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Env.  
Blind ck - Benthol

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BIOLOGICAL MONITORING  
AT  
BLIND, VANGORDA AND ANVIL CREEKS  
1988

PREPARED FOR  
CURRAGH RESOURCES INC.

PREPARED BY  
BONNIE BURNS  
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## 1. INTRODUCTION

During the biological monitoring program conducted on Rose Creek in the summer of 1988, (Burns 1989), three stations were set up to determine their background benthic communities. These three sites were located on Anvil, Blind and Vangorda Creeks. The station on Anvil Creek was established to determine background data prior to its mixing with Rose Creek for comparison purposes. The stations on Blind and Vangorda Creeks were both established to obtain background data of these areas prior to the future development of the ore bodies.

## 2. STUDY AREA

Curragh Resources Inc. operates a lead-zinc mine and mill located in the Anvil Range near the Town of Faro at approximately 62 ° 20' N, 133° 25' W (Figure 1).

The locations of the background sample sites are illustrated in Figure 2. The description of these sites is as follows:

Anvil Creek: just upstream of the confluence with Rose  
Creek

Blind Creek: just downstream of the bridge on Blind

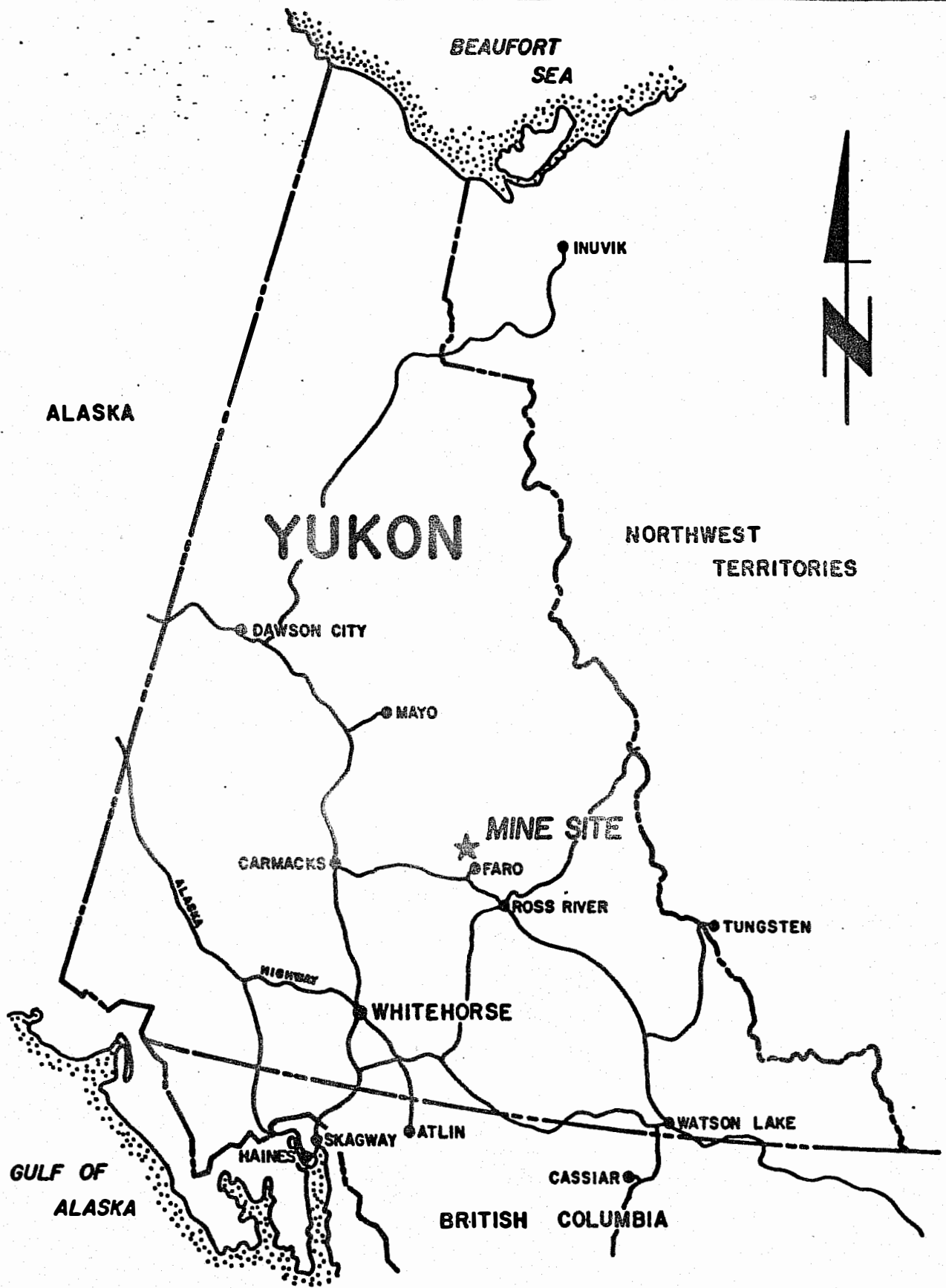
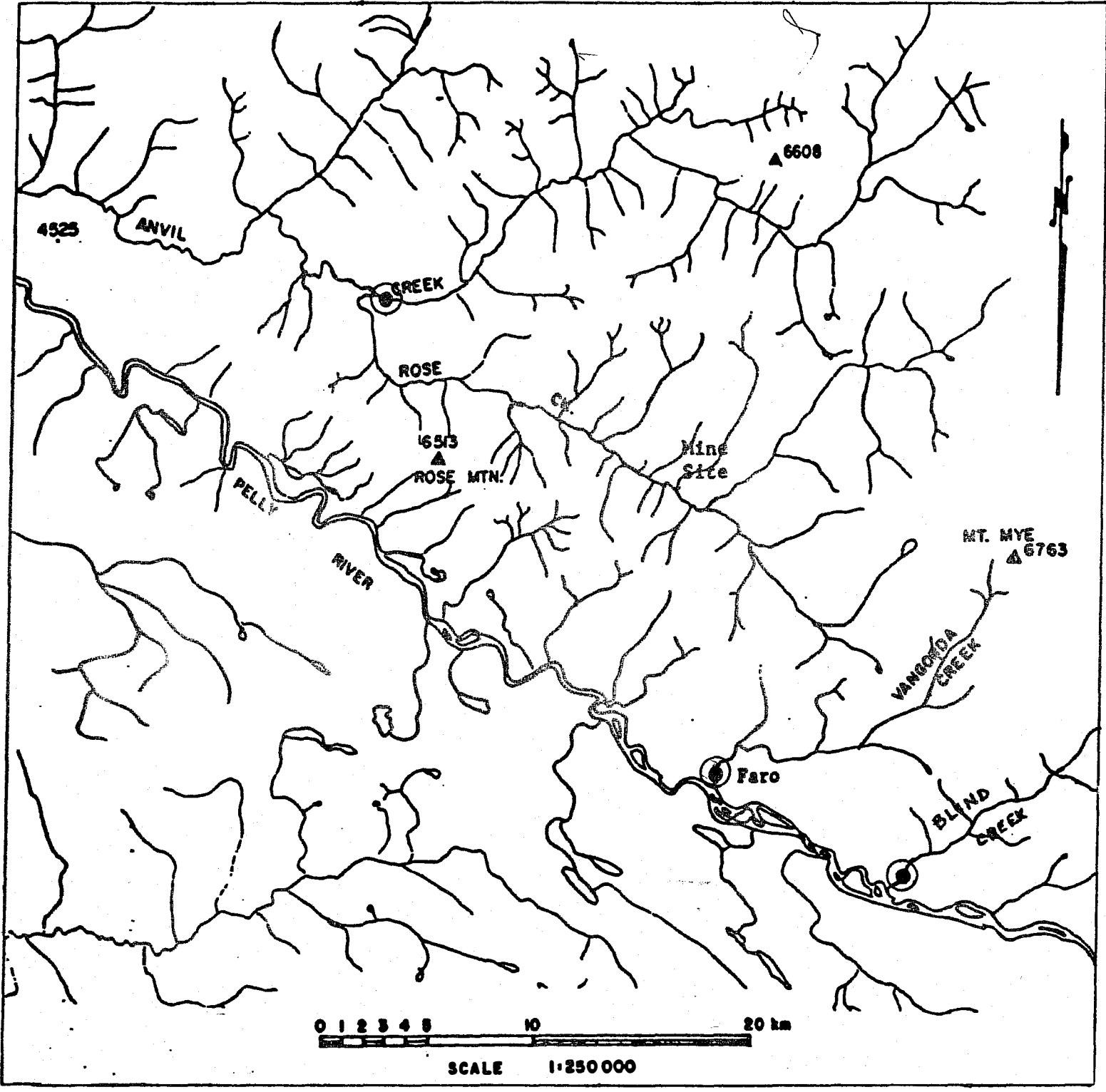


FIGURE 1 Location of Curragh Resources Inc



FIGURE 2 LOCATION OF SAMPLE SITES



● Sample site

Creek Road

Vangorda Creek: approximately 500 m upstream of the confluence with Pelly River

3. METHODS

3.1 Water Quality

Water quality samples were collected at each site when the artificial substrate samplers were installed, August 5, 1988, and when they were retrieved, September 21 and 22, 1988.

Water temperature and pH were measured insitu using a Fisher Scientific Model 119 pH/Temp meter. Samples for alkalinity were collected in 200 ml polyethylene bottles and analyzed the same day in Faro. Samples for total metals were collected in acid washed 200 ml polyethylene bottles preserved with 1.0 ml of HNO<sub>3</sub> and analyzed by Bondar Clegg, Whitehorse.

3.2 Benthic Invertebrate Sampling

Artificial substrate samplers were used for benthic invertebrate sampling. The samplers were chrome

plated cylindrical shaped barbecue chicken baskets measuring 26 cm long with a diameter of 17 cm. Each substrate sampler was filled with washed cobble-sized indigenous rocks collected from the stream bed or the bank at each sample site. The surface area provided by this "artificial substrate" was approximately  $6000 \pm 1000 \text{ cm}^2$  (Baker 1979). Three rock filled samplers were placed in the stream spanning a distance of approximately 3 meters at each station on August 5, 1988. The samplers were tied together and tied to shore. These samplers were then left to colonize for six and a half weeks.

On September 21 and 22 the artificial substrate samplers were retrieved by placing a bucket downstream and under the basket. On shore the basket was opened in the bucket, then all the cobbles were carefully washed and discarded back to the stream. The debris and benthic invertebrates remaining in the bucket from each of the three substrate samplers were placed in a one litre nalgene bottle and preserved with 10% formalin, thus, producing a composite sample for each location. In Whitehorse, this debris was sorted, the benthic invertebrates placed in labelled vials containing ethanol, and sent to Charlie Low in Victoria, B.C. for identification and enumeration.

The Shannon-Wiener Index was used to calculate diversity (Pielou 1975).

Diversity (H') =  $-\sum p_i \log p_i$

where  $p_i = \frac{n_i}{N}$

$n_i$  = total number of individuals in the  $i$ th genus or species

$N$  = total number of individuals identified to genus or species level in one sample

The evenness index was calculated using the following formula from Pielou (1975).

Evenness (J') =  $\frac{H'}{\log S}$

where  $H'$  = Diversity

$S$  = the total number of genus or species

Individuals that were not identified to genus or

species level were not included in the diversity or evenness calculations but are presented in Appendix A.

Diversity can range from zero (if all the individuals belong to the same species) to around nine. Diversity usually varies between three and four in clean water streams and is usually less than one in polluted streams when the diversity calculation uses  $\log_2$  (Wilhm 1970). The calculations in this study use  $\log_{10}$ . After converting these criteria to base 10 logs, an unstressed population would have a diversity of 0.9 or more, whereas a stressed population would have a diversity of 0.3 or less. (Environmental Protection, per. comm).

A community dominated by one or two species will have a low diversity whereas a community with several species equally represented will have a higher index.

The evenness index indicates how evenly distributed the genus or species is throughout a sample with the maximum value that can be attained being one.

As artificial substrate samplers were used, density

was calculated for volume of substrate rather than area. The volume of the basket was determined then multiplied by the number of baskets used per station. The total number of invertebrates was then calculated per cubic meter per site.

#### 4. RESULTS AND DISCUSSION

##### 4.1 Water Quality

There were no anomalies in the water quality data (Table 1). The metals values for zinc, copper and lead were near or below the detection limit. Manganese and iron levels were relatively low at all three sites.

Alkalinity is fairly high in Anvil and Vangorda Creeks indicating these waters should have a good buffering capacity. The alkalinity in Blind Creek, however, is quite low and the creek may not adjust well should acid mine drainage occur in this area.

Sulphate levels were low in Anvil and Blind Creeks but higher in Vangorda Creek. Sulphate is a product of the oxidation of the sulphide bearing ores found in the Vangorda deposit, and higher levels would be expected in the Vangorda Creek.

TABLE 1  
WATER QUALITY DATA

STATION	TEMP. DEGREES C	pH	ALKALINITY MG/L AS CaCO3	H.P.R. mg/l	NO4 mg/l	NO3 mg/l	Zn mg/l	Cu mg/l	Pb mg/l	Mn mg/l	Fe mg/l
<b>BLIND CREEK</b>											
AUG. 5/88	11.1	8.06	59.9	4.0	10.0	0.29	0.002	<0.002	<0.005	0.017	0.290
SEPT. 22/88	3.5	7.31	66.2	1.0	7.0	0.05	0.002	<0.002	<0.005	0.014	0.155
<b>VANCOUVER CREEK</b>											
AUG. 5/88	10.4	8.35	137.6	4.0	28.0	0.29	0.009	0.002	<0.005	0.011	0.240
SEPT. 22/88	2.5	7.83	147.0	2.0	42.0	0.14	0.008	0.002	0.005	0.008	0.035
<b>ANVIL CREEK</b>											
AUG. 5/88	5.7	8.23	120.8	1.0	11.0	0.12	0.002	<0.002	<0.005	0.012	0.150
SEPT. 22/88	1.8	7.79	134.4	1.0	14.0	<0.01	<0.002	0.003	<0.005	0.015	0.195

Ammonia levels were lower in September than August and generally reflect levels of ammonia in natural waters (Environment Canada 1976).

#### 4.2 Benthic Invertebrate Sampling

There is minimum background data that has been collected at these locations. Ken Weagle collected two years of benthic data at three sites on Vangorda Creek in 1980 and 1981. All sites were located upstream of the station that was established in this study. In 1980, Ken Weagle collected benthic data at two stations on Blind Creek, one which corresponds to the site that was used in this study. In 1983, biological monitoring was conducted at the site on Anvil Creek that was established in this study (Godin, 1985). It is not within the scope of this report to make comparisons with this data, but to indicate that some limited data does exist.

The diversity, evenness and density indices are presented in Table 2. Blind Creek would appear to be the most productive according to its density, although it had the lowest diversity index. Upon retrieval, only one sampler was totally submerged in Blind Creek.

The other two had been tampered with and were partially submerged. Calculations for density were adjusted accordingly.

TABLE 2

INDICES AND TOTALS

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STATION	DIVERSITY	EVENNESS	M <sup>3</sup>	DENSITY OF	TOTAL #
				INDIVIDUALS	OF TAXONOMIC GROUPS
Blind Cr.	0.89149	0.71020	21017	186	19
Vangorda Cr.	1.08854	0.83667	8192	145	22
Anvil Cr.	0.97691	0.75087	12316	218	19

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Vangorda Creek had the highest diversity but the lowest density. The samplers were placed in the middle of the creek to ensure complete submersion throughout the study. The flow here was very fast and could possibly explain the lower number of invertebrates present. Due to the time of year that the baskets were retrieved, a great deal of leaf litter and other detris had accumulated on the baskets, which may or may not have affected the benthic communities.

The indices for Anvil Creek fell between those for Blind and Vangorda Creeks.

Plecopter were the most abundant organisms at all three stations (Table 3). Blind Creek had the greatest percentage with 60.8% and also a large composition (28.0%) was made up of Ephemeroptera. Very few Diptera (Chironomidae and Simuliidae) were found in Blind Creek but were well represented in Vangorda and Anvil Creeks.

TABLE 3

The percentage of Composition of Different Taxonomic  
Groups at each Station

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Taxonomic Group	Blind Creek	Vangorda Creek	Anvil Creek
Ephemeroptera (mayflies)	28.0	6.2	15.6
Plecoptera (stoneflies)	60.8	44.1	38.1
Trichoptera (caddisflies)	4.8	3.4	4.6
Chironomidae (midges)	4.3	24.1	30.1
Simuliidae (black flies)	1.6	21.4	10.6
Others	0.5	0.7	0.5
<b>TOTAL</b>	<b>100.0</b>	<b>99.9</b>	<b>99.5</b>

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Others: one of the following: Enchytraeidae  
Nematoda

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APPENDIX A  
TAXONOMIC LIST AND MACRO INVERTEBRATE DATA

	Blind Creek	Vangorda Creek	Anvil Creek
Phylum Arthropoda			
Class Insecta			
Order Ephemeroptera			
<u>Ehemerella spinifera</u>	1		
<u>Ephemerella doddsi</u>	1		4
<u>Baetis</u> sp	6	6	1
<u>Cinygmula</u> sp		2	1
<u>Ameletus</u> sp	1		
<u>Epeorus longimanus</u>	2		
<u>Rithrogena</u> sp	41	1	28
Order Plecoptera			
<u>Sweltsa</u> sp group	2	6	6
<u>Zapada</u> sp	20	17	42
<u>Malenka</u> sp		1	24
<u>Capnia</u> sp	9	11	10
<u>Skwala</u> (paralella?)	1		
<u>Taenionema</u> sp	63	29	
<u>Isoperla</u> sp	18		
<u>Kogotus</u> sp			1
Order Trichoptera			
<u>Rhyacophila</u> (acropedes?)	7	1	1
<u>Rhyacophila angelita</u>		1	
<u>Parapsyche</u> sp	2	2	8
<u>Glossosoma</u> sp			1
<u>Chyranda</u> sp		1	
Order Diptera			
Family Chironomidae			
Chironomidae pupae		1	8
<u>Cricotopus</u> sp	3	5	48
<u>Euryhapsis</u> sp		11	
<u>Heterotrissocladius</u> sp	2	3	

	Blind Creek	Vangorda Creek	Anvil Creek
<u>Cardiocladius</u> sp	3	8	10
<u>Psectrocladius</u> sp B			1
<u>Diamesa</u> sp		5	
<u>Pseudokiefferiella</u> sp		2	
Family Simuliidae			
<u>Simulium</u> sp	3	6	10
<u>Prosimulium</u> sp		25	13
Phylum Annelida			
Class Oligochaeta			
Order Haplotaxida			
Enchytraeidae	1		1
Phylum Nematoda		1	