340.0	28.3
LONG LAKE										
site #1	0-3	3	5017	250	7440	70	2607	95	353.3	11.6
	4-6	3	4360	1053	8140	301	3537	186	456.7	20.8
	7-9	3	5090	390	8047	165	3661	193	473.3	15.3
site #2	0-3	3	5003	240	5523	72	1627	135	213.3	15.3
	4-6	3	5250	492	6277	195	2440	175	330.0	10.0
	7-9	3	6067	449	5103	454	2317	188	343.3	60.3
site #3	0-3	3	4717	293	5243	611	1083	65	170.0	17.3
	4-6	3	4467	91	4100	183	1243	198	196.7	30.6
	7-9	3	4350	229	3973	25	1343	21	226.7	5.8
	10-12	2	4235	106	4425	233	1515	120	260.0	42.4
MIDDLE QUINSAM										
site #1	0-3	3	4977	715	11367	902	5957	764	730.0	40.0
	4-6	3	4853	525	8947	341	4177	240	700.0	72.1
	7-9	3	4490	1368	7463	376	3060	125	640.0	26.5
	10-12	3	4130	1325	7447	387	3247	110	753.3	20.8
site #2	0-3	3	4537	1076	10400	900	4957	391	580.0	75.5
	4-6	3	4603	890	8837	748	3863	255	580.0	62.4
	7-9	3	4773	648	7227	175	2840	30	520.0	10.0
	10-12	3	5067	459	7560	132	3173	64	630.0	34.6
site #3	0-3	3	5430	161	9373	241	4047	140	433.3	28.9
	4-6	3	14000	7653	9030	1058	3160	382	806.7	334.9
	7-9	3	6350	1877	7620	594	2600	344	446.7	73.7
	10-12	3	9280	5012	8393	191	3003	256	566.7	288.8
	13-15	3	6960	3166	7640	982	2957	293	546.7	90.7

.../cont.

TABLE 10.1 QUINSAM COAL SURVEY - HEAVY METAL LEVELS IN LAKE SEDIMENTS (ug/g), AUGUST, 1983

LAKE	CORE (in.)	n	MERCURY $\bar{x}$	MERCURY S.D.
NONAME LAKE				
site #1	0-3	3	0.31	0.064
	4-6	3	0.34	0.065
	7-9	3	0.25	0.035
site #2	0-3	3	0.28	0.006
	4-6	3	0.23	0.038
site #3	0-3	3	0.43	0.029
	4-6	3	0.31	0.038
	7-9	2	0.24	0.042
LONG LAKE				
site #1	0-3	3	0.29	0.023
	4-6	3	0.24	0.006
	7-9	3	0.20	0.006
site #2	0-3	3	0.59	0.066
	4-6	3	0.63	0.127
	7-9	3	0.45	0.072
site #3	0-3	3	0.64	0.026
	4-6	3	0.45	0.095
	7-9	3	0.28	0.087
	10-12	2	0.29	0.021
	13-15	2	0.35	0.042
MIDDLE QUINSAM LAKE				
site #1	0-3	3	0.35	0.067
	4-6	3	0.31	0.035
	7-9	3	0.29	0.056
	10-12	3	0.25	0.017
site #2	0-3	3	0.44	0.055
	4-6	3	0.35	0.040
	7-9	3	0.33	0.029
	10-12	3	0.32	0.061
site #3	0-3	3	0.32	0.035
	4-6	3	0.35	0.095
	7-9	2	0.28	0.007
	10-12	3	0.26	0.021
	13-15	3	0.24	0.006

TABLE 10.2 QUINSAM COAL SURVEY - HEAVY METAL LEVELS IN LONG LAKE SEDIMENT (ug/g) SEPTEMBER, 1983

CORE		ARSENIC		BARIUM		COBALT		CHROMIUM	
(in.)	n	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
0-3	10	769.3	138.40	756.8	238.52	17.10	7.78	19.62	1.80
4-6	10	157.7	52.93	326.7	80.64	27.02	8.35	23.80	1.94
7-9	10	108.6	32.36	270.4	69.14	21.42	1.88	24.22	1.30
10-12	7	110.3	25.45	299.4	38.37	28.60	3.98	25.81	2.07

CORE		COPPER		MANGANESE		MOLYBDENUM		PHOSPHORUS	
(in.)	n	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
0-3	10	36.34	5.45	3972.1	3487.6	54.65	18.63	5038	320.2
4-6	10	47.21	6.44	6714.8	4741.7	12.56	8.61	2994	370.4
7-9	10	45.27	4.27	1095.7	659.4	19.89	6.75	3511	590.9
10-12	7	53.90	7.55	2731.7	3914.4	27.83	10.16	3523	640.2

CORE		LEAD		STRONTIUM		TITANIUM		VANADIUM	
(in.)	n	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
0-3	10	22.70	4.42	29.71	4.57	342.0	32.6	100.2	5.27
4-6	10	< 14.00*	7.82	21.88	2.05	492.8	65.9	132.1	6.85
7-9	10	5.30	0.95	20.97	1.09	523.0	30.6	128.9	3.57
10-12	7	< 7.43*	5.62	22.89	2.55	524.3	49.6	140.0	6.56

*less than detection limit used in calculation of mean

.../cont.

TABLE 10.2 QUINSAM COAL SURVEY - HEAVY METAL LEVELS IN LONG LAKE SEDIMENT (ug/g) SEPTEMBER, 1983 (cont.)

CORE (in.)	n	ZINC		ALUMINUM		IRON		SILICON	
		$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
0-3	10	83.89	8.08	13650	1125.7	163600	17539	2081	439.1
4-6	10	90.44	6.62	19060	3013.4	157600	19426	2071	453.1
7-9	10	85.48	9.55	18710	729.5	131400	16379	2202	393.7
10-12	7	91.39	7.38	19943	1114.8	140286	19763	2050	389.5

CORE (in.)	n	CALCIUM		MAGNESIUM		SODIUM		MERCURY	
		$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
0-3	10	4970	233.2	1185	274.6	< 195.0*	10.8	0.55	0.067
4-6	10	4469	334.0	1563	213.9	230.0	40.0	0.56	0.057
7-9	10	4511	223.5	1681	130.3	260.0	39.7	0.39	0.056
10-12	7	4965	448.1	1720	233.0	241.4	35.3	0.46	0.069

*Less than detection values used in calculation of mean