

ASSESSMENT OF BENTHIC INVERTEBRATE
AND JUVENILE FISH POPULATIONS
IN FOXY AND BUCK CREEKS,
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by

DAVID BUSTARD and ASSOCIATES

for

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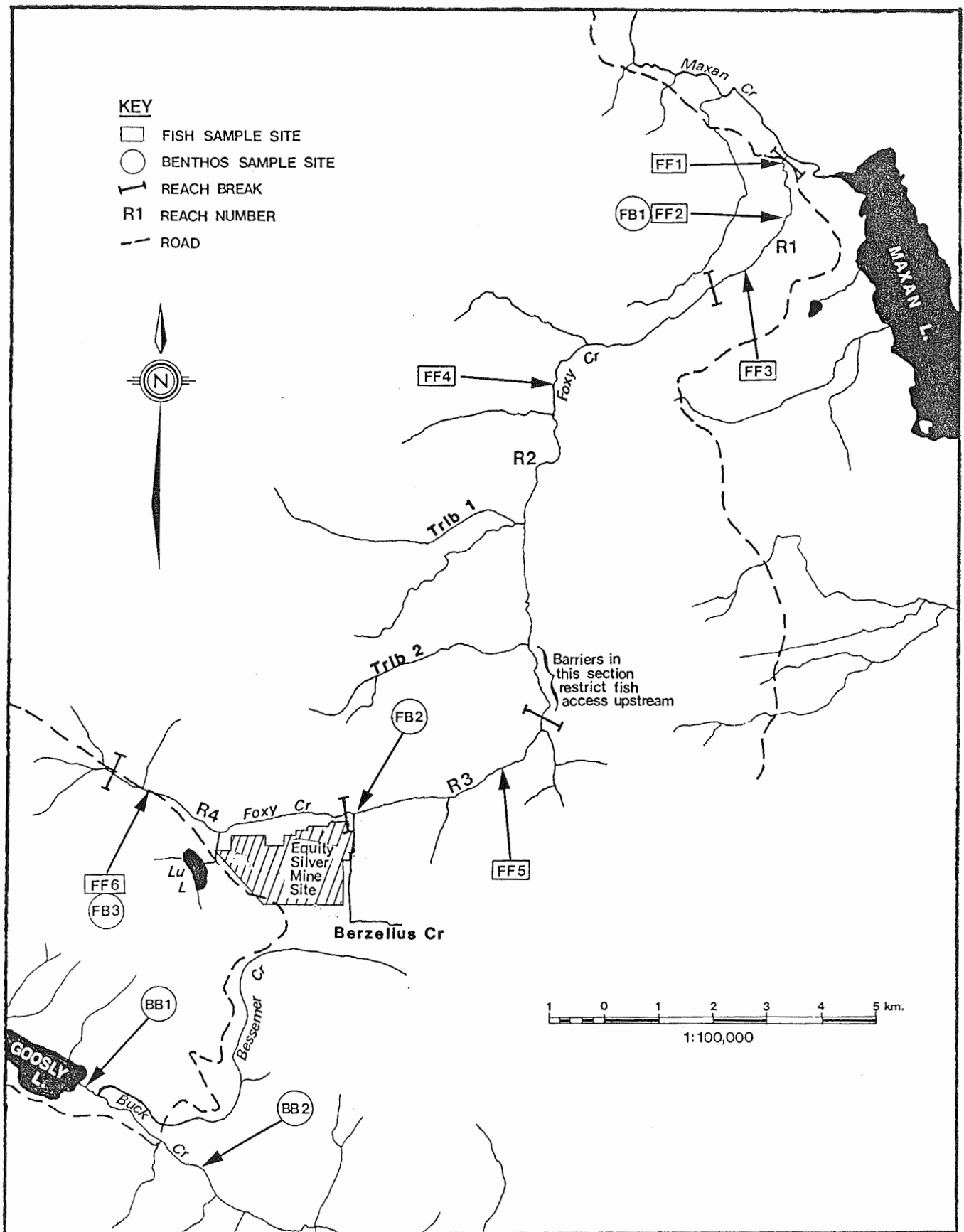
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1.0 INTRODUCTION

Field studies assessing fish and benthic invertebrate populations in Foxy Creek, a small stream located in north central British Columbia near Houston (Figure 1.1) were undertaken in late August and September 1984. As well, benthic invertebrate populations were evaluated in Buck Creek, an adjacent stream. These studies were conducted for Equity Silver Mines Ltd. to evaluate the implications of the mine's operations on the adjacent Foxy and Buck creek watersheds (Figure 1.2).

Fish sampling efforts focussed on Foxy Creek since little previous information was available describing the fish resources in this system. Background information consisted of a brief fisheries reconnaissance of Foxy Creek conducted prior to the mine development (Data on file, Ministry of Environment, Smithers) and several collections of rainbow trout for heavy metal analyses undertaken since 1982 (Figure 1.3). Coho salmon (Oncorhynchus kisutch), sockeye salmon (Oncorhynchus nerka) and rainbow trout (Salmo gairdneri) are known to utilize Maxan Creek in the vicinity of its confluence with Foxy Creek (Hancock et al. 1983, Tredger 1982). However, no quantitative studies describing the fish resources and their distribution within Foxy Creek have been undertaken to date.

Benthic invertebrate populations in Foxy and Buck creeks above and below potential impact zones from the mine's



DAVID BUSTARD
& ASSOCIATES

Location of fish and benthic
invertebrate sample sites

FIGURE
1.1



Figure 1.2. Upper Foxy Creek showing Equity Silver Mine's tailings pond in the background.



Figure 1.3. Rainbow trout populations occur downstream of Equity Silver Mine's operation in Foxy Creek.

operation were also evaluated. Previous benthic invertebrate information has been collected in Foxy and Buck creeks by the Environmental Protection Service (EPS) during July and October 1973 (Hallam and Kussat 1974) and in July 1982 (M. Ross, unpublished data).

2.0 METHODS

Field studies were conducted by a crew of two and three depending on the site during late August and September, 1984. Sites in the mid-sections of Foxy Creek were not sampled until late September due to high flow conditions earlier in the month. Access to sites FF3 to FF5 (Figure 1.1) in Foxy Creek was by helicopter. All other sites were accessible by vehicle, although a boat was also required to gain access to site BB1 in Buck Creek upstream of Goosly Lake.

2.1 JUVENILE FISH SAMPLES

Two detailed juvenile fish sample sites were established to serve as baseline study areas to monitor fish populations in lower Foxy Creek. As well, four smaller sample sites were established in the mid and upper sections of Foxy Creek in the vicinity of potential barriers to establish the upper extent of utilization by fish in the system.

The detailed index sites, 50 and 55 m in length, were blocked with stopnets at their upstream and downstream ends, and sampled using an electroshocker (Figure 2.1). The modified Peterson mark-and-recapture method (Ricker 1975) was used to



Figure 2.1. Sites were blocked with stopnets and electrofished to sample fish populations. This site (FF5) did not have any fish present.



Figure 2.2. Benthic invertebrates were collected using a Waters-Knapp sampler. This site (BB2) was located in Buck Creek upstream of Bessemer Creek.

estimate populations for the sample sites. A caudal fin clip was used to mark fish and the recapture was conducted several hours after the marked fish were released.

The other four fish sample sites ranged in length from 16 to 36 m. These sites were selected based on a helicopter reconnaissance of potential barriers. Sites were located upstream of potential barriers to determine whether fish were present. The sites were blocked with stopnets at their upper and lower ends and fish were captured using an electroshocker. The two-step removal method (Seber and LeCren 1967) was used to estimate fish populations. This method was used at these sites due to the small number of fish being handled and time limitations imposed by helicopter access to the sites. Formulas used in calculating the population estimates and standard errors are presented in Appendix 1.

Sample site areas were calculated from measurements of length and a series of width measurements made at 5-m intervals along the sample site. As well, water depths (maximum and mean), substrate and cover characteristics were recorded at each cross section. Substrate characteristics were recorded as D50 and D90 estimates (i.e., the diameter of bed material which is larger than 50% and 90% respectively of the remaining bed material as defined in Chamberlin (1980)). Fish captured were anaesthetized with 2-phenoxyethanol, measured to the nearest millimeter and returned to the stream at the end of the sampling.

Ten 20-gram samples of rainbow trout were retained at site FF2 for tissue analysis of heavy metals. Scales for aging were removed from these ten samples. As well, weights from 20 rainbow trout parr were obtained for biomass estimates. Weights used in biomass estimates for rainbow trout fry were obtained from an adjacent Bulkley River tributary, since the balance used in the field was not sensitive enough to accurately measure such small fish.

In addition, ten 20-gram samples of rainbow trout for tissue heavy metal analysis were obtained in Buck Creek by electroshocking above the Bessemer Creek confluence. Only six samples were obtained in the short section of Buck Creek downstream of Bessemer Creek and upstream of Goosly Lake despite considerable effort. The close proximity of Goosly Lake probably affects fish use of this section of Buck Creek. Scales for aging were removed from 12 of the larger trout and lengths and weights were obtained from the 35 rainbow trout used in the samples. Each sample was placed in a separate plastic bag, frozen, and shipped air freight to ASL Laboratories for metal analyses. The length, weight and age characteristics of these fish are presented in Appendix 2. The results of the heavy metal analyses were returned directly to Equity Silver Mines Ltd. and are not presented in this report.

2.2 BENTHIC INVERTEBRATE SAMPLES

Benthic invertebrates were sampled at five sites in Foxy and Buck creeks (Figure 1.1). Six replicate samples were col-

lected at each site. Iron stakes were used as benchmarks on the stream's right bank and samples were taken at intervals across the wetted width of the channel. Sample sites were generally located in riffle sections, although Buck Creek had few suitable sites. An effort was made to sample from sites of similar physical characteristics (substrate, water velocity and depth) within each stream system.

Samples were collected using a Waters-Knapp sampler (Waters and Knapp 1961) with a 250 um mesh size (Figure 2.2). The substrate was agitated to approximately 10 cm depth and larger stones were brushed to loosen adhering organisms. All samples were preserved in formalin solution and subsequently identified to family, and in most cases genus level for the dominant and sub-dominant orders. Information describing site depth, substrate characteristics, water velocity, temperature and dissolved oxygen was collected at the benthic sites. Water samples were returned to Equity Silver Mine's lab for pH and conductivity measurements.

3.0 RESULTS

3.1 JUVENILE FISH

Fish are present in Foxy Creek from its confluence with Maxan Creek upstream to the top end of Reach 2 (Figure 1.1 and Figures 3.1 and 3.2). A series of chutes and small falls located in the canyon section 10 to 12 km upstream of Maxan Creek (5 to 7 km downstream from the Equity Silver Mine site) limit fish access into the upper sections of Foxy Creek.

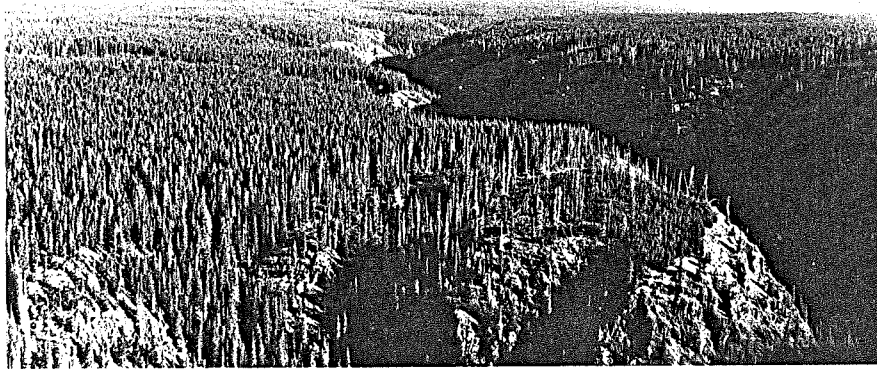


Figure 3.1. Foxy Creek flows through a steep canyon area before it enters Maxan Creek approximately 17 km downstream of Equity Silver Mine's operation.



Figure 3.2. Rainbow trout populations are found within the canyon up to a point approximately 10 km upstream of Maxan Creek.

Sampling at two sites upstream of these barriers indicated that the top 2 reaches of Foxy Creek are barren. Fish are present above two beaver dams in Reach 1 and a narrow constriction at a log jam site 5 km upstream in Foxy Creek canyon, indicating that these areas are not obstructions. Additional information describing the reach characteristics of Foxy Creek is presented in Appendix 3.

A total of 1225 m² or 166 m of stream length of Foxy Creek was sampled. The four sample sites conducted in the fish-producing section of Foxy Creek represent between 1.0 - 1.5% of the total stream length in this section.

Rainbow trout juveniles were the main fish species present and comprised 99.4% of the total 1502 fish estimated within the sample sites. Juvenile chinook salmon (Oncorhynchus tshawytscha), Dolly Varden char (Salvelinus malma) and longnose dace (Rhinichthys cataractae) comprised the remainder of the catch. As well, 3 Pacific lamprey ammocoetes (Lampetra tridentata) were captured at the lower two sample sites. A summary of the fish density and biomass estimates for each site is presented in Table 3.1, while the more detailed fish sampling results are provided in Appendix 4.

Overall fish densities and biomass were highest at site FF2 (Table 3.1) located approximately 1 km upstream of the Maxan Creek confluence. Both detailed sample sites in Reach 1 of Foxy Creek had very high numbers of rainbow trout fry and parr (Figures 3.3 and 3.4) The parr were comprised largely

Table 3.1: Summary of fish densities and biomass estimates at six sample sites in Foxy Creek during September 1984.

DENSITY ESTIMATES (fish/m²)

Reach	Site	Rainbow Trout		Chinook Salmon	Dolly Varden Char	Longnose Dace	Total
		0+	≥1+				
1	FF1	.88	.63	.21	0	.01	1.73
1	FF2	1.66	.86	.20	.01	.01	2.73
1	FF3	.41	.02	0	.02	0	.45
2	FF4	.02	.02	.08	0	0	.12
3	FF5	No fish captured.					
4	FF6	No fish captured.					
Mean (FF1-4)		.74	.38	.12	<.01	<.01	1.26

BIOMASS ESTIMATES (g/m²)

Reach	Site	Rainbow Trout		Chinook Salmon	Dolly Varden Char	Longnose Dace	Total
		0+	≥1+				
1	FF1	.54	3.82	4.37	0	.03	8.76
1	FF2	1.08	5.30	4.01	.08	.03	10.50
1	FF3	.37	.12	0	.04	0	.53
2	FF4	.01	.20	2.27	0	0	2.48
3	FF5	No fish captured.					
4	FF6	No fish captured.					
Mean (FF1-4)		.50	2.36	2.66	.02	.02	5.57



Figure 3.3. Site FF1 in lower Foxy Creek possessed high populations of rainbow trout.

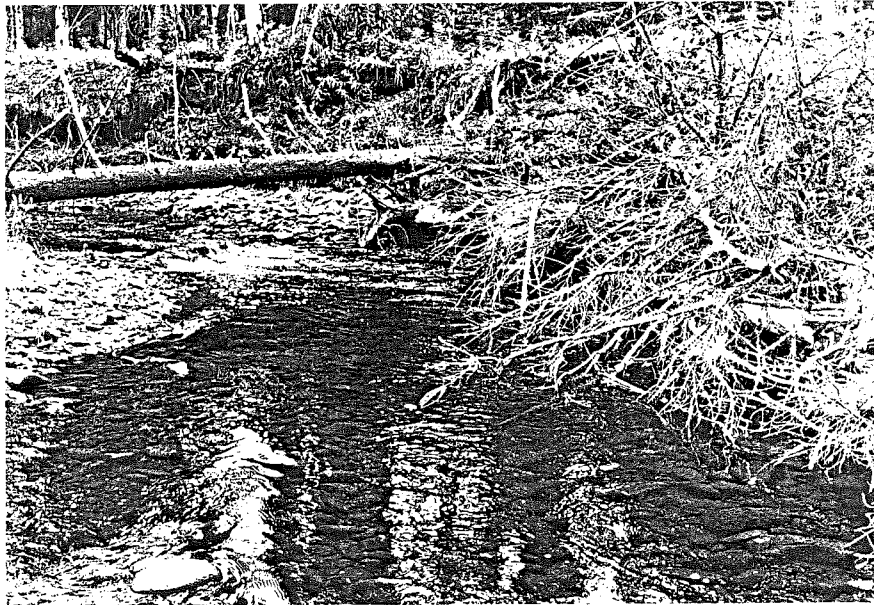


Figure 3.4. Site FF2 located 1 km upstream in Foxy Creek had the highest densities of rainbow trout sampled.

of age 1+ (78%) and 2+ (19%) fish with approximately 3% of the sample age 3+. Rainbow trout fry and parr numbers dropped off significantly at the upper sample sites, particularly in Reach 2 which is located in an extensive canyon area. Rainbow trout parr numbers were low at FF3, a site dominated by shallow riffle habitat typically preferred by fry. Site FF4 was a deep and faster site more suited to parr.

Population estimates have been derived by applying the catch per linear meter of stream to the total stream length represented by each sample (Table 3.2). The results suggest an estimated 40,000 rainbow trout fry in Foxy Creek, with 98% of this estimate occurring in the lowest 3 km of the creek. As well, an estimated population of 18,700 parr is present in Foxy Creek, with approximately 78% of this estimate occurring in the lowest reach. Population estimates for Reach 2 in particular, are weak due to the small sample area.

Chinook salmon and Dolly Varden char estimates are 175 and 350 fish respectively, and fewer than 100 longnose dace are estimated to occur in Foxy Creek based on the September samples.

3.2 BENTHIC INVERTEBRATES

The results summarizing the number of benthic invertebrates sampled at the five sites are presented in Table 3.3. Additional detailed information for each sample site is presented in Appendix 5.

Table 3.2: Population estimates for Foxy Creek fish, September 1984.

Site	Number of fish per linear meter			Length of stream represented (m)*	Population estimates by section		
	0+	1+	≥2+		0+	1+	≥2+
				<u>Rainbow Trout</u>			
FF1	5.38	3.86	1.28	1000	5380	3860	1280
FF2	9.80	5.05	1.16	2500	24500	12625	2900
FF3	3.85	0.23	0	2500	9625	575	0
FF4	0.12	0.12	0.48	7000	840	840	3360
Total					40345	17900	7540
				<u>Chinook Salmon</u>			
FF2	.07			2500	175		
				<u>Dolly Varden Char</u>			
FF3	.14			2500	350		
				<u>Longnose Dace</u>			
FF1		.02		1000		20	
FF2		.02		2500		50	
Total						70	

* Reach 1 channel lengths have been doubled to account for the numerous channel splits which occur in this reach.

Table 3.3: Summary of benthic invertebrates/m² and number of taxa per sample collected at five sample sites in Foxy and Buck creeks during late August and September, 1984.

Replicate*	FOXY CREEK			BUCK CREEK		
	Foxy Ck. above Maxan Ck.	Foxy Ck. below Berzelius Ck.	Foxy Ck. above Lu Diversion	Buck Ck. below Bessemer Ck.	Buck Ck. above Bessemer Ck.	
1	1740	729	854	1667	1375	
2	5365	2406	1167	1448	1750	
3	8573	1208	833	625	1406	
4	6917	1219	677	1375	865	
5	15198	1156	677	2135	906	
6	9688	906	823	1656	656	
Mean	7914	1271	838	1484	1160	
SD**	4128	538	164	454	379	
<hr/>						
1	21	15	12	16	16	
2	19	22	19	13	16	
3	21	16	14	12	21	
4	18	16	13	9	16	
5	19	15	18	7	15	
6	12	20	14	10	12	
Mean	18.3	17.3	15.0	11.2	16.0	
SD	3.0	2.7	2.6	2.9	2.6	

* The numbers collected for each sample (Appendix 5) have been corrected by a factor (10.417) which allows them to be expressed on a m² basis.

** SD refers to standard deviation of the mean.

TOTAL TAXA

TOTAL NUMBER

The number of benthic invertebrates per m² ranged from just over 600 at several Buck Creek samples and in upper Foxy Creek to over 15,000 in a sample in lower Foxy Creek (Table 3.3). The greatest abundance of benthic invertebrates consistently occurred at the lower Foxy Creek site. Numbers at this site were more than five times the benthic invertebrate numbers obtained at any of the other sites.

The total number of taxa represented in the samples provides an indication of the richness of the benthic community. Taxa numbers per sample ranged from a low of 7 at the Buck Creek site downstream of Bessemer Creek to a high of 22 at the Foxy Creek site downstream of Berzelius Creek (Table 3.3). The means for the sites ranged from 11 to 18 at all sites.

Table 3.4 summarizes the composition of the benthic invertebrate communities at the five sites. It should be emphasized that the Foxy Creek sample sites are physically very different from those in Buck Creek. Foxy Creek sites were characterized by large substrate and fast water velocities, while Buck Creek samples were in sites with slower water velocities and silt and sandy substrate.

The main difference between sites above the Lu Diversion (Figure 3.5) and below Berzelius Creek (Figure 3.6) in upper Foxy Creek was the increase in Diptera and the reduction of Ephemeroptera below Berzelius Creek. The lowest site in Foxy Creek (FB1) was characterized by an exceptionally large number of Diptera (particularly Hydrobaeninae larva)

Table 3.4: Summary of composition of benthic invertebrate communities at five sample sites in Foxy and Buck creeks during late August and early September, 1984.

Site	N ¹	% COMPOSITION (NUMBER)							
		Ephemeroptera	Plecoptera	Trichoptera	Coleoptera	Diptera	Oligochaeta	Pelecypoda	Other
Foxy above Maxan (FB1)	4558	3.2 (144)	4.9 (223)	1.1 (48)	<0.1 (3)	90.5(4124)	<0.1 (3)	0.2 (8)	0.1 (5)
Foxy below Berzelius (FB2)	732	9.0 (66)	25.8 (189)	4.2 (31)	5.8(42)	54.8 (401)	0.1 (1)	0 (0)	0.3 (2)
Foxy above Lu Diversion (FB3)	483	36.6 (177)	40.0 (193)	6.8 (33)	4.3(21)	10.6 (51)	0 (0)	0 (0)	1.7 (8)
Buck below Bessemer(BB1)	855	5.4 (46)	52.0 (445)	0.7 (6)	0.1(1)	37.0 (316)	4.6 (39)	0.1 (1)	0.1 (1)
Buck above Bessemer(BB2)	666	5.7 (38)	25.3 (169)	0.8 (5)	2.6(17)	21.9 (146)	21.1 (141)	22.1(147)	0.5 (3)

¹ Total number of benthic invertebrates in the six replicate samples.



Figure 3.5. Site FB3 was located in Foxy Creek upstream of the Lu Diversion and served as a control site for stream benthos populations.



Figure 3.6. Site FB2 was located in Foxy Creek downstream of Berzelius Creek and within the area receiving treated water from the mine's operation.

averaging over 6000 organisms per m². Otherwise, the community composition of the lower Foxy Creek site was generally similar to upper sites. Many of the Plecoptera in the Foxy Creek samples were small, and had probably hatched during the month previous to sampling.

Benthic samples taken from Buck Creek above Bessemer Creek were comprised largely of Plecoptera, Diptera, Oligochaetes and Pelecypoda (Table 3.4). The site below Bessemer Creek was dominated by Plecoptera and Diptera. Although the two sites were physically similar, the upper site had a higher sand content which may account for the large numbers of Pelecypoda (mainly small, newly-hatched mussels.)

4.0 DISCUSSION

4.1 JUVENILE FISH

Results of September 1984 sampling indicate lower Foxy Creek provides important rearing habitat for rainbow trout fry and parr. A single resident adult (32 cm fork length) captured in Foxy Creek in July 1982 and the presence of small fry (25 - 28 mm fork length) suggest that these juveniles are resident rainbow and not steelhead trout. The presence of coho and sockeye salmon in Maxan Creek immediately downstream of Foxy Creek (Hancock et al. 1983) and of chinook salmon in Foxy Creek (Table 3.1) indicate that it is possible for steelhead trout to reach Foxy Creek. The inability to distinguish between resident rainbow and steelhead trout can only be clarified by direct observations during the trout

spawning period.

It is probable that the rainbow trout population in lower Foxy Creek is linked to the Maxan Lake rainbow trout population. The outlet of Maxan Lake is less than 1 km from the confluence of Maxan and Foxy creeks (Figure 1.1), and adult rainbow trout from Maxan Lake may move into Foxy Creek to spawn. The presence of newly-emerged rainbow trout fry suggests that spawning occurs in lower Foxy Creek. Reach 1 has an abundance of suitable spawning gravels. After emergence, juvenile rainbow trout remain in Foxy Creek for up to 4 years and then probably move into Maxan Lake.

Rainbow trout densities in lower Foxy Creek were remarkably high compared to estimates made for rainbow trout populations in other Bulkley and Morice River tributaries (Table 4.1). The very high fry densities of 1.3 fry/m^2 are double those reported for all sites except upper Lamprey Creek. The presence of large numbers of yearlings and older parr indicates that the high fry numbers have carried through to the older age classes.

Estimates of parr/m^2 are approximately double those reported in other adjacent streams. Many of these other systems are lake-headed and are considered productive, although it should be noted that the estimates for these systems are for different years. The streamflows in Foxy Creek were not unusually low at the time of sampling. Low flow conditions may sometimes lead to short-term crowding and high fish

Table 4.1: Juvenile rainbow trout densities in lower Foxy Creek compared to other rainbow trout tributaries of the Bulkley and Morice rivers

<u>System</u>	<u>Site</u>	<u>Fry/m²</u>	<u>Parr/m²</u>
Buck ¹	5 and 6	0.14	0.26
McQuarrie ¹	2	0.63	0.51
Byman ¹	1	0.18	0.27
Lamprey ²	13 and 14	1.37	0.38
Owen ²	8 and 9	0.55	0.03
Des ³	(\bar{x} of 7 sites)	0.49	0.12
Maxan ¹	1	0.31	0.19
Crow ¹	1	0.08	0.47
Foxy	1 and 2	1.27	0.95

- 1 Tredger (1982)
- 2 Tredger (1981)
- 3 Envirocon (1983)

densities.

The presence of juvenile chinook salmon in lower Foxy Creek had not been reported to date. It is probable that these fish moved up into Foxy Creek after emergence in Maxan Creek. Chinook salmon generally favour spawning in lake-headed areas such as Maxan Creek, since the lakes tend to provide a more stable egg incubation environment. Chinook salmon spawning has been reported in Maxan Creek during some years (Data on file, Dept. of Fisheries and Oceans, Smithers).

4.2 BENTHIC INVERTEBRATES

The benthic invertebrate samples collected in Foxy Creek suggest that the total number of invertebrates was higher in the site located downstream of the treated water inflows from Equity Silver Mines (FB2) than upstream (FB3). However, this increased number was largely a reflection of more Diptera, generally considered more tolerant of a wider range of water quality conditions (Roback 1974) than Ephemeroptera which were less abundant in the lower site. Further sampling at several sites would help to distinguish whether these differences result from the mine's operation or just natural variability between sites.

A comparison of invertebrate numbers in the 1984 Foxy Creek samples to samples collected in 1982 (M. Ross, EPS) and in 1973 (Hallam and Kussat 1974) suggests that invertebrate numbers at the upper site (FB3) are generally within the range of those collected previously (Table 4.2). However,

Table 4.2: Summary of 1984 benthic invertebrate sample numbers/m² in Foxy and Buck creeks compared to previous studies on these systems and to two other tributary streams of the Bulkley River.

	<u>Sept.</u> <u>1984</u>	<u>July</u> ¹ <u>1982</u>	<u>July</u> ² <u>1973</u>	<u>Oct.</u> ² <u>1973</u>
<u>Foxy Creek</u>				
Above Lu Diversion(FB3)	838	1111	1138	1247
Below Berzelius (FB2)	1271	358	-	-
Above Maxan (FB1)	7914	-	-	-
<u>Buck Creek</u>				
Above Bessemer (BB2)	1160	1802	674	1090
Below Bessemer (BB1)	1484	-	-	-
	<u>Sept.</u> <u>1983</u>			
Goathorn Creek	1576			
Tenas Creek	2584			

- 1 Preliminary data derived from M. Ross, Environmental Protection Service. Calculations made based on mean number of organisms/sample times 10.417 to convert to m² basis.
- 2 Derived from Hallam and Kussat (1974). Mean number of organisms/sample times 10.417 to convert to m² basis.
- 3 Bustard (1984).

numbers at FB2 were nearly four times as high as the 1982 samples collected prior to the release of treated mine water.

Several factors could lead to considerable variation in numbers and species composition when comparing to the earlier data. Although the sampler design was similar, the earlier samples were collected using a 350 um mesh size compared to a 250 um mesh size in 1984. This would lead to lower numbers in the earlier samples. As well, the time and location of collection was not the same between years. Considerable variability occurs naturally in benthos studies, but this is increased substantially when a systematic sampling program is not used.

Benthic invertebrate numbers were slightly higher below Bessemer Creek (BB1) than above (BB2) although the benthic community composition was generally quite different and there were fewer taxa present at the downstream site. The total numbers of organisms fall within the range of those reported by earlier studies (Table 4.2). Comparisons to the site located downstream of Bessemer Creek cannot be made due to confusion in earlier studies as to where Bessemer Creek entered Buck Creek. In the earlier studies, samples were not taken downstream of Bessemer Creek.

The upper Foxy and Buck creek total numbers of invertebrates fall within the lower range of numbers reported for several tributaries of the Telkwa River (Table 4.2), the only other system with a comparable data base. However, the lower Foxy

Creek site has higher numbers than reported in these other systems, largely the result of very high numbers of Diptera.

5.0 CONCLUSION

In conclusion, although there is considerable variability between sites, these preliminary studies suggest that Equity Silver Mine's operations have not had a serious impact on upper Foxy or Buck creek benthic invertebrate numbers and diversity to date. Viable invertebrate populations exist below Bessemer Creek on Buck Creek and in Foxy Creek downstream of Berzelius Creek. The studies also indicate that lower Foxy Creek has a significant rainbow trout population that warrants protection.

LaPoint et al. (1984), in a review of studies examining the effects of high metal concentrations on benthic invertebrates, conclude that in most systems, the stream's physical characteristics (particularly water velocity and substrate characteristics) and nutrient concentrations overwhelm the effects of metals on resident fauna. If future studies are to be undertaken to establish background levels in Foxy and Buck creeks, a systematic program to monitor benthic and fish populations is recommended. This should enable potential shifts in numbers and diversity of invertebrate and fish populations which may occur over time in these watersheds to be detected, and differentiated from those occurring naturally within the system.

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Appendix 1: Formulas used in deriving fish population estimates and standard errors.

1) Modified Petersen Mark-and-Recapture Population Estimates (Ricker 1975).

$$\hat{N} = \frac{(m + 1)(c + 1)}{r + 1} - 1$$

\hat{N} = Population estimate

m = Total number of marked fish released after the 1st pass

c = Total number of marked and unmarked fish in the recapture

r = Marks recaptured

$$S.E.(\hat{N}) = \hat{N} \sqrt{\frac{(\hat{N} - m)(\hat{N} - c)}{m c (N - 1)}}$$

2) Two-Step Removal Method (Seber and LeCren 1967).

$$\hat{N} = \frac{(U_1)^2}{U_1 - U_2}$$

\hat{N} = Population estimate

U = Number of fish collected in first removal

U = Number of fish collected in second removal

T = Total number of fish collected ($U_1 + U_2$)

$$S.E.(\hat{N}) = \sqrt{\frac{(U_1) \times (U_2)^2 \times T}{(U_1 - U_2)^4}}$$

Appendix 2: Length, weight and age data describing rainbow trout collected for tissue heavy metal analyses.

<u>Location</u>	<u>Date</u>	<u>Sample Number</u>	<u>Fork Length (mm)</u>	<u>Weight (grams)</u>	<u>Age</u>
Foxy(FF2)	Sept. 1/84	1	128	21.4	2+
	"	2	126	24.7	2+
	"	3	130	24.4	2+
	"	4	116	22.4	2+
	"	5	157	58.2	3+
	"	6	120	22.6	2+
	"	7	116	16.4	2+
	"	8	114	18.7	2+
	"	9	153	44.4	3+
	"	10	128	21.7	2+
Buck(BB1)*	Sept. 6/84	1	212	134.6	3+
	"	2	180	71.1	3+
	"	3a	105	13.3	2+
	"	3b	81	7.9	1+
	"	4	114	17.3	2+
	"	5a	90	9.2	1+
	"	5b	82	7.6	1+
	"	5c	75	6.6	1+
	"	6a	107	12.5	2+
	"	6b	78	5.6	1+
Buck(BB2)	Sept. 7/84	1	120	19.9	2+
	"	2	170	63.9	3+
	"	3a	106	14.3	2+
	"	3b	79	6.5	**
	"	4a	89	9.5	**
	"	4b	85	7.0	**
	"	4c	75	5.9	**
	"	5a	75	6.3	**
	"	5b	83	7.9	**
	"	5c	77	6.1	**
	"	6a	98	12.4	**
	"	6b	83	8.0	**
	"	7a	83	8.4	**
	"	7b	77	5.8	**
	"	7c	82	7.7	**
	"	8a	80	6.9	**
	"	8b	77	6.3	**
	"	8c	73	6.3	**
	"	9a	83	7.4	**
	"	9b	79	6.5	**
	"	9c	80	6.3	**
	"	10a	79	7.0	**
	"	10b	78	6.2	**
	"	10c	70	4.5	**
	"	10d	73	5.2	**

* Lower Buck Creek (150 - 250m above Goosly Lake) was electrofished for 3 hours. An inadequate number of rainbow trout were captured to develop a full sample of 10 fish. 5 prickly sculpins and 3 longnose suckers were also captured. Rainbow trout fry were observed at BB2 but not at BB1.

**These fish are assumed to be age 1+ based on fork length measurements.

Appendix 3: Foxy Creek reach descriptions.

	<u>Length (km)</u>	<u>Slope (%)</u>	<u>Substrate</u>	<u>Comments</u>
Reach 1	3	1.0	gravel & small cobble	The lower reach of Foxy Creek is a large gravel outwash, not confined by valley walls as in upstream reaches. This section is subject to channel shifting and most sections are multi-channelled. Organic debris is present throughout this reach including several beaver dams at the upper section of this reach which do not block fish access.
Reach 2	10	3.0	cobble & bedrock some boulders	This reach is bounded by impressive canyons 100-200 m high which confine the stream to a single channel. There is less organic debris in this reach. Several large log jams at km 4 and km 5 do not restrict fish access. A series of chutes and falls upstream of tributary 2 restrict fish access in this upper section of the canyon. The pool/glide habitat is more suitable to parr, and spawning and fry rearing areas appear limited. Tributaries in this section have barriers at their lower ends likely restricting fish use.
Reach 3	4	2.5	cobble & gravel	This reach is less confined than Reach 2 and has some side channels and a greater mix of pool/riffle habitat. Organic debris plays a greater role as stream cover and creating diverse habitat. Good potential fish habitat, but fish are not present due to downstream barriers.
Reach 4	5	2.0	gravel & cobble	This lower gradient reach is the headwater area of Foxy Creek. Most of this reach drains meadow and wetlands, and the creek does not have very much debris control, since most of the stream margin is bounded by shrubs. Stream banks are relatively stable, although natural drainages have been modified due to mine site alteration of Lu and Berzelius creeks. Fish are not present in this section.

Appendix 4: Site descriptions and detailed results of
fish sampling in Foxy Creek, September 1984.

Table A.4.1: Key to abbreviations used in Appendix 4.

BM	benchmark
D50	diameter of bed material larger than 50 percent of the remaining bed material
D90	diameter of bed material larger than 90 percent of the remaining bed material
\bar{x}	average
f1	fork length
$\bar{f1}$	average fork length
U1	number of fish collected in first removal
U2	number of fish collected in second removal
T	total number of fish collected (U1 + U2)
M	number of fish marked after first pass
C	number of marked and unmarked fish recaptured
R	number of recaptured marked fish
N	number; total population of fish in site (estimated from sample - see Appendix 1)
S.E.	standard error of population estimate
Morts	number of mortalities in sampling
N Corr.	population estimate corrected for mortalities
Rbt	rainbow trout
DV	Dolly Varden char
Ch	chinook salmon
Lnd	longnose dace
0+	fish in their first growing season prior to their first winter
1+	fish in their second growing season after one winter
1-3 (R2)	Photo reference number from D. Bustard files

SITE DESCRIPTION - FFI

Location: Site starts approx. 10 m upstream of Maxan bridge in the channel closest to Maxan Lake. Area: 305 m²
 Crew: DB, MO Date: Aug. 31/84 Length of stream margin: 50 m Photos: 5-8 (R1) Water Temperature: 9°C @ 13:30 hr
 Comment: This site has excellent debris cover and is one of two channels comprising Foxy Ck.

FISH SAMPLE SITE:

Location (m)	Width (m)	Mean Depth (cm)	Max. Depth (cm)	Bank Cover	Debris Cover	D50/D90 (cm)
0	5.9	22	30	-	X	5/9
5	4.5	33	45	-	X	<1/4
10	6.6	50	75	-	X	5/12
15	7.9	15	20	-	X	8/15
20	7.6	15	20	-	X	5/12
25	5.7	50	95	-	X	<1/5
30	5.0	20	28	-	X	6/13
35	5.5	40	44	-	X	6/20
40	5.2	20	30	-	X	5/12
45	9.1	25	50	-	X	2/4
50	3.9	15	38	-	X	7/18

FISH SAMPLE:

Species	Age	fl-range (mm)	fl (mm)	Mean Weight (g)	M	C	R	N	S.E.	Morts	N Corr.	N/m ²	N/Linear m	Biomass g/m ²	
Rbt	0+	25-41	33.9	0.61	43	64	10	259	63.1	10	269	.882	5.38	0.54	
Rbt	1+	63-96	77.2	6.04	76	54	21	191	36.8	2	193	.630	3.86	3.82	
Rbt	2+	102-194	120.5	20.84	27	27	11	64	11.0	0	64	.210	1.28	4.37	
Lnd	2+	93	93.0	8.00*	1	0	0	1	Nf	0	1	.003	0.02	0.03	
Lamprey ammocoetes - 2															
Total												527	1.725	10.54	8.76

Note: For abbreviations and symbols used in this table see first page of appendix.

* Estimated weight

SITE DESCRIPTION - FF2

Location: At water sampling station approx. 20 m upstream of benthos benchmark. Left channel. Area: 319 m²
Crew: DB, MO Date: Sept. 1/84 Length of stream margin: 54.1 m Photos: 9-10 (R1) Water Temperature: 8.5°C @ 10:30
Comment: 25% riffle, 15% pool (debris), 60% glide. This site is most of the flow of a divided section of stream.
 Good cobble cover for fry, particularly in lower section of area.

FISH SAMPLE SITE:		Location (m)	Width (m)	Mean Depth (cm)	Max. Depth (cm)	Bank Cover	Debris Cover	D50/D90 (cm)								
		0	5.9	20	28	-	-	12/25								
		5	5.7	20	30	-	-	13/18								
		10	6.2	20	30	-	-	9/20								
		15	5.7	22	32	-	-	10/16								
		20	5.5	30	50	-	x	8/20								
		25	6.3	20	27	-	-	9/25								
		30	6.7	15	20	-	x	12/25								
		35	5.8	18	32	-	x	12/30								
		40	4.5	40	52	-	x	10/25								
		45	4.8	20	32	-	x	12/20								
		50	6.9	15	20	-	x	8/15								
		54.1	6.7	15	20	-	-	6/20								
FISH SAMPLE:		Species	Age	f1-range (mm)	f1 (mm)	Mean Weight (g)	M	C	R	N	S.E.	Morts	N Corr.	N/m ²	N/Linear	Biomass g/m ²
		Rbt	0+	25-42	34.7	0.65	123	128	30	515	70.5	15	530	1.661	9.80	1.08
		Rbt	1+	61-101	78.0	6.19	165	171	104	271	10.1	2	273	.856	5.05	5.30
		Rbt	2+	103-162	119.5	20.28	41	40	26	63	4.4	0	63	.197	1.16	4.01
		Ch	0+	74-81	78.7	6.00*	3	2	2	3	NA	1	4	.013	0.07	0.08
		Lnd	21+	89	89.0	8.00*	0	1	0	1	NA	0	1	.003	0.02	0.03
		Lamprey ammocoetes - 1														
		Total											871	2.730	16.1	10.50

Note: For abbreviations and symbols used in this table see first page of appendix.

* Estimated weight

SITE DESCRIPTION - FF3

Location: Approx. 2.5 km upstream of Maxan Ck. Above two beaver dams and just below canyon. Area: 205 m²
Crew: DB,DS,MF Date: Sept. 25/84 Length of stream margin: 21.8 m Photos: 9 (R3) Water Temperature: 20C @ 10.15 hr
Comment: This site is a broad shallow riffle with good fry habitat and good spawning gravel. Slope: 1:5
Access: by helicopter.

FISH SAMPLE SITE:

Location (m)	Width (m)	Mean Depth (cm)	Max. Depth (cm)	Bank Cover	Debris Cover	D50/D90 (cm)
0	11.1	15	30	-	x	4/12
5	9.9	17	38	-	x	2/8
10	9.0	20	55	-	x	3/10
15	9.1	15	55	x	-	4/13
20	8.0	20	40	x	-	4/10
\bar{x}	9.4					

FISH SAMPLE:

Species	Age	f1-range (mm)	f1 (mm)	Mean Height (g)	U1	U2	T	N	S.E.	Morts	N Corr.	N/m ²	N/Linear m	Biomass g/m ²
Rbt	0+	32-48	39.0	0.90	71	11	82	84	2.0	0	84	.410	3.85	0.37
Rbt	1+	67-82	72.8	5.12	5	0	5	5	NA	0	5	.024	0.23	0.12
Dv	0+	65-66	65.3	2.75	3	0	3	3	NA	0	3	.015	0.14	0.04
Total											92	.449	4.22	0.53

Note: For abbreviations and symbols used in this table see first page of appendix.

SITE DESCRIPTION - FF4

Location: Approx. 7 km upstream of Maxan in Foxy Canyon. Helicopter access.
 Crew: DB, DS, MF Date: Sept. 25/84 Length of stream margin: 16.5 m Photos: 14-17 (R3) Water Temperature: 10C @ 1200 hr
 Area: 102 m²
 Comment: This site is located upstream of an extensive log jam and chute in the lower section of Foxy Canyon.
 Slope: 2%
 Most of this site is glide and offered poor fry habitat.

FISH SAMPLE SITE:

Location (m)	Width (m)	Mean Depth (cm)	Max. Depth (cm)	Bank Cover	Debris Cover	D50/D90 (cm)
0	6.3	40	50	-	-	6/12
5	6.4	33	40	-	-	7/9
10	6.0	33	44	-	-	6/29
15	6.2	35	50	-	-	14/27
16.5						
\bar{x}	6.2					

FISH SAMPLE:

Species	Age	fl-range (mm)	fl (mm)	Mean Height (g)	U1	U2	T	N	S.E.	Morts	N Corr.	N/m ²	N/Linear m	Biomass g/m ²
Rbt	0+	32-33	32.5	0.57	2	0	2	2	NA	0	2	.020	0.12	0.01
Rbt	1+	92-95	93.5	10.28	2	0	2	2	NA	0	2	.020	0.12	0.20
Rbt	2+	111-171	135.6	28.91	7	1	8	8	1.8	0	8	.078	0.48	2.27
Total											12	.118	0.73	2.48

Note: For abbreviations and symbols used in this table see first page of appendix.

SITE DESCRIPTION - FF5

Location: Approx. 14 km upstream of Maxan Ck. and 3 km downstream of Berzelius Ck. and mine site. Area: 204 m²
 Crew: DB, OS, MF Date: Sept. 25/84 Length of stream margin: 36.5 m Photos: 18-20 (R3) Water Temperature: 10C @ 1300 hr
 Comment: This site is a riffle/glide complex with good potential fish habitat but upstream of barriers. The substrate in this section is slippery with attached algae. Helicopter access. Slope: 1.5%

FISH SAMPLE SITE:		Location (m)	Width (m)	Mean Depth (cm)	Max. Depth (cm)	Bank Cover	Debris Cover	D50/D90 (cm)
		0	7.2	19	23	x	-	5/11
		5	6.1	16	17	-	-	3/12
		10	4.8	28	40	-	-	4/9
		15	4.2	32	38	-	x	3/12
		20	4.8	25	30	-	x	6/12
		25	6.3	20	32	-	x	4/13
		30	6.5	17	25	x	-	5/16
		35	5.3	18	30	x	-	4/12
		36.5						
		\bar{x}	5.6					

FISH SAMPLE:	Species	Age	fl-range (mm)	fl (mm)	Mean Weight (g)	H	C	R	N	S.E.	Morts	Corr.	N/m ²	N/Linear m	Biomass g/m ²
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NO FISH PRESENT
 (2 passes @ 600 seconds/pass)

Total

Note: For abbreviations and symbols used in this table see first page of appendix.

SITE DESCRIPTION - FF6
 Approx. 21 km upstream of Maxan Ck. (above Lu Diversion) and immediately below road crossing
 Location: from mine. Area: 90 m²
 Crew: DB, DS Date: Sept. 7/84 Length of stream margin: 32 m Photos: 6 (R1) Water Temperature: 5°C @ 1600 hr
 Comment: Approx. 70% riffle and 30% glide. Heavy rains have brought flow levels up. Vehicle access.

FISH SAMPLE SITE:

Location (m)	Width (m)	Mean Depth (cm)	Max. Depth (cm)	Bank Cover	Debris Cover	D50/D90 (cm)
0	2.6	-	25	-	x	7/15
5	2.4	-	18	-	x	5/12
10	2.3	-	20	-	x	7/18
15	3.0	-	18	-	x	8/15
20	3.8	-	16	-	x	7/25
25	2.9	-	50	-	x	<1/5
30	2.7	-	50	-	x	<1/5
32	-----	-----	-----	-----	-----	-----
\bar{x}	2.8					

FISH SAMPLE:

Species	Age	fl-range (mm)	fl (mm)	Mean Weight (g)	M	C	R	N	S.E.	Morts	N Corr.	N/m ²	N/Linear m	Biomass g/m ²
NO FISH PRESENT														

Total

Note: For abbreviations and symbols used in this table see first page of appendix.

Appendix 5: Detailed results of the benthic invertebrate
sampling in Foxy and Buck creeks, September
1984

LOCATION	FB1 -Foxy Creek above	1	2	3	4	5	6
	Maxan Creek						
DATE	August 31/84						
EPHEMEROPTERA							
	Baetis	2	14	18	16	7	
	Ameletus	4				2	2
	Ephemerella	3	22	5	15	2	3
	Iron	1	2	3	3	1	1
	Cinygmula	3	2	3	1	6	1
	Paraleptophlebia		1	1			
PLECOPTERA							
	Alloperla	71	23	33	22	41	7
	Isogenus	1	9	3	4	3	
	Arcynopteryx			1		2	
	Nemoura			1	2		
	Pteronarcys						
	Chloroperla						
COLEOPTERA							
	Heterlimnius		larva	2		1	
	"		adult				
	Hydrophilus		adult				
TRICHOPTERA							
	Glossosoma						
	Psychomyia		1	3	3	2	
	Arctopsyche	1	8	2			
	Drusus	2	4	5	5	1	
	Limnephilus	1					
	Rhyacophila		7	2	1		
	Hydroptila						
	Dicosmoecus						
DIPTERA							
	Hexatoma	4		2	3	3	4
	Antocha						
	Ephydra	1					2
	"						
	Dolichopodidae	1					
	Psychoda	8	5	4	27	9	6
	Pelopiinae	4	21	20	12	4	4
	Hydrobaeninae	45	370	675	540	1345	895
	"	2	5	23	5	22	4
	"						
	Prosimulium		larva				
	"		pupa	1			
	Culicoides	2	17	17	3	6	1
	Tipula			1		1	
HOMOPTERA							
	Aphidae						
ACARINA							
OLIGOCHAETA							
		1			1	1	
HIRUDINEA							
		2	1	1		1	
ANNELIDA							
PELECYPODA							
		8					
Total No. of Taxa		21	19	21	18	19	12
Total No. of Organisms		167	515	823	664	1459	930

LOCATION	FB2 - Foxy Creek	1	2	3	4	5	6
DATE	below Berzelius Creek Sept. 7/84						
EPHEMEROPTERA							
Baetis		2	4		6	8	1
Ameletus			2	6			
Ephemerella		2	16	6	3	7	3
Iron							
Cinygmula							
Paraleptophlebia							
PLECOPTERA							
Alloperla		1	17	11	4	11	4
Isogenus		6	11	15	11	14	3
Arcynopteryx			3	3		1	1
Nemoura		3	38		7	3	18
Pteronarcys			1		2	1	
Chloroperla							
COLEOPTERA							
Heterlimnius	larva	1	17	3	2	6	10
"	adult		2				1
Hydrophilus	adult						
TRICHOPTERA							
Glossosoma			2			1	
Psychomyia		3	7	2	1	3	7
Arctopsyche			1				
Drusus							
Limnephilus							
Rhyacophila					1		2
Hydroptila							
Dicosmoecus			1				
DIPTERA							
Hexatoma		2	5	4	5		
Antocha		3	5	1	1	3	1
Ephydra	larva		3	2	4		3
"	pupa						
Dolichopodidae		1	2	3		1	1
Psychoda							
Pelopiinae	larva		6	13			1
Hydrobaeninae	larva	41	76	30	64	48	26
"	pupa	1	10	6	3	1	
"	adult	1					1
Prosimulium	larva						
"	pupa						
Culicoides		2		9	2	3	1
Tipula			2	2	1		1
HOMOPTERA							
Aphidae							
ACARINA							
OLIGOCHAETA							1
HIRUDINEA		1					1
ANNELIDA							
PELECYPODA							
Total No. of Taxa		15	22	16	16	15	20
Total No. of Organisms		70	231	116	117	111	87

LOCATION	FB3 - Foxy Creek					
DATE	above Lu Diversion					
	Sept. 7/84					
	1	2	3	4	5	6
EPHEMEROPTERA						
Baetis	14	10	15	6	10	12
Ameletus						
Ephemerella	13	4		1	4	5
Iron		1	2		1	
Cinygmula	12	5	11	7	17	16
Paraleptophlebia		2		5		4
PLECOPTERA						
Alloperla	5	21	4	15	3	10
Isogenus	19	42	18	11	1	12
Arcynopteryx		1	2		1	
Nemoura	3	1	8	6	5	5
Pteronarcys						
Chloroperla						
COLEOPTERA						
Heterlimnius	1	3	1		3	5
"		2		4	2	
Hydrophilus						
TRICHOPTERA						
Glossosoma			1			
Psychomyia	5	8	5		4	1
Arctopsyche			1	1	1	2
Drusus						
Limnephilus						
Rhyacophila	1			1		
Hydroptila	1		1			
Dicosmoecus						
DIPTERA						
Hexatoma						
Antocha						
Ephydra		2			2	1
"						
Dolichopodidae						
Psychoda						
Pelopiinae						
Hydrobaeninae	7	5	9	6	5	4
"	1					
"						
Prosimulium			2		1	
"		1				1
Culicoides		1		1		
Tipula		1			1	
HOMOPTERA						
Aphidae		1				
ACARINA						
		1			2	1
OLIGOCHAETA						
HIRUDINEA						
				1	2	
ANNELIDA						
PELECYPODA						
Total No. of Taxa	12	19	14	13	18	14
Total No. of Organisms	82	112	80	65	65	79

LOCATION	BB1 - Buck Creek	1	2	3	4	5	6
DATE	below Bessemer Creek						
	Sept. 6/84						
EPHEMEROPTERA							
Baetis		3	1	2			1
Ameletus		4	3		3		
Ephemerella			1	1	1		
Iron							
Cinygmula							
Paraleptophlebia		6	7	1		9	3
PLECOPTERA							
Alloperla		16	5	10	45	39	16
Isogenus		22	11	4	46	26	45
Arcynopteryx							
Nemoura				2			1
Pteronarcys							
Chloroperla		27	42	7	7	37	37
COLEOPTERA							
Heterlimnius	larva						
"	adult						
Hydrophilus	adult	1					
TRICHOPTERA							
Glossosoma							
Psychomyia		2					
Arctopsyche		2					
Drusus							
Limnephilus		2					
Rhyacophila							
Hydroptila							
Dicosmoecus							
DIPTERA							
Hexatoma							
Antocha							
Ephydra	larva	2	10	11	12	27	14
"	pupa				1		
Dolichopodidae		2	1				
Psychoda		1					
Pelopiinae	larva						
Hydrobaeninae	larva	30	55	19	16	63	39
"	pupa						1
"	adult						
Prosimulium	larva			1			
"	pupa						
Culicoides			1	1		4	
Tipula		3	1		1		
HOMOPTERA							
Aphidae							
ACARINA							
OLIGOCHAETA		37					2
HIRUDINEA							
ANNELEIDA			1				
PELECYPODA							
				1			
Total No. of Taxa		16	13	12	9	7	10
Total No. of Organisms		160	139	60	132	205	159

LOCATION	BB2 - Buck Creek	1	2	3	4	5	6
DATE	above Bessemer Creek Sept. 6/84						
EPHEMEROPTERA							
	Baetis	6		1			
	Ameletus	6	7	5	1	2	2
	Ephemerella	2	2				
	Iron						
	Cinygmula			1			
	Paraleptophlebia	2		1			
PLECOPTERA							
	Alloperla	19	6	42	5	3	7
	Isogenus	6	2	22	1	1	2
	Arcynopteryx	1		1		1	
	Nemoura	3	2	1	1	2	
	Pteronarcys						
	Chloroperla	8	5	3	9	6	10
COLEOPTERA							
	Heterlimnius		larva				
	"		adult	11	1		1
	Hydrophilus		adult	1		1	1
TRICHOPTERA							
	Glossosoma						
	Psychomyia						
	Arctopsyche	2	1	1			
	Drusus						
	Limnephilus		1				
	Rhyacophila						
	Hydroptila						
	Dicosmoecus						
DIPTERA							
	Hexatoma			4	1		
	Antocha						
	Ephydra	larva					
	"	pupa	13	15	24	8	14
					3	2	2
	Dolichopodidae						
	Psychoda						
	Pelopiinae	larva					
	Hydrobaeninae	larva	7	1	6	4	3
	"	pupa			1	1	1
	"	adult					
	Prosimulium	larva	4				
	"	pupa					
	Culicoides		1		2		
	Tipula	1	4	1	1	3	1
HOMOPTERA							
	Aphidae			1	1		
ACARINA							
	OLIGOCHAETA	48	57	6	9	16	5
HIRUDINEA							
	ANNELIDA			2			
	PELECYPODA	4	52	8	36	31	16
	Total No. of Taxa	16	16	21	16	15	12
	Total No. of Organisms	132	168	135	83	87	63

BENTHOS SAMPLE SITE DESCRIPTION FORM

Stream Buck Creek Date Sept.6/84 Time 1700 hr

Location Above Goosly Lake approx. 250 m. This is the same site as marked by Wilkes and Maclean and is presumably below Bessemer Creek.

Site Number BB1 Replicates 6 Crew DB, DS

Current Velocity:

<u>Total</u>						<u>Mean</u>	
<u>Width</u>	4 m	<u>Distance</u>	6 m	<u>Time</u>	12 sec 12 sec 11 sec	<u>Velocity</u>	.51 m/sec

<u>Sample No.</u>	1	2	3	4	5	6
<u>Distance from BM(m)</u>	2.5	3.5	4.5	5.5	1m up 4.5	1m up 5.5
<u>Depth (cm)</u>	21	35	49	28	39	32
<u>D50 (cm)</u>	1	<1	<1	<1	<1	1
<u>D90 (cm)</u>	3	2	3	3	2	4

Photographs - Water Temperature 10 C

Dissolved Oxygen 9.6 ppm pH 7.38 Conductivity 89.9 umhos/cm

General Comments This section of Buck Creek has very few sites suitable for benthos sampling. The substrate is generally sands and silts. This short riffle section was the only site found which offered some gravel sections.

BENTHOS SAMPLE SITE DESCRIPTION FORM

Stream Foxy Creek Date Sept.1/84 Time 1500 hr

Location Water sample station approx. 1 km upstream from Maxan Creek. Metal rod benchmark approx. 30 m downstream from small road - right side of stream.

Site Number FB1 Replicates 6 Crew DB, MO

Current Velocity:

Total
Width 6.5m Distance 10 m Time 12 sec Mean
11 sec Velocity .91 m/sec
10 sec

<u>Sample No.</u>	1	2	3	4	5	6
Distance from BM(m)	3.0	4.0	5.0	6.0	7.0	8.0
Depth (cm)	10	30	27	22	15	10
D50 (cm)	3	4	3	3	4	4
D90 (cm)	8	10	10	12	9	12

Photographs - Water Temperature 90C

Dissolved Oxygen 10.2 ppm pH 7.51 Conductivity 45.9 umhos/cm

General Comments All measurements taken with no problems. Flow conditions were declining towards late summer minimums. Conductivity and pH measurements conducted 1 week after sample taken.

BENTHOS SAMPLE SITE DESCRIPTION FORM

Stream Foxy Creek Date Sept.7/84 Time 1400 hr

Location Downstream of Foxy and Berzelius confluence.
Approx. 50 m downstream of water quality sample
site. Metal rod benchmark on right side.

Site Number FB2 Replicates 6 Crew DB, DS

Current Velocity:

<u>Total</u>			<u>Mean</u>				
<u>Width</u>	5 m	<u>Distance</u>	8 m	<u>Time</u>	10 sec	<u>Velocity</u>	.65 m/sec
					15 sec		
					12 sec		

<u>Sample No.</u>	1	2	3	4	5	6
				1m up	1m up	1m up
Distance from BM(m)	6.0	7.5	9.0	6.0	7.5	9.0
Depth (cm)	25	26	22	32	27	26
D50 (cm)	8	2	6	4	8	2
D90 (cm)	27	15	20	12	14	18

Photographs 3 & 4 (R2) Water Temperature 7°C

Dissolved Oxygen 10.7 ppm pH 7.57 Conductivity 861 umhos/cm

General Comments No problems with measurements.

BENTHOS SAMPLE SITE DESCRIPTION FORM

Stream Foxy Creek Date Sept.7/84 Time 1600 hr

Location Upstream of Lu Diversion. Site located approx.
30 m below road crossing of Foxy Creek.

Site Number FB3 Replicates 6 Crew DB, DS

Current Velocity:

<u>Total</u>						<u>Mean</u>	
<u>Width</u>	4 m	<u>Distance</u>	6 m	<u>Time</u>	7 sec	<u>Velocity</u>	.90 m/sec
					5 sec		
					8 sec		

<u>Sample No.</u>		1	2	3	4	5	6
		1m down	1m down			1m up	1m up
Distance from BM(m)		1.5	3.0	1.5	3.0	1.5	3.0
Depth (cm)		22	15	18	10	20	12
D50 (cm)		5	6	6	3	8	4
D90 (cm)		10	15	12	13	10	12

Photographs 5 (R2) Water Temperature 5°C

Dissolved Oxygen 12.0 ppm pH 7.09 Conductivity 32.2 umhos/cm

General Comments No problems with measurements. Should consider re-locating this site to a section just upstream of the road crossing to serve as a better control.