Appendix A

Photographs of Habitat and Substrate in Twin Lakes Creek

Photo 1 Stream bed substrate at site ETL, upstream from the point of mine effluent discharge.

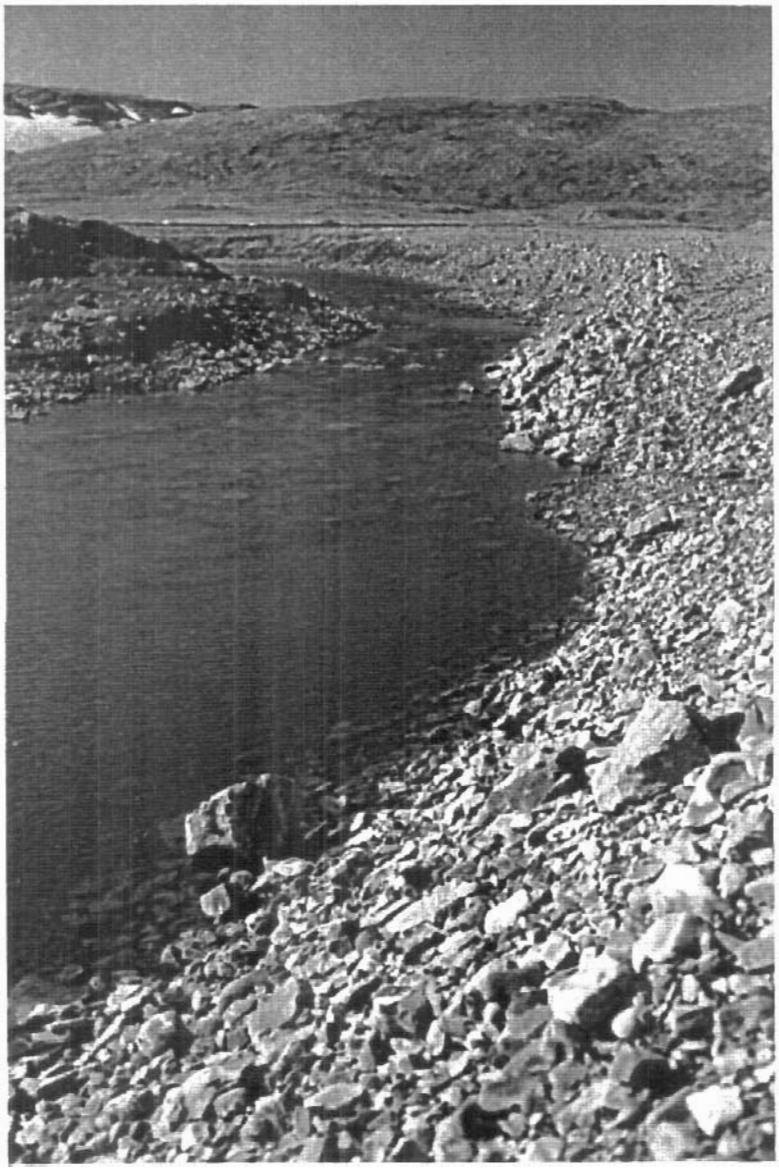

Photo 2 **View upstream from site ETL, towards East Twin Lake.**

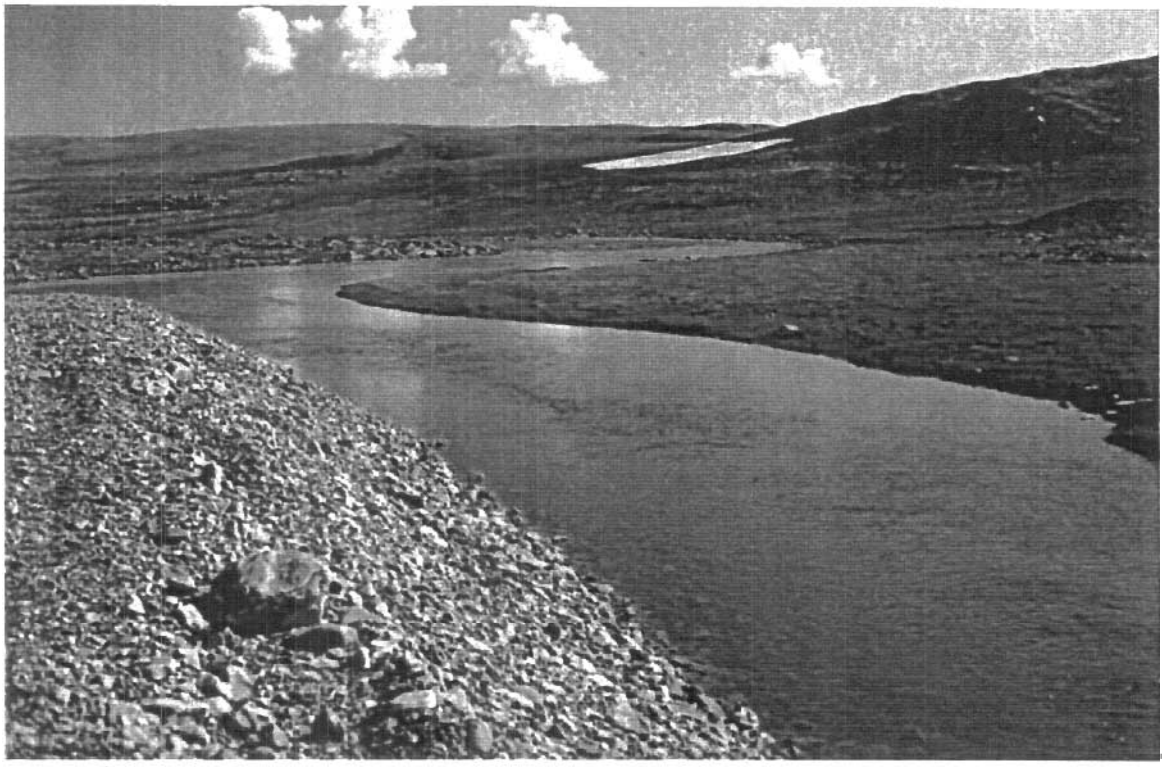

Photo 3 View downstream from site ERL. The mine effluent enters at left, and the combined flow of Twin Lakes Creek proceeds to the right, and into the distance.

Photo 4 Stream bed substrate at site WTL, immediately below the effluent discharge weir.

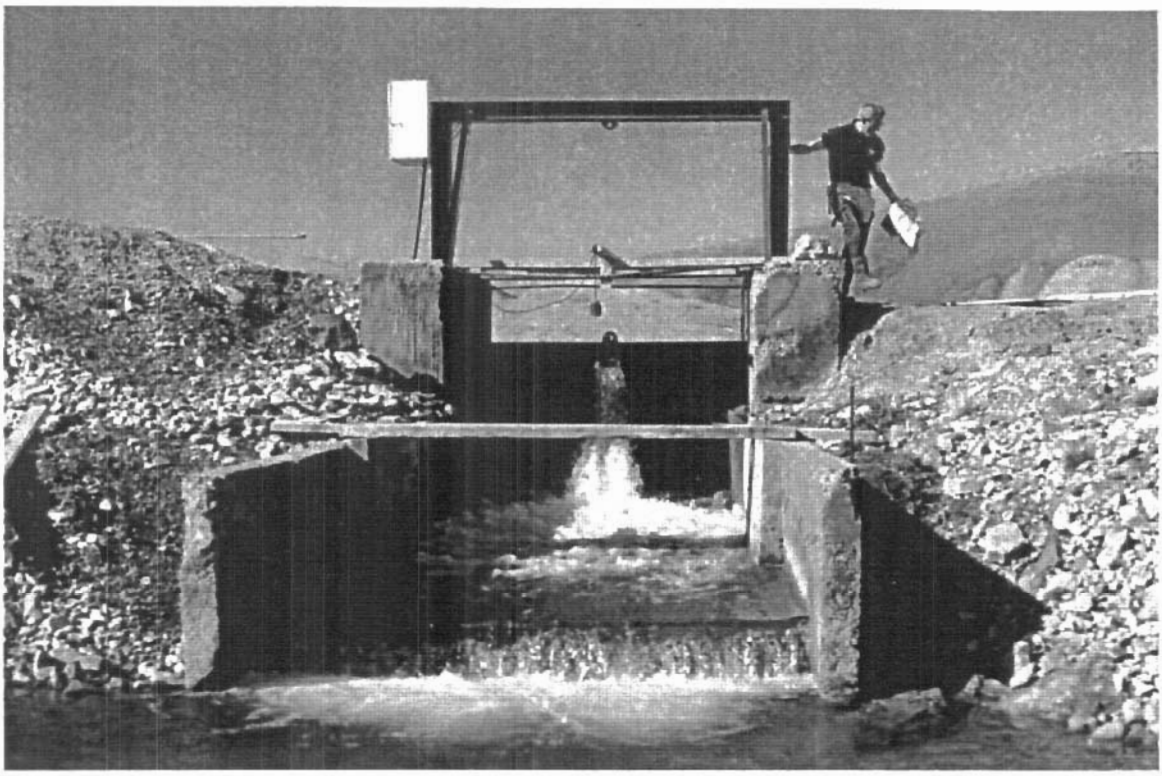

Photo 5 **The effluent discharge weir from the West Twin Lakes tailings area.**

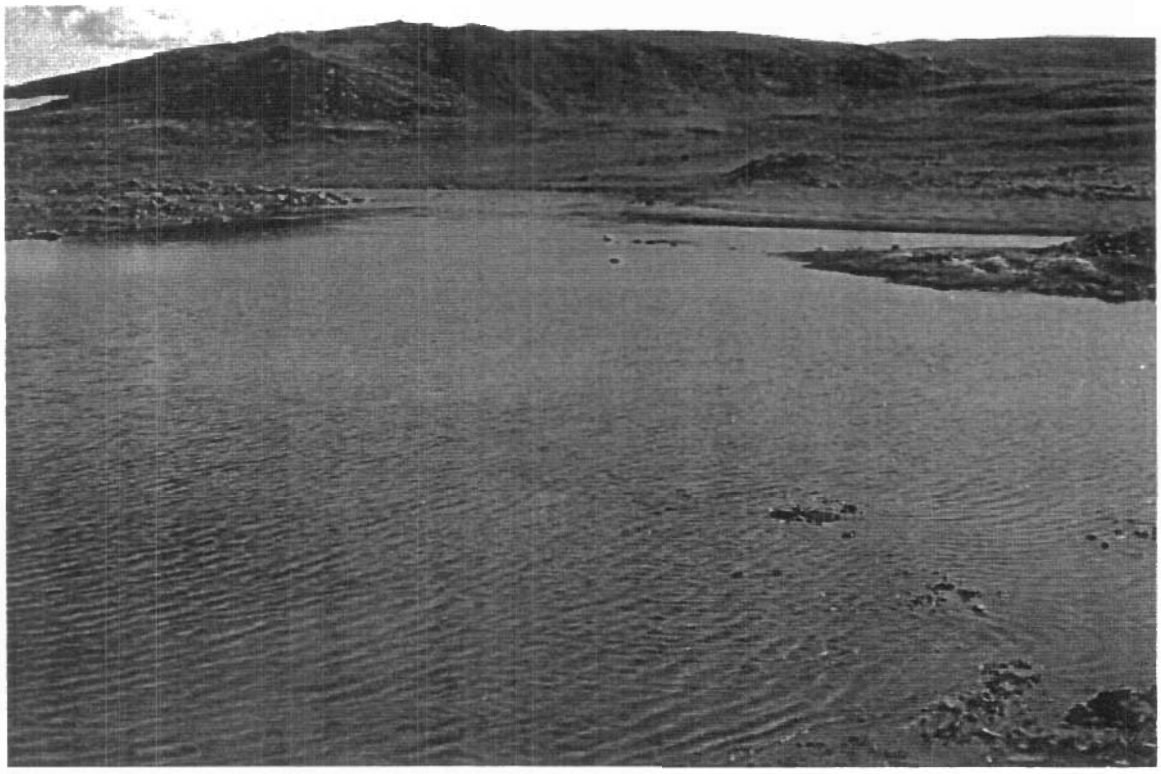

Photo 6 **View downstream from the effluent discharge weir. The flow from East Twin Lake enters at the far right, and the combined flows leave directly away from the viewer, turning to the left in the distance.**

Photo 7 View of a typical riffle section of Twin Lakes Creek, several hundred metres downstream from the effluent discharge weir.

Photo 8 View of a small cascade (about 1.5 m drop) about 400 m downstream from the effluent discharge weir.

Photo 9 View of a waterfall (about 10 m drop) about 600 m downstream from the effluent discharge weir.

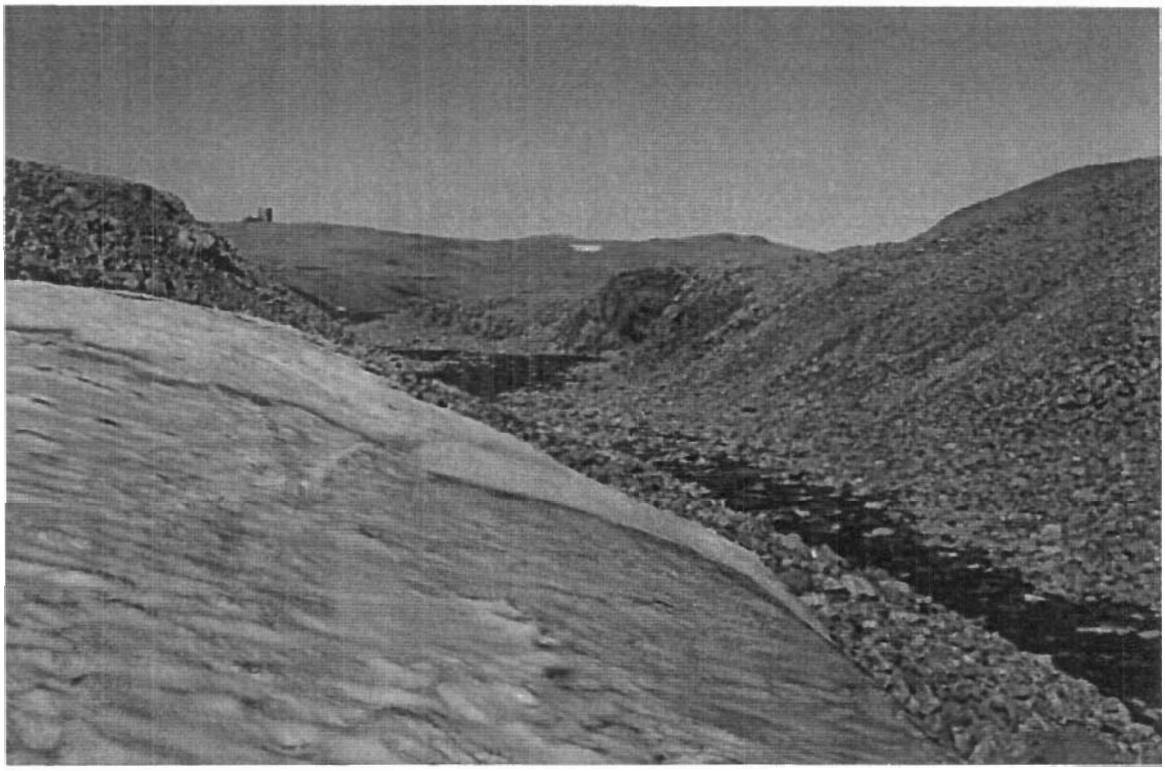

Photo 10 View downstream from the waterfall, towards sampling station 159-9, operated by Nanisivik Mine.

Photo 11 View of Twin Lakes Creek as it passes by the natural sulfide mineral zone near the mine, about 3 km downstream from the point of effluent discharge.

Appendix B

Locations of Benthic Invertebrate Sampling Stations in Twin Lakes Creek, July 11, 2003

Site ETL. Location: 73° 01' 30.600" N, 84° 28' 01.244" W. Elevation approximately 380 m. Located on Twin Lakes Creek immediately upstream of the mine effluent discharge point.

Site WTL. Location: 73° 01' 32.249" N, 84° 28' 33.841" W. Elevation approximately 370 m. Located immediately below the mine effluent discharge point, in a large pool isolated from the main stream channel.

Site TLC. Location: 73° 01' 41.709" N, 84° 28' 28.564" W. Elevation approximately 369 m. Located approximately 400 m downstream from the mine effluent discharge point.

Appendix C

Certificates of Chemical Analysis for Water Samples Submitted to the Research and Productivity Council Laboratory

RPC
921 College Hill Rd,
Fredericton, N.B. E3B 6Z9
Report No.: 31733-IAS

Jacques Whitford Environment
PO Box 1116
Fredericton NB E3B 5C2
Attn: M. Stephenson
Job No.: 15058

August 15, 2003
Revised: October 14, 2003

Fax: 506-452-7652

General Chemistry Analysis

	Concentration (mg/L)			
RPC ID	31733-03	31733-04	31733-05	31733-06
Client ID	T0-1	T0-2	T150-1	T150-2
Sodium	0.35	0.35	2.99	1.36
Potassium	0.18	0.18	2.54	1.06
Calcium	2.30	2.27	40.3	17.1
Magnesium	1.50	1.51	3.54	2.26
Iron	0.08	0.08	0.11	0.09
Manganese	0.001	0.001	0.025	0.010
Copper	< 0.001	< 0.001	0.002	< 0.001
Zinc	< 0.001	< 0.001	0.006	0.002
Ammonia (as N)	< 0.05	< 0.05	0.16	< 0.05
pH	6.7	6.8	6.9	6.8
Alkalinity (as $CaCO_3$)	7	8	11	9
Chloride	< 0.5	< 0.5	25.9	10.1
Sulfate	5	4	74	33
Nitrate + Nitrite (as N)	< 0.05	< 0.05	0.27	0.10
o-Phosphate (as P)	< 0.01	< 0.01	< 0.01	< 0.01
r-Silica (as SiO_2)	0.6	0.6	0.5	0.5
Total Organic Carbon	< 0.5	< 0.5	0.7	< 0.5
Turbidity (NTU)	1.8	2.2	1.2	1.3
Conductivity (uS/cm)	28	28	276	133

Calculated Parameters				
Bicarbonate as $CaCO_3$	7.0	8.0	11.0	9.0
Carbonate as $CaCO_3$	0.003	0.005	0.009	0.006
Hydroxide as $CaCO_3$	0.003	0.003	0.004	0.003
Cation sum (meq/L)	0.262	0.262	2.52	1.13
Anion sum (meq/L)	0.244	0.243	2.51	1.16
% difference	3.63	3.68	0.11	-1.23
Theoretical Conductivity	27.7	27.0	293	137
Hardness (as $CaCO_3$)	11.9	11.9	115	52.0
Ion Sum (mg/L)	14.3	13.9	158	71.4
Saturation pH (5°C)	10.3	10.3	8.96	9.38
Langelier Index (5°C)	-3.59	-3.47	-2.02	-2.55

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Peter Crowhurst, B.Sc., C.Chem.
Analytical Chemist
Inorganic Analytical Chemistry

RPC
921 College Hill Rd,
Fredericton, N.B. E3B 6Z9
Report No.: 31733-IAS

Jacques Whitford Environment
PO Box 1116
Fredericton NB E3B 5C2
Attn: M. Stephenson
Job No.: 15058

August 15, 2003
Revised: October 14, 2003

Fax: 506-452-7652

General Chemistry Analysis

	Concentration (mg/L)			
RPC ID	31733-07	31733-08	31733-09	31733-10
Client ID	T400-1	T400-2	T600-1	T600-2
Sodium	1.34	1.20	1.30	1.33
Potassium	1.05	0.94	1.03	1.06
Calcium	16.5	14.7	16.2	16.4
Magnesium	2.27	2.20	2.33	2.44
Iron	0.09	0.09	0.08	0.09
Manganese	0.011	0.010	0.011	0.011
Copper	< 0.001	< 0.001	< 0.001	< 0.001
Zinc	0.002	< 0.001	0.001	< 0.001
Ammonia (as N)	< 0.05	< 0.05	< 0.05	< 0.05
pH	6.9	7.0	7.0	7.0
Alkalinity (as $CaCO_3$)	8	8	8	8
Chloride	8.9	7.8	8.2	8.1
Sulfate	33	30	32	36
Nitrate + Nitrite (as N)	0.10	0.09	0.10	0.10
o-Phosphate (as P)	< 0.01	< 0.01	< 0.01	< 0.01
r-Silica (as SiO_2)	0.5	0.5	0.6	0.6
Total Organic Carbon	< 0.5	< 0.5	0.5	0.5
Turbidity (NTU)	1.2	1.2	1.2	1.4
Conductivity (uS/cm)	131	116	128	130

Calculated Parameters				
Bicarbonate as $CaCO_3$	8.0	8.0	8.0	8.0
Carbonate as $CaCO_3$	0.006	0.008	0.008	0.008
Hydroxide as $CaCO_3$	0.004	0.005	0.005	0.005
Cation sum (meq/L)	1.10	0.996	1.09	1.11
Anion sum (meq/L)	1.11	1.01	1.06	1.15
% difference	-0.20	-0.74	1.08	-1.58
Theoretical Conductivity	132	120	129	135
Hardness (as $CaCO_3$)	50.5	45.8	50.0	51.0
Ion Sum (mg/L)	69.0	62.7	67.1	71.4
Saturation pH (5°C)	9.44	9.49	9.45	9.45
Langelier Index (5°C)	-2.51	-2.49	-2.45	-2.43

Appendix D

Physical and Chemical Water Quality Data Corrected During the Plume Delineation Study July 11, 2003

Effluent Conductivity = 740 uS/cm; background stream conductivity = 29 uS/cm.

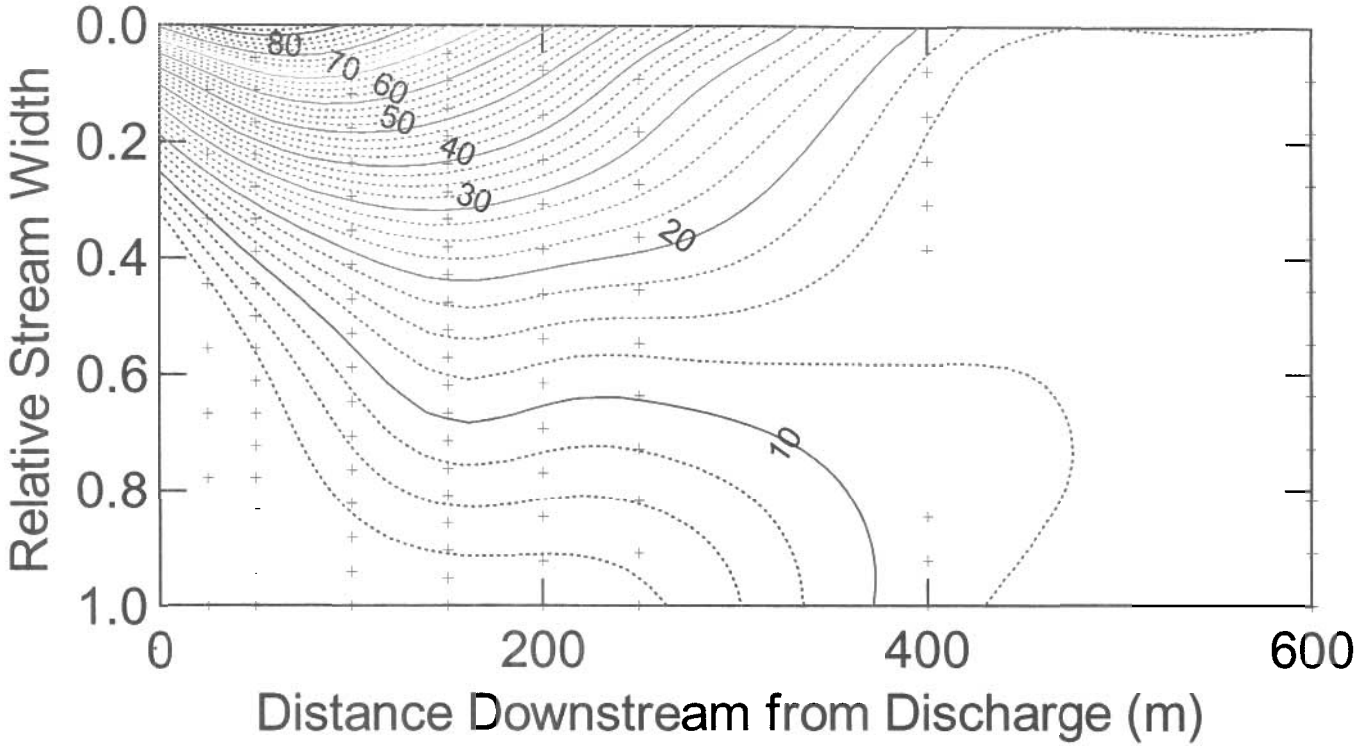
Distance Across Stream (m)	T0	% effluent	T50	% effluent	T100	% effluent	T150	% effluent	T200	% effluent	T250	% effluent	T400	% effluent	T600	% effluent
1.000	29.000	0.000	723.000	97.609	573.000	76.512	468.000	61.744	420.000	54.993	211.000	25.598	137.000	15.190	127.000	13.783
2.000	28.000	-0.141	694.000	93.530	509.000	67.511	450.000	59.212	354.000	45.710	208.000	25.176	133.000	14.627	127.000	13.783
3.000	28.000	-0.141	539.000	71.730	458.000	60.338	404.000	52.743	300.000	38.115	205.000	24.754	128.000	13.924	127.000	13.783
4.000	28.000	-0.141	350.000	45.148	363.000	46.976	357.000	46.132	210.000	25.457	197.000	23.629	125.000	13.502	127.000	13.783
5.000	28.000	-0.141	199.000	23.910	270.000	33.896	305.000	38.819	136.000	15.049	175.000	20.534	125.000	13.502	127.000	13.783
6.000	28.000	-0.141	145.000	16.315	205.000	24.754	282.000	35.584	87.000	8.158	147.000	16.596	125.000	13.502	127.000	13.783
7.000	28.000	-0.141	115.000	12.096	144.000	16.174	250.000	31.083	61.000	4.501	111.000	11.533	123.000	13.221	127.000	13.783
8.000	29.000	0.000	76.000	6.610	110.000	11.392	235.000	28.973	43.000	1.969	97.000	9.564	121.000	12.940	127.000	13.783
9.000	29.000	0.000	53.000	3.376	84.000	7.736	223.000	27.286	33.000	0.563	60.000	4.360	117.000	12.377	127.000	13.783
10.000			46.000	2.391	67.000	5.345	213.000	25.879	31.000	0.281	41.000	1.688	115.000	12.096	127.000	13.783
11.000			35.000	0.844	55.000	3.657	204.000	24.613	31.000	0.281	34.000	0.703	114.000	11.955	127.000	13.783
12.000			29.000	0.000	43.000	1.969	197.000	23.629	31.000	0.281			113.000	11.814		
13.000			28.000	-0.141	36.000	0.985	186.000	22.082	31.000	0.281			111.000	11.533		
14.000			28.000	-0.141	32.000	0.422	174.000	20.394								
15.000			28.000	-0.141	29.000	0.000	160.000	18.425								
16.000			28.000	-0.141	29.000	0.000	135.000	14.909								
17.000			29.000	0.000	29.000	0.000	108.000	11.111								
18.000			29.000	0.000			83.000	7.595								
19.000							57.000	3.938								
20.000							42.000	1.828								
							33.000	0.563								

% effluent = ((measured*100)-2900)/(740-29)

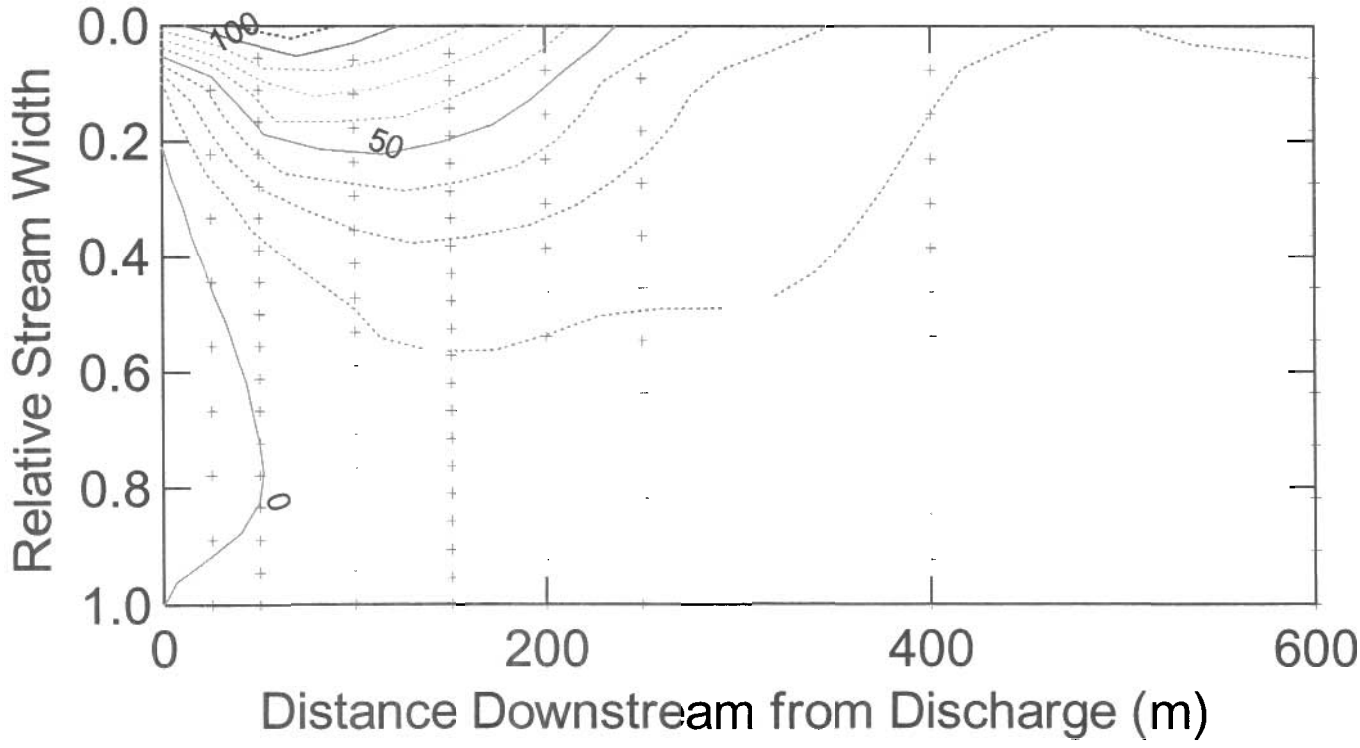
Effluent Temperature 13.7 C; stream temperature 6.2 C														
Distance Across Stream (m)	T0	Temperature	T50	Temperature	T100	Temperature	T150	Temperature	T200	Temperature	T250	Temperature	T400	Temperature	T600	Temperature
1.000	6.500	4.000	14.600	112.000	12.800	88.000	12.300	81.333	10.500	57.333	7.900	22.667	7.200	13.333	7.100	12.000
2.000	6.400	2.667	14.300	108.000	12.100	78.667	11.200	66.667	9.800	48.000	7.900	22.667	7.100	12.000	7.100	12.000
3.000	6.300	1.333	12.800	88.000	11.300	68.000	10.500	57.333	9.200	40.000	7.800	21.333	7.000	10.667	7.100	12.000
4.000	6.200	0.000	9.900	49.333	10.100	52.000	10.000	50.667	8.100	25.333	7.700	20.000	7.000	10.667	7.100	12.000
5.000	6.200	0.000	8.100	25.333	9.000	37.333	9.400	42.667	7.200	13.333	7.500	17.333	7.000	10.667	7.100	12.000
6.000	6.200	0.000	7.500	17.333	8.100	25.333	9.000	37.333	6.600	5.333	7.200	13.333	7.000	10.667	7.100	12.000
7.000	6.200	0.000	7.100	12.000	7.400	16.000	8.600	32.000	6.400	2.667	6.900	9.333	7.000	10.667	7.100	12.000
8.000	6.200	0.000	6.700	6.667	7.000	10.667	8.400	29.333	6.300	1.333	6.700	6.667	7.000	10.667	7.100	12.000
9.000	6.200	0.000	6.400	2.667	6.700	6.667	8.200	26.667	6.200	0.000	6.400	2.667	6.900	9.333	7.100	12.000
10.000			6.300	1.333	6.600	5.333	8.100	25.333	6.200	0.000	6.300	1.333	6.900	9.333	7.100	12.000
11.000			6.200	0.000	6.400	2.667	8.000	24.000	6.200	0.000	6.300	1.333	6.900	9.333	7.100	12.000
12.000			6.200	0.000	6.300	1.333	7.900	22.667	6.200	0.000			6.900	9.333		
13.000			6.200	0.000	6.200	0.000	7.700	20.000	6.300	1.333			7.000	10.667		
14.000			6.200	0.000	6.200	0.000	7.600	18.667								
15.000			6.200	0.000	6.200	0.000	7.500	17.333								
16.000			6.200	0.000	6.300	1.333	7.200	13.333								
17.000			6.400	2.667	6.300	1.333	6.900	9.333								
18.000			6.700	6.667			6.600	5.333								
19.000							6.400	2.667								
20.000							6.200	0.000								
							6.100	-1.333								

temperature = ((measured*100)-620)/(13.7-6.2)

Effluent Dilution Measured by Conductivity



Effluent Dilution Measured by Temperature



Appendix E

Stream Flow Data, Twin Lakes Creek
July 11, 2003

Downstream of Confluence							
Station	Depth	Area	V1	Flow1	V2	Flow2	Average Flow
1	0.08	0.06	0.22	0.0132	0.22	0.0132	0.0132
2	0.11	0.11	0.25	0.0275	0.24	0.0264	0.02695
3	0.15	0.15	0.47	0.0705	0.47	0.0705	0.0705
4	0.18	0.18	0.55	0.099	0.53	0.0954	0.0972
5	0.19	0.19	0.42	0.0798	0.41	0.0779	0.07885
6	0.25	0.25	0.38	0.095	0.39	0.0975	0.09625
7	0.25	0.25	0.23	0.0575	0.21	0.0525	0.055
8	0.26	0.26	0.2	0.052	0.22	0.0572	0.0546
9	0.22	0.22	0.29	0.0638	0.3	0.066	0.0649
10	0.24	0.24	0.59	0.1416	0.59	0.1416	0.1416
11	0.225	0.225	0.33	0.07425	0.34	0.0765	0.075375
12	0.21	0.21	0.33	0.0693	0.37	0.0777	0.0735
13	0.18	0.18	0.51	0.0918	0.52	0.0936	0.0927
14	0.14	0.14	0.26	0.0364	0.3	0.042	0.0392
15	0.13	0.13	0.24	0.0312	0.25	0.0325	0.03185
16	0.11	0.11	0.25	0.0275	0.24	0.0264	0.02695
17	0.09	0.0675	0.17	0.011475	0.14	0.00945	0.0104625
				1.041825		1.05635	**1.0490875**

Upstream of Confluence							
Station	Depth	Area	V1	Flow1	V2	Flow2	Average Flow
1	0.14	0.105	0.35	0.03675	0.34	0.0357	0.036225
2	0.34	0.34	0.37	0.1258	0.37	0.1258	0.1258
3	0.35	0.35	0.62	0.217	0.61	0.2135	0.21525
4	0.38	0.38	0.63	0.2394	0.63	0.2394	0.2394
5	0.34	0.34	0.48	0.1632	0.44	0.1496	0.1564
6	0.22	0.22	0.37	0.0814	0.36	0.0792	0.0803
7	0.2	0.2	0.47	0.094	0.46	0.092	0.093
8	0.18	0.18	0.24	0.0432	0.23	0.0414	0.0423
9	0.175	0.13125	0.21	0.0275625	0.21	0.0275625	0.0275625
				1.0283125		1.0041625	**1.0162375**

Shallow Weir 2.0 m wide							
Station	Depth	Area	V1	Flow1	**V2**	Flow2	Average Flow
0.58	0.06	0.0498	1.25	0.06225	1.27	0.063246	0.062748
1.08	0.05	0.024	1.1	0.0264	1.06	0.02544	0.02592
1.54	0.04	0.0396	1.28	0.050688	1.27	0.050292	0.05049
				0.139338		0.138978	**0.139158**

Appendix F

Benthic Invertebrates Collected in Twin Lakes Creek
July 11, 2003

Taxa	Samples															
	TLC1	TLC2	TLC3	TLC4	TLC5		WTL1	WTL2	WTL3	WTL4	WTL5	ETL1	ETL2	ETL3	ETL4	ETL5	
Chironomidae	3	12	5	7	7							9	9	14	3	23	
Tipulidae				2													
Other Diptera															1		
Cladocera	1			1													

Notes: TLC-2 was re-sorted for QA purposes and 1 additional chironomid was recovered (included in total above)
ETL-4 was re-sorted for QA purposes, but no additional benthos were recovered
Chironomids appear to be mainly Orthocladiinae
Cladocera were mainly large Daphnia, presumably drifting down from East Twin Lake (not true benthos).
No benthic invertebrates at all were found at WTL site. Possibly this area freezes completely in winter (no direct stream flow)?