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Beak Consultants Limited

PRAIRIE CREEK PROJECT
FISHERIES AND INVERTEBRATE STUDIES, 1981

A Report Prepared For

CADILLAC EXPLORATIONS LTD
CALGARY, ALBERTA

Grainger River

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PRAIRIE CREEK PROJECT
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SUMMARY

1. Potential fish overwintering habitat was found in Prairie Creek, the Tetcela and Grainger Rivers.

2. Ice bridge surveys revealed that minimal disturbance to aquatic habitat had occurred at road crossings and no barriers to fish migration were present. Minor increases in silt loading probably occurred as a result of ice bridges, but the effects were likely minimal and not considered of a magnitude to affect fish migration or seriously impact aquatic invertebrate communities.

3. The spring survey documented the presence of grayling spawning habitat in all streams investigated. No barriers to migrating spring spawners were evident in the rivers examined.

4. Arctic grayling were found to use the Grainger River, Tetcela River and the Sundog Creek tributary for spawning. Northern pike appeared to be using the Grainger River.

5. In Prairie Creek, grayling did not appear to penetrate upstream of the park boundary. Several age classes of Dolly Varden and mountain whitefish were observed in Prairie Creek; utilization of the creek appeared to be for feeding. Spawning in this system by these species is possible, but was not confirmed.

6. Trace metal analyses indicated that levels for arsenic, copper, lead, zinc and mercury were well below levels set by the Canadian Food and Drug Directorate for consumable tissues.

7. Low sample sizes of invertebrates were collected during the 1981 survey. Numbers were not sufficiently high to enable reliable interpretations. It was recommended that if future invertebrate studies are contemplated for Prairie Creek and associated streams, artificial substrates should replace surber methods.

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1.0 INTRODUCTION

An environmental evaluation was completed for Cadillac Explorations Ltd. on the Prairie Creek property (Ker, Priestman and Associates Ltd., 1980). Additional aquatic baseline investigations were requested and subsequently undertaken in the winter and spring of 1981. Specific objectives of the 1981 aquatic surveys were to:

a) determine the presence and extent of potential fish overwintering habitat in Prairie Creek both upstream and downstream of the mine site and in the waterbodies crossed or paralleled by the winter road;

b) evaluate the effects on aquatic habitats attributable to the removal of ice bridges along the winter road prior to and after ice break-up;

c) determine the utilization of Prairie Creek by arctic grayling (Thymallus arcticus) and also their use of streams crossed by the winter road judged to have spawning potential;

d) collect fish samples for trace metal analysis above and below the mine site; and

e) document species composition and relative abundance of benthic macro-invertebrate communities in Prairie Creek, Harrison Creek and aquatic systems traversed by the winter access road.

The report detailed herein presents the results of these surveys.

2.0 METHODS

2.1 Winter Survey

The winter field survey was conducted from 13 to 27 March 1981. Prairie Creek, upstream and downstream of the mine site, was sampled at identical stations as in 1980. Streams crossed by the winter road and found to have fishery potential in 1980 (Figure 1), were also examined in 1981. These systems included the Grainger River, Grainger tributaries, Fishtrap Creek and the Tetcela River (2 crossings). Access to these sites was by helicopter.

Sampling involved the drilling of auger holes through the ice both upstream and downstream of the crossings. Water depth, water flow, ice cover depth, and air and water temperatures (hand-held thermometer) were recorded. Dissolved oxygen concentration was measured using a Y.S.I. Model 54 Oxygen-Temperature Meter in order to determine the capability of water to support fish. An aerial reconnaissance of the systems above and below the crossings was also made to document the presence and extent of open water areas.

2.2 Ice Bridge Survey

Following the cessation of traffic flow and the removal of the ice bridges on the winter road, a helicopter reconnaissance was undertaken on 8 April 1981. Ground and aerial inspection of the clean-up operation of the ice bridges was made concentrating on those streams identified by the winter survey to have fish overwintering potential. The crossings were examined for habitat alteration and debris. Following ice break-up and in conjunction with the spring survey, crossings were revisited and inspected.

2.3 Spring Survey

The spring survey was conducted from 21 to 25 May 1981. This program concentrated on watercourses found to contain grayling in 1980; these included the Grainger River, Tetcela River, a Sundog Creek tributary and Prairie Creek. The systems were accessed by helicopter and by road near the mine site. The same stations as in the 1980 studies were sampled: R3, R4, R5, R7 and M1 to M6 (Figures 1 and 2). On Prairie Creek, the program was expanded and two additional stations were sampled; M1A located upstream of the airstrip but slightly below the confluence of the large tributary with Prairie Creek; and M5A situated approximately half-way between the mine site and the Prairie Creek / South Nahanni River confluence (Figure 1).

Physical parameters at these sites have been previously described in the report by Ker, Priestman and Associates Ltd. (1980). Additional parameters were recorded in the spring of 1981; these included:

a) water colour;
b) water temperature;
c) substrate particle size;
d) flood signs;
e) flow stage;
f) debris (floodplain, channel and/or stable); and
g) potential obstructions to fish migration.

Qualitative assessments were made on flood signs, flow stage, debris presence and potential obstructions, while water temperature was measured with a hand-held thermometer. The classification of substrate particle size was made following Hynes (1970).

Chemical parameters of waters measured were:

a) pH using a Hellige colorimeter;
b) dissolved oxygen concentrations by a Model OX-9 Hach Kit; and
c) conductivity with a Beckman Type RB-5.

The purpose of physical and chemical data collection was to provide a general description of the environment in order to give insight into the quality of the various habitats for fish production.

Fish habitats were sampled using a variety of sampling devices including gillnet, electroshocker and minnow trap. The use of any of these was largely dictated by physical characteristics of the stream and water levels.

All sites were sampled with a Smith-Root Type VII-A Electrofisher. This method proved effective except on the Grainger River and Prairie Creek where high water levels confined electroshocking to the stream edges, side channels and back eddies. At least 300 m of stream, if possible, was electroshocked at each site. Ganged variable mesh monofilament gillnets were used in those systems where water was deep and slow moving. Nets consisted of three 15 m panels of 25 mm (1 in), 38 mm (1.5 in) and 50 mm (2 in) stretched mesh. At M6, only the 50 mm mesh panel was used because of the lack of suitable sampling area. Upstream from this site, at M2, a 7.5 m multifilament gillnet of 50 mm stretched mesh was set. Minnow traps were employed to attempt capture of minnows and other forage species, but proved unsuccessful.

A visual reconnaissance by helicopter was also conducted upstream and downstream of each crossing in order to assess the availability of aquatic habitat, to identify migration barriers and to look for congregations of fish present on or enroute to spawning areas.

Those fish collected were identified to species and enumerated. Most captured fish were released alive, but some representative samples were retained and kept frozen for life history studies. Sculpins, Dolly Varden and whitefish collected at Stations M1, M2, M4 and M5 were frozen and sent to the laboratory for analysis of trace metal concentrations in muscle tissue.

For all preserved fish the following features were recorded:

a) fork length;
b) weight;
c) sex;
d) maturity;
e) gonad weight and width of mature males;

f) egg size and counts of mature females;

g) age by scales and/or otoliths depending on species; and

h) qualitative stomach content analysis.

These data are summarized in Tables 7 and 8. Codes used in the data summaries are as follows:

Species: Table 3

Gear: GN - gillnet; ES - electroshocking

Age: Sc - Scale; Oto - Otolith; R - regenerated scale

Sex: M - male; F - female; J - juvenile; A - adult

Maturity:	Female	Male	Condition	As described by Kesteven (1969)
	1	6	Immature	Stage I
	2	7	Maturing	Stage III and IV
	3	8	Mature - Ripe	Stage V and VI
	4	9	Spawning	Stage VII
	5	10	Spent	Stage VIII

Stomach Content: B - benthos; F - fish; E - eggs.

Catch per unit effort (C.P.U.E.) was determined for gillnetting and electroshocking; calculated by using the following formula:

$$\text{Electroshocker C.P.U.E.} = \frac{\text{total no. fish caught or identified}}{\text{total no. minutes electrofishing}} = \text{fish/min}$$

$$\text{Gillnet C.P.U.E.} = \frac{\dfrac{\text{total no. fish caught}}{\text{total length of net (m)}}}{\text{soak time (1 hr)}} = \text{fish/m/hr.}$$

2.4 Benthic Invertebrates

Benthic invertebrate samples were collected from 8 stations near the Cadillac mine site (i.e. in Prairie Creek and Harrison Creek) and 7 stations in watercourses traversed by the winter road (Figures 1 and 2). Over the period 21 May through 25 May 1981, 8 replicate samples per station were collected with a Surber sampler. All samples were appropriately labelled, preserved and forwarded to BEAK's Vancouver laboratory for analyses.

In addition to those minesite stations sampled in 1980 (i.e. Stations M1, M2, M3, M4, M5; Ker, Priestman & Associates Ltd., 1980), three sites were included for study; these were Station M1A (situated on Prairie Creek upstream of the airstrip, but downstream of the confluence of the large unnamed tributary and Prairie Creek); Station M5A (situated approximately one-half the distance between the minesite and the Prairie Creek/Nahanni River confluence); and Station M6 (situated approximately 1 km upstream of the Prairie Creek/Nahanni River confluence).

Sampling stations related to the access road were selected on the basis of information obtained during the 1980 program. Only those areas deemed as exhibiting some fisheries potential were studied in May 1981 (Ker, Priestman & Associates Ltd., 1980). Winter road stations included:

a) Station R3 - an unnamed tributary;
b) Station R4U - Tetcela River; upstream of the confluence with the unnamed tributary and upstream of the road crossing;
c) Station R4D - Tetcela River; upstream of the confluence with the unnamed tributary and downstream of the road crossing;
d) Station R5U - Tetcela River; downstream of the confluence with the unnamed tributary and upstream of the road crossing;
e) Station R5D - Tetcela River; downstream of the confluence with the unnamed tributary and downstream of the road crossing;
f) Station R7U - Grainger River; upstream of the road crossing; and
g) Station R7D - Grainger River; downstream of the road crossing.

3.0 RESULTS AND DISCUSSION

3.1 Winter Survey

The results of the winter survey are presented in Table 1. The data indicate that potential fish overwintering habitat was present in the Tetcela River and Prairie Creek in 1980 - 1981, based on dissolved oxygen levels of 10 ppm or more, water depth of 15 cm or more, and the presence of open water areas. Prairie Creek had extensive areas of open water from the confluence of the South Nahanni River to an area just above M-1. Flow was also detectable and the presence of open water may be related to the unseasonable mild winter. In the past, Environment Canada (1978) has also reported continuous yearly flows at their gauging station near the Cadillac mine site in 1977. Similarly, the Tetcela River had open water near the road crossing and flow was detectable. The tributaries of Prairie Creek, including Harrison Creek, were all frozen to the bottom. The Grainger River had no open water areas, but there was free water under the ice at locations both above and below the road crossing. Flows were not detectable, but dissolved oxygen was high (Table 1). Therefore, the Grainger likely contains potential fish overwintering habitat, but the limited amounts of water may restrict the kinds and number of fish it is capable of supporting.

Other systems including Fishtrap Creek and the lake in the Grainger Pass had some water below the ice cover, but low dissolved oxygen concentrations of 1 ppm or less would preclude the possibility of any fish overwintering at these sites. Sundog Creek tributary was also found to contain no fish overwintering habitat. This system was frozen to the bottom, although there was snow melt on the ice surface and some water was present between the layers of ice.

3.2 Ice Bridge Survey

The winter road stream crossings were investigated prior to and after break-up. Before the initial survey all ice bridges had been removed except for the Grainger crossing which was later manually removed. Ground surveillance of the crossings on the Grainger River, Tetcela River (2 crossings) and the Sundog Creek tributary

(Plates 1 to 4) indicated that following break-up no barriers would be present to prevent the upstream migration of fish. Limited amounts of fill and vegetation debris remained on the ice surface which likely produced a brief increase in suspended solids with break-up. However, the amount of these materials was low and was not considered to be sufficient to cause delays in fish migration, or to significantly impact the invertebrate fauna downstream of the crossings.

After the spring break-up no habitat alteration was evident at any crossing with the exception of the eastern approach to Sundog Creek tributary which still had not completely been flushed by the spring run-off (Plate 4). However, the debris presented no barrier to fish migration. Large quantities of dead fall were evident in this system and on the Tetcela River near both crossings, but presented no barrier to fish migration. In both cases the instream debris appeared to be related to natural bank erosion rather than ice bridges. Some erosion from the road bed was evident at Site R4 on the Tetcela River (Plate 3), where spring run-off had dug a deep channel (50 to 75 cm deep) down to a gravel base on the western approach of the crossing. The inclination of the road and its exposed substrate lend itself to erosion. During the spring visit no siltation as a result of this erosion was occurring. The river was very turbid, attributable to a large natural bank slide approximately 5 km upstream of the crossing. Photographic plates of the ice bridges prior to and following break-up are presented on the following pages.

3.3 Spring Survey

The physical data on the streams sampled and the fish species encountered during the spring survey are given in Tables 2 and 3, respectively. Generally, the data indicates that the streams are similar to each other in pH, dissolved oxygen and conductivity.

Turbidity and spring flows showed variation between systems. This is no doubt reflective of the different watersheds; the Grainger River originates in the Nahanni Range, Tetcela River and the tributary to Sundog Creek drain the south-facing slopes of the Ram Plateau, while Prairie Creek originates in the Manetoe Range of the Mackenzie Mountains. Prairie Creek exhibited peak discharge during the survey, while in the other systems along the winter road peak discharges had occurred sometime earlier.

The fish species composition was also different between the systems examined (Table 3). Based on the sampling effort, the Tetcela River appeared to have the most species diversity, while in the Sundog Creek tributary only arctic grayling were found. Dolly Varden and mountain whitefish were encountered only in Prairie Creek. Arctic grayling were common to all streams sampled.

Specific observations on the streams, relative abundance and life history data of the fish caught at each stream is discussed in the following sections.

3.3.1 Winter Road Crossings

Helicopter overview of approximately 7 km upstream and 7 km downstream of the road crossings on the Grainger River, Tetcela River and the Sundog Creek tributary revealed no barriers to fish migration. Extensive dead fall caused by natural bank erosion on the Tetcela River and the Sundog Creek tributary also did not present physical barriers to migration. Fish congregations in these systems were not apparent from the air, perhaps due to the dark amber colour of the Grainger River and the turbidity of the Tetcela. Similarly, the Sundog Creek tributary with its dark shale-like substrate did not provide a good background for aerial observations.

All streams along the winter road, as previously mentioned, had reached peak discharge before the survey and the high water mark appeared to be 40-50 cm above the observed levels. Water levels on all systems except the Sundog Creek tributary were high. This system was relatively shallower with water depth not exceeding 20 cm in riffle areas. The turbidity of the Tetcela River at Site R4 appears to be due to a natural bank slump and erosion located approximately 5 km upstream of the road crossing. The slide does not constitute a barrier to fish migration and upstream of this natural process the water was clear.

In general, spawning areas with gravel substrate suitable for arctic grayling were available in all systems examined during the survey, both upstream and downstream of the winter road crossings. Spawning areas as described by Hatfield et al. (1972) were observed in the Grainger River. However the stream section immediately at the crossing on the Grainger does not contain suitable spawning habitat because most of the substrate (95%) was of pebble size or larger. Upstream and downstream of the crossing potential spawning areas were evident. At Site R5 on the Tetcela River the stream appeared suitable for grayling spawners in the vicinity of the crossing, but at Site R4 these habitats were limited. The substrate in the riffle area at Site R3 on the Sundog Creek tributary was estimated to be 50% gravel and sand, reported to be good substrate for spawning grayling (Tack, 1980). This system also exhibits a good pool to riffle development and extensive rearing areas.

The results of the fish sampling near the road crossings in these streams are given in Table 4. Fish catches were low; probably reflecting inhernetly low population levels. However, sampling efficiency cannot be discounted for results from the Grainger and Tetcela Rivers since high water levels prevented total coverage of the area by electrofisher. More species of fish were taken in both the Tetcela and Grainger Rivers during this survey than during the previous summer survey reported by Ker, Priestman and Associates Ltd. (1980). Of particular interest was the occurrence in 1981 of northern pike in the Grainger River. Hatfield et al. (1972) had reported the species as using the lower regions of the Grainger River as a rearing area.

Adult and juvenile grayling were found in all the systems sampled. The life history data collected for these species, although limited because of sample size, does shed light on the grayling utilization of the streams (Table 7). The data suggest that grayling spawners were present in all systems with the possible exception of R4, where only 1 juvenile was identified. This conclusion is further supported by the following observations in the state of maturity of the adult grayling captures:

Females	Males	Condition
	3	Immature
		Maturing
		Mature
8		Spawning
2	1	Spent

Most of the female graylings captured had fully developed eggs which were loose in the body cavity. Also, the egg counts of these fish were less than 1,500, suggesting that spawning was in progress and eggs had been exuded. Generally grayling females contain an average of 4,000-7,000 eggs (Scott and Crossman, 1973).

Female grayling spawners ranged from 153-248 mm fork length, 46-156 g weight, and were 3-5 years old. Male spawners ranged from 110-228 mm fork length, 16-101 g weight, and were 3-4 years old. The mature grayling of age 3 were found only in the Tetcela River. In Great Slave Lake most spawners are 6-9 years of age (McPhail and Lindsey, 1970; Scott and Crossman, 1973), but in other drainages of northern Canada and Alaska spawners mature at age 4 and 5 (Tack, 1971; Craig and Poulin, 1974; and de Bruyn and McCart, 1974). As well, in portions of the Donnelly River, N.W.T., grayling mature as early as age 2, but more become mature at ages 3 and 4 (Tripp and McCart, 1974). It is evident that age and size at maturity varies between different areas. The reason is unknown, although it could be a function of water temperature, latitude (Scott and Crossman, 1973) and/or food supply (Nikolsky, 1963).

The juvenile grayling captured in the systems were likely utilizing the area for feeding. The presence of juveniles with adults is interesting since adults home to specific spawning streams and spawning locations. Tack (1980) theorized that juveniles follow the adults to spawning areas; thus providing a mechanism for the imprintation of migration patterns.

Northern pike may also utilize sections of the Grainger River for spawning, as two spawning females and one spawning male were captured. Pike require flooded vegetation for reproduction (Scott and Crossman, 1973). Suitable spawning areas such as this may be present in sections of the Grainger during spring freshet, or in upstream areas not examined.

3.3.2 Prairie Creek

The fish capture results in Prairie and Harrison Creeks are presented in Table 5. Similar to the winter road sampling sites, the C.P.U.E. was low. Mountain whitefish was the most common fish in Prairie Creek, followed by slimy sculpin and Dolly Varden. Similar to the 1980 survey, arctic grayling were encountered only at Site M6, near the confluence of Prairie Creek and South Nahanni River. In contrast to the 1980 summer survey, whitefish were found in Prairie Creek upstream of Site M6. Juvenile and adult mountain whitefish and Dolly Varden were also captured, but 0+ individuals were absent. Dolly Varden fry emergence from gravel substrate occurs in late April to mid-May (Scott and Crossman, 1973), and if fry are present in Prairie Creek they should have appeared in catches.

Based on the results of both the 1980 and 1981 surveys, it appears that arctic grayling do not penetrate far upstream in Prairie Creek above its mouth. The species likely spawns near the confluence, since in 1980 fry were caught at M-6 and in the 1981 survey three males and one female in spawning condition were taken (Table 8). Other sources (R.D. Wickstrom and M. Johanson, pers. comm.) claim that grayling utilize Prairie Creek upsteam of station M-6. In the summer of 1981, grayling were found in very small numbers further upstream than M6, but within the park boundary (D. Sutherland, pers. comm.). The reason for this limited penetration of grayling up Prairie Creek is yet unknown. There appear to be no physical barriers to fish migration on the system, other than rapids and small chutes. The creek also appears to have some spawning potential for grayling in the section from M6 to M1A. The distribution of grayling in Prairie Creek may, however, be explanable for at least in Alaska, according to Tack (1980) grayling spawning is limited to the main stem of unsilted rivers and to the lower sections of their larger tributaries.

Harrison Creek (Site M3) was sampled near its confluence with Prairie Creek and small numbers of fish taken (Table 5). Sampling upstream of M3 yielded no results.

Fish utilization of Harrison Creek habitats upstream of M3 is not expected due to steep gradient, the absence of pools and subterranean flows during summer. During the spring survey the creek experienced periodic increases in turbidity near Station M3 and upstream of this site. Construction activity resulted in periodic siltation.

Dolly Varden in Prairie Creek were of age 3 to 9 (Table 6). Their size (fork length) is much smaller than those reported by Scott and Crossman (1973), perhaps related to the low productivity of Prairie Creek. The migration patterns of Dolly Varden in the Nahanni area is unknown. The occurrence of spawning in Prairie Creek is also unknown since no fall studies have been conducted, but unlikely since no young of the year have been captured. However, Scott and Crossman (1973) reported that the species has a strong homing instinct and that 3-4 year old individuals return to the gravelly stream in which they were spawned. The presence of these age classes in the spring survey may suggest that Dolly Varden spawning could occur in Prairie Creek. Sexual maturity is usually 3-6 years of age (Scott and Crossman, 1973). These age classes were present in Prairie Creek in the spring survey (Table 6).

The presence of mountain whitefish in Prairie Creek and their reported presence by Stein et al. (1973) in the Norman Wells and Fort Simpson areas of the Mackenzie River, significantly extends the northern distribution reported by McPhail and Lindsey (1970). The life histories of the whitefish from Prairie Creek are given in Table 6 and Table 8. They were of age 3 to 7 years and one 1 year old fish was also captured at Site M6. Their sizes (fork length) were much smaller than those reported by Stein et al. (1973) near Fort Simpson. Mountain whitefish are reported to be sexually mature at age 3 and 4 (Scott and Crossman, 1973). It is not known if they spawn in Prairie Creek, since as previously mentioned, no fall studies have been undertaken to date. Two whitefish fry were captured at Site M-6 in 1980, suggesting that there is successful whitefish spawning near the confluence with the south Nahanni River.

3.4 Trace Metal Analyses

Tables 9 and 10 summarize trace metal data for fish samples collected upstream and downstream of the minesite, respectively. At some stations the amount of tissue samples was small, as a result homogenates of several individual fish were required in order to provide sufficient tissue for laboratory treatment. Slimy sculpin samples necessitated fourteen and twelve individuals to enable tests from upstream and downstream locations, respectively.

The Canadian Food and Drug Directorate has established maximum levels of metals in consumable tissues (wet weight basis); these being:

Arsenic	-	5 µg/g
Copper	-	100 µg/g
Lead	-	10 µg/g
Zinc	-	100 µg/g
Mercury	-	0.50 µg/g

All samples collected in Prairie Creek exhibited trace metal levels that were below the government standard. Zinc concentrations appeared to be the highest, with slimy sculpin exhibiting the highest concentration of the three fish species tested. As noted in Ker, Priestman (1980), slimy sculpin are a resident species inhabiting stream bottoms and consequently have the potential of a greater frequency of exposure to sediment materials that may contain metals. Other species are migratory and inhabitat primarily the water column, therefore exposure would be lower, which is exemplified by lower concentrations both upstream and downstream of the mine (Dolly Varden and mountain whitefish).

Concentrations of zinc in slimy sculpin were 39 µg/g upstream and 48 µg/g downstream of the mine. Dolly Varden tissue exhibited a mean concentration of 7.1 µg/g zinc upstream and a mean of 3.9 µg/g downstream of the mine. Mean concentrations for mountain whitefish upstream and downstream were 6.5 µg/g and 6.2 µg/g, respectively.

In general, other metals were low and often below detectable levels for the amount of material available for analyses.

Comparing data from July 1980 and May 1981, indicates substantial increases in the concentration of some metal parameters. These increases were recorded at control and experimental stations. For example, in May 1980 slimy sculpin exhibited 4.7 µg/g zinc upstream and 7.5 µg/g downstream of the mine. In 1981, the respective locations increased to 39 and 48 µg/g. Mercury, lead and copper at control stations similarly increased slightly in May 1981 relative to July 1980. The fact that both control and experimental sites exhibited such marked increases (primarily sculpin) tends to suggest either accumulation since the previous survey or that the Prairie Creek system inherently displays a high degree of seasonal variability with respect to metal concentrations.

3.5 Benthic Invertebrates

Tables 11 and 12 summarize total number of organisms and total number of taxa collected during the May 1981 program. For comparative purposes, these data are also provided for the July 1980 survey. Tables 13 and 14 summarize taxonomic information on benthic samples with the organization of data into tolerance groups. Group 3 fauna consist of those organisms most sensitive to adverse changes in water quality; Group 2 are facultative forms and Group 1 are those most tolerant to negative impacts in water quality. Tables 15 through 22 summarize taxonomic and abundance information for the Prairie Creek mine site stations. Tables 23 through 29 summarize comparable data for the access road.

The most dominant orders of aquatic invertebrates were those categorized as Groups 3 and 2 (i.e. Ephemeroptera, Trichoptera, Plecoptera and Diptera, respectively). However, the most significant point regarding the May 1981 data base is the low sample sizes at virtually all stations. Station M1A (Table 11) supported the highest number of fauna, 108 per m^2, with the highest number of taxa, 22. Other stations associated with the mine site ranged from a low of 3 (Station M3) to a high of 77 organisms/m^2 (Station M5). Access road stations (Table 2) ranged from 4 to 67 organisms/m^2 (Stations R7U and R3, respectively).

Given the number of fauna collected in May 1981, it is not possible to utilize these figures as a basis for biological interpretation of environmental quality. It was the intention of the May program to increase data reliability by increasing sample replication from 4 (in 1980) to 8 (in May 1981). Based on Elliott (1971), the number of sampling units (i.e. replicates) required to provide a precision level of 20% (Standard Error expressed as a percent of the mean; this percentage is considered reasonable for benthic samples) for the 1980 data base was:

a) mine site stations = 15 replicates per station; and
b) access road stations = 12 replicates per station.

On these grounds, the number of replicates for 1981 was increased to 8 as a workable figure. However, based on comparable calculations for the May 1981 data base, the number of replicates required have increased to the following:

a) mine site stations = 32 replicates per stations; and
b) access road stations = 18 replicates per station.

It would appear that Prairie Creek exhibits considerable seasonal variability as well as not being a highly productive system in terms of benthic fauna. The low number of benthic organisms collected in May 1981 corroborates impressions elicited subsequent to the 1980 field program that densities of benthic invertebrates were low within the Prairie Creek system.

If future studies are to be undertaken in this area, the program be designed to accomodate artificial substrates to sample benthic invertebrates. This method tends to collect a greater number of fauna and effectively eliminates the factor of substrate variability at stations. A comparable substrate is provided at each sampling station (controls and experimental). As a result, the impact, or lack thereof, of water quality on communities of invertebrates inhabiting the samplers can be assessed with a greater degree of reliability. Some methods of artificial substrate sampling are provided in Bull (1978), Dickson et al. (1971) and Beak et al. (1973).

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TABLES

TABLE I: Winter Physical Data from Watercourses Associated with the Cadillac Mines Development

Waterbody	Sampling Location	Air Temp. (°C)	Water Temp. (°C)	Ice Thickness (cm)	Water Depth (cm)	D.O. (mg/l)
Grainger River (riffle)	1/2 km downstream of road crossing	-3.0	0.0	50	10	10.0
Grainger River (pool)	1/2 km downstream of road crossing	-3.0	0.0	70	8	10.0
Grainger River Tributary	at road crossing	1.0	-	25	-	-
Grainger River Tributary	upstream of road crossing	1.0	-	35	-	-
Lake in Grainger Pass		-4.0	1.5	68	200	1.0 (top) 0.75 (bottom)
Fish Trap Creek	1 km downstream of road crossing	-3.0	0.0	70	80	0.7 (top) 0.5 (bottom)
Tetcela River	riffle downstream from road crossing	-2.0	0.0	open	30	10.2
Sundog Creek Tributary	pool at road crossing	-2.0	-	90	-	-
	riffle at road crossing	-3.0	-	90	-	-
Prairie Creek	M-6	3.0	0.0	open	30	14.4
Prairie Creek	M-5	2.0	0.0	open	30	13.2
Prairie Creek	M-1	0.0	0.0	open	15-30	12.8

TABLE 2: Spring (May 21-25) Physical Data from Watercourses Associated with the Cadillac Mine Development

Waterbody	Sampling Location	Air Temp. (°C)	Water Temp. (°C)	Water Colour	pH	D.O. (cm)	Conductivity (microhms)
Grainger River	R7D	21	8.5	Dark-amber	7.5	10	168
Tetcela River	R5D	20	6.0	Turbid grey	7.4	12	285
Tetcela River	R4D	20	9.5	Turbid grey	7.3	11	195
Sundog Creek Tributary	R3	20	6.0	Light amber	7.1	11	145
Prairie Creek	M1A		6.0	Turbid green	7.6	11	205
Prairie Creek	M6	16	2.0	Turbid grey	7.6	14	190

TABLE 3: Scientific*, Common and Code Names of Fish Collected from Prairie Creek and the Most Important Fish-bearing Rivers Crossed by the Winter Road, 1981

Scientific Name	Common Name	Code	River Systems: Prairie Creek	Trib. Sundog Creek	Tetcela River	Grainger River
Salvelinus malma	Dolly Varden	DOLY	+			
Thymallus arcticus	Arctic Grayling	ARGR	+	+	+	+
Prosopium williamsoni	Mountain Whitefish	RMWF	+			
Esox lucius	Northern Pike	PIKE			+	+
Couesius plumbeus	Lake Chub	LACH			+	+
Rhinichthys cataractae	Longnose Dace	LODA			+	
Lota lota	Burbot	BURB			+	
Cotus cognatus	Slimy Sculpin	SLSC	+		+	+
TOTAL			4	1	6	4

* After Scott and Crossman (1973).

TABLE 4: The Fish Catches and Catch per Unit Effort (C.P.U.E.) for the River Systems Crossed by the Winter Road, May 1981

Station	Electroshocking		Gillnet		ARGR	PIKE	LACH	LODA	BURB	SLSC	Total
	Distance (m)	C.P.U.E. (fish/min)	hrs.	C.P.U.E. (fish/m/hr)							
Grainger River R#7	350	0.17	41.5	0.005	3(2,1)*	4(1,3)	2			4	13
Tetcela River R#4	500	0.066			1						1
Tetcela River R#5	600	1.54	17.3	0.005	19(6,13)	1(1,0)	48	1	1(1,0)	4	74
Trib. Sundog Cr. R#3	500	0.38			9(1,8)						9
Percent Composition					33.0	5.2	51.5	1.0	1.0	8.2	100.0

* (juvenile, adult)

TABLE 5: The Fish Catches and Catch per Unit Effort (C.P.U.E.) for the Prairie Creek System (includes Harrison Creek M#3), of May 1981

Station	Electroshocking Distance (m)	Electroshocking C.P.U.E. (fish/min)	Gillnet hrs.	Gillnet C.P.U.E. (fish/m/hr)	DOLY	ARGR	RMWF	SLSC	Total
M#1A	800	0.66			6(2,4)*		15(1,4)	4	25
M#1	850	0.96			4(4,0)		9(2,7)	20	33
M#2	75	2.24	3.5	0.19	6(5,1)		17(10,7)	11	34
M#3	250	0.90			2(1,1)		10(10,0)	8	20
M#4	500	1.15			5(1,4)		12(2,10)	6	23
M#5	750	0.62			1(0,1)		11(2,9)	10	22
M#5A	500	0.65	16.25	0.0	-		11(4,7)	4	15
M#6	500	0.48	13.25	0.04	3(0,3)	6(0,6)	6(1,5)	4	19
									191
Percent Composition					19.9	3.1	41.9	35.1	100.0

TABLE 6: Mean Length and Weight by Age Group for Dolly Varden and Mountain Whitefish, Prairie Creek, May 1981

	AGE					
	3	4	5	6	7	8
Dolly Varden						
Length (mm)						
N	4	5	2	2		3
Mean	109.8	145	197.5	240		307
Range	99-124	102-176	189-206	234-246		300-311
Weight (g)						
N	4	5	2	2		3
Mean	14.0	37.85	78.5	135.8		317.71
Range	9.95 - 19.04	12.07 - 57.22	60.55 - 96.45	123.82 - 147.77		298.44 345.99
Mountain Whitefish						
Length (mm)						
N	7	7	7	4	2	
Mean	154.7	191.0	209.9	238.2	225	
Range	142-168	178-210	196-226	220-269	222-228	
Weight (g)						
N	7	7	7	4	2	
Mean	36.88	81.16	97.20	129.82	111.57	
Range	27.77 - 45.84	69.84 - 96.78	82.79 - 131.03	105.39 - 179.91	104.26 - 118.87	

TABLE 7: Data Summary of Fish Survey Along Winter Road

Location Station Date	Species	Gear	Fork Length (mm)	Weight (g)	Age		Sex	Maturity	Eggs		Gonad		Stomach Content
					Scale	Otolith			Size (mm)	Number	Weight (g)	Width (mm)	
Grainger River - R#7													
230581	PIKE	GN	343	274.91	R		M	9			1.39	5.0	
230581	PIKE	GN	169	34.54	3		J						F
230581	PIKE	GN	551	1200.00	R		F	4		30			
230581	PIKE	GN	570	1325.00	8		F	4					
230581	ARGR	GN	248	156.08	5		F	4	3	50			
220581	ARGR	GN	127	19.41		2	J						
210581	ARGR	ES	157	36.03	3		J						
230581	LACH	GN	107	15.24			F	4	2	150			
220581	LACH	GN	98	12.95			F		1	310			
220581	SLSC	GN	60	2.08									
210581	SLSC	ES	65	2.10	3								
210581	SLSC	ES	52	1.71	2								
210581	SLSC	ES	33	0.49			J						
Tetcela River - R#5													
220581	PIKE	GN	224	79.46	5		J						F
220581	ARGR	ES	70	3.29	1		J						
220581	ARGR	ES	62	2.21	1		J						
220581	ARGR	ES	85	5.66	1		J						
220581	ARGR	ES	153	33.44	3		M	6					
220581	ARGR	GN	193	68.13	4	4	F	5		3			
220581	ARGR	GN	204	80.30	4	5	F	4		318			
220581	ARGR	GN	184	70.05	4	4	F	5					

TABLE 7 Cont'd: Data Summary of Fish Survey Along Winter Road

Location Station Date	Species	Gear	Fork Length (mm)	Weight (g)	Age		Sex	Maturity	Eggs		Gonad		Stomach Content
					Scale	Otolith			Size (mm)	Number	Weight (g)	Width (mm)	
Tetcela River - R#5													
240581	ARGR	ES	110	16.29	3		M	6					
240581	ARGR	ES	146	33.03	3	3	J						
240581	ARGR	ES	151	33.62	3		J						
240581	ARGR	ES	153	46.83	3	3	F	4	2	290			
220581	LACH	ES	67	2.98	1		J						
220581	LACH	ES	63	2.33	1		J						
220581	LACH	ES	54	1.23	1		J						
220581	LACH	ES	53	1.19	1		J						
220581	LACH	ES	55	1.44	1		J						
220581	LACH	ES	30	1.18	1		J						
220581	LACH	ES	30	0.31			J						
220581	SLSC	ES	48	1.64	2	2							
220581	BURB	ES	237	71.74			J						
Sundog Creek - R#3													
220581	ARGR	ES	226	115.02	5	5	F	4	2	1020			B
220581	ARGR	ES	226	141.35	5	5	F	4		1250			B,E
220581	ARGR	ES	224	128.27	5	5	F	4		1050			
220581	ARGR	ES	204	95.30	4	4	F	4		820			
220581	ARGR	ES	157	34.86	3	3	M	6					
220581	ARGR	ES	214	125.44	4	4	F	4		1230			
220581	ARGR	ES	228	101.56	4	4	M	10			0.35	4	

TABLE 8: Data Summary of Fish Survey on Prairie Creek

Location Station Date	Species	Gear	Fork Length (mm)	Weight (g)	Age		Sex	Maturity	Eggs		Gonad		Stomach Content
					Scale	Otolith			Size (mm)	Number	Weight (g)	Width (mm)	
M#1A													
230581	DOLY	ES	124	19.04		3	J						
230581	DOLY	ES	136	25.70			J						
230581	DOLY	ES	246	147.77		6	A						
230581	DOLY	ES	206	96.45		5							F
230581	DOLY	ES	176	55.55		4							
230581	RMWF	ES	222	118.87	7								
230581	RMWF	ES	208	103.90	5								
230581	RMWF	ES	168	41.77	3								
230581	SLSC	ES	76	4.47			F	2					
230581	SLSC	ES	63	2.31									
M#1													
240581	SLSC	ES	78	4.97									
240581	SLSC	ES	71	3.73									
240581	SLSC	ES	46	1.08									
240581	SLSC	ES	48	1.21									
240581	SLSC	ES	40	0.62									
M#2													
240581	DOLY	GN	234	123.82		6	A						
240581	DOLY	ES	121	23.08		4	J						
240581	DOLY	ES	104	12.35		3	J						
240581	DOLY	ES	112	14.66		3	J						
240581	DOLY	ES	99	9.95		3	J						

TABLE 8 Cont'd: Data Summary of Fish Survey on Prairie Creek

Location Station Date	Species	Gear	Fork Length (mm)	Weight (g)	Age		Sex	Maturity	Eggs		Gonad		Stomach Content
					Scale	Otolith			Size (mm)	Number	Weight (g)	Width (mm)	
M#2													
240581	RMWF	ES	230	113.83	6		A						
240581	RMWF	ES	220	105.39	6		A						
240581	RMWF	ES	196	84.78	5		A						
240581	RMWF	ES	208	92.38	5		A						
240581	RMWF	ES	210	98.57	R		A						
240581	RMWF	ES	183	75.06	4								
240581	RMWF	ES	157	39.04	3								
240581	RMWF	ES	162	35.36	3								
240581	RMWF	ES	146	38.03	3								
240581	RMWF	ES	142	29.48	3								
240581	RMWF	ES	118	15.18	2								
240581	RMWF	GN	269	179.91	6		A						
240581	RMWF	GN	234	120.13	6		A						
240581	RMWF	GN	241	135.16	R		A						

TABLE 8 Cont'd: Data Summary of Fish Survey on Prairie Creek

Location Station Date	Species	Gear	Fork Length (mm)	Weight (g)	Age		Sex	Maturity	Eggs		Gonad		Stomach Content
					Scale	Otolith			Size (mm)	Number	Weight (g)	Width (mm)	
M#2													
240581	SLSC	ES	88	7.92									
240581	SLSC	ES	81	7.33									
240581	SLSC	ES	75	4.38									
240581	SLSC	ES	80	6.61									
240581	SLSC	ES	69	4.31									
240581	SLSC	ES	71	3.26									
240581	SLSC	ES	39	0.53									
M#4													
250581	DOLY	ES	311	345.99		8	A						F
250581	DOLY	ES	252	169.28			A						
250581	DOLY	ES	189	60.55		5							
250581	SLSC	ES	168	57.22		4							
250581	SLSC	ES	97	9.70									
250581	SLSC	ES	88	7.29									
250581	SLSC	ES	91	10.05									
250581	SLSC	ES	72	4.32									

TABLE 8 Cont'd: Data Summary of Fish Survey on Prairie Creek

Location Station Date	Species	Gear	Fork Length (mm)	Weight (g)	Age		Sex	Maturity	Eggs		Gonad		Stomach Content
					Scale	Otolith			Size (mm)	Number	Weight (g)	Width (mm)	
M#5													
250581	DOLY	ES	102	12.07	R	4							
250581	RMWF	ES	228	104.26	7								
250581	RMWF	ES	212	89.73	5								
250581	RMWF	ES	205	82.79	5								
250581	RMWF	ES	214	95.82	5								
250581	RMWF	ES	181	69.84	4								
250581	RMWF	ES	58	1.88			J						
250581	SLSC	ES	81	7.33									
250581	SLSC	ES	81	6.10									
250581	SLSC	ES	82	8.30									
250581	SLSC	ES	79	8.12									
250581	SLSC	ES	74	7.85			F	2		200			
250581	SLSC	ES	70	3.32									
250581	SLSC	ES	68	4.90									
250581	SLSC	ES	59	2.36									
M#5A													
230581	RMWF	ES	194	82.78	4								
230581	RMWF	ES	210	96.78	4								
230581	RMWF	ES	178	79.00	4								
230581	RMWF	ES	166	45.84	3								
230581	RMWF	ES	128	19.75	R								
230581	RMWF	ES	67	2.66			J						

TABLE 8 Cont'd: Data Summary of Fish Survey on Prairie Creek

Location Station Date	Species	Gear	Fork Length (mm)	Weight (g)	Age		Sex	Maturity	Eggs		Gonad		Stomach Content
					Scale	Otolith			Size (mm)	Number	Weight (g)	Width (mm)	
M#6													
230581	ARGR	GN	240	163.52	R		M	6					
230581	ARGR	GN	282	354.69	6		F	4	2	3317			
230581	ARGR	GN	345	510.00	R		M	9					
230581	ARGR	GN	326	475.00	6		M	9					
230581	ARGR	GN	320	460.00	6		M	9					
230581	DOLY	ES	158	41.31		4	M	6					
230581	DOLY	GN	300	286.41		8	M	6					
230581	DOLY	GN	310	320.71		8	M	6					
230581	RMWF	ES	193	74.58	4		F	1					
230581	RMWF	ES	198	90.05	4		M	6					
230581	RMWF	ES	142	27.77	3		M	6					
230581	RMWF	ES	68	3.02	1		J						
230581	RMWF	GN	226	131.03	5	5	F	1					

TABLE 9: Summary of Trace Metal Analyses, Prairie Creek, May 1981 (Upstream of Mine Site)

Parameter	Sample No. & Station 1* (M1,M1A,M2)	2† (M1A,M2)	3 (M1A)	4 (M1A)	5 (M1A)	6 (M2)	7 (M2)	8 (M2)	9 (M2)	10 (M2)
Fish Species	SS	DV	DV	DV	DV	DV	DV	MW	MW	MW
No. Fish in Sample	14	3	1	1	1	1	3	1	1	1
Fork Length (mm)										
Range	39-88	99-136	246	206	176	234	104-127	230	220	196
Mean	66.0	119.7	-	-	-	-	81.0	-	-	-
Std. Dev.	16.2	18.9	-	-	-	-	60.9	-	-	-
Weight (gm)										
Range	0.53-7.92	10.0-25.7	147.8	96.5	55.6	123.8	12.3-23.1	113.8	105.4	84.8
Mean	3.8	15.2	-	-	-	-	16.7	-	-	-
Std. Dev.	2.4	12.8	-	-	-	-	5.6	-	-	-
% Moisture	79	79	79	79	79	81	77	78	77	78
Metals (µg/g wet wt.)										
Cadmium	< 0.97	< 1.2	< 0.77	< 1.1	< 1.5	< 0.83	< 2.5	< 0.81	< 0.94	< 1.2
Copper	3.5	1.7	1.4	< 1.1	1.5	2.2	3.0	0.81	2.1	1.7
Lead	2.1	< 2.4	< 1.6	< 2.2	< 3.1	< 1.7	< 5.0	< 1.6	< 1.9	< 2.6
Mercury	0.16	< 0.033	0.058	0.034	0.048	0.070	< 0.034	< 0.023	< 0.023	< 0.030
Zinc	39	7.2	6.6	4.8	7.8	4.9	11	5.9	5.6	8.1
Arsenic	0.46	< 0.16	0.24	< 0.15	< 0.21	0.18	< 0.34	0.27	< 0.13	< 0.16

Note: For sculpin tissue homogenates of whole fish were used in the analyses to provide a sufficient sample; dorsal musculature was excised from other species.

Std. Dev. = ± 1 Standard Deviation

SS = Slimy Sculpin
DV = Dolly Varden Char
MW = Rocky Mountain Whitefish

* M1 = 5 Fish
M1A = 2 Fish
M2 = 7 Fish

† M1A = 2 Fish
M2 = 1 Fish

Detection limits varied as a result of variations in the amount of tissue available for analysis

Table 10: Summary of Trace Metal Analyses, Prairie Creek, May 1981 (Downstream of Mine Site)

Parameter	11* (M4,M5)	12 (M4)	13 (M4)	14 (M4)	15 (M4,M5)	16 (M5)	17 (M5)	18 (M5)	19 (M5)	20 (M5)
	Sample No. & Station									
Fish Species	SS	DV	DV	DV	DV	MW	MW	MW	MW	MW
No. Fish in Sample	12	1	1	1	2	1	1	1	1	1
Fork Length (mm)										
Range	59-97	311	252	189	168-102	228	212	205	214	181
Mean	71.8	-	-	-	135.0	-	-	-	-	-
Std. Dev.	22.5	-	-	-	46.7	-	-	-	-	-
Weight (gm)										
Range	2.4-10.1	346.0	169.3	68.6	12.1-57.2	104.6	89.7	82.8	95.8	65.8
Mean	6.8	-	-	-	34.7	-	-	-	-	-
Std. Dev.	2.3	-	-	-	31.9	-	-	-	-	-
% Moisture	79	78	80	81	80	78	83	79	80	81
Metals (µg/g wet wt.)										
Cadmium	<0.78	<0.98	<0.99	<1.3	<0.97	<1.5	<1.1	<1.2	<0.97	<1.1
Copper	1.1	0.98	<0.99	2.1	<0.97	<1.5	1.7	2.5	2.1	2.1
Lead	<1.6	<2.0	<2.0	<2.6	<1.9	<2.9	<2.1	<2.5	<1.9	<2.1
Mercury	0.20	0.094	0.044	<0.028	0.034	<0.033	<0.028	0.026	<0.031	<0.031
Zinc	48	4.2	4.2	4.3	2.9	11	4.4	6.8	4.4	4.6
Arsenic	0.21	<0.10	0.092	<0.29	0.40	0.32	<0.34	0.21	0.25	<0.18

Note: For sculpin tissue homogenates of whole fish were used in the analyses to provide a sufficient sample; dorsal musculature was excised from other species.

Std. Dev. = ± 1 Standard Deviation

SS = Slimy Sculpin
DV = Dolly Varden Char
MW = Rocky Mountain Whitefish

* M4 = 4 Fish
M5 = 8 Fish

Detection limits varied as a result of variations in the amount of tissue available for analysis

TABLE 11: Summary of Benthic Invertebrate Data, Prairie Creek Stations, July 1980 and May 1981 (Surber Samples).

PARAMETER	STATIONS M1A	M1	M2	M3*	M4	M5	M5A	M6
Total No. Organisms/m^2								
July 1980†	-	156	94	334	215	349	-	-
May 1981	108	11	53	3	45	77	26	75
Total No. Taxa Sampled								
July 1980†	-	14	8	20	12	7	-	-
May 1981	22	3	9	1	11	12	9	11

* Station M3 situated in Harrison Creek.

† 1980 data based on 4 replicates per station; 1981 data based on 8 replicates per station.

TABLE 12: Summary of Benthic Invertebrate Data, Winter Road Stations, July 1980 and May 1981 (Surber Samples).

PARAMETER	Ram River Tributary #2	Tetcela River				Grainger River	
	R3	R4U	R4D	R5U	R5D	R7U	R7D
Total No. Organisms/m²							
July 1980*	97	51	33	46	17	108	404
May 1981	67	39	13	28	21	4	11
Total No. Taxa Sampled							
July 1980*	9	5	4	8	5	18	22
May 1981	11	8	3	14	8	4	7

* 1980 data based on 4 replicates per station; 1981 data based on 8 replicates per station.

NOTE:

Station R4U - upstream of confluence with unnamed tributary and upstream road crossing

Station R4D - upstream of confluence with unnamed tributary and downstream of road crossing

Station R5U - downstream of confluence with unnamed tributary and upstream of road crossing

Station R5D - downstream of confluence with unnamed tributary and downstream of road crossing

Station R7U - upstream of road crossing

Station R7D - downstream of road crossing

TABLE 13: Summary of Benthic Invertebrate Identification (Mine Site)

Detailed Identification
Cadillac Mines - K4606
Surber Samples

Taxa	Life Stage*	Mean No. Organisms/m^2 Prairie Creek M1	Prairie Creek M1-A	Prairie Creek M2	Harrison Creek M3	Prairie Creek M4	Prairie Creek M5	Prairie Creek M5-A	Prairie Creek M6
GROUP 3 ORGANISMS									
EPHEMEROPTERA									
Heptageniidae									
Rhithrogena sp.	N	6.5	10.8	26.9	-	25.8	37.6	11.8	25.8
Cinygmula sp.	N	3.2	35.5	9.7	-	4.3	10.8	1.1	5.4
Epeorus (Iron) sp.	N	-	3.2	1.1	-	3.2	6.5	1.1	16.1
E. (Ironopsis) sp.	N	-	-	-	-	-	-	1.1	-
Baetidae									
Baetis insignificans	N	-	3.2	3.2	-	4.3	4.3	6.5	3.2
B. sp.	N	-	3.2	-	-	1.1	-	-	-
Siphlonuridae									
Ameletus sp.	N	-	5.4	-	-	1.1	-	1.1	-
Ephemerellidae									
Ephemerella (Ephemerella) inermis	N	-	1.1	-	-	-	-	-	-
E. (Drunella) doddsi	N	-	3.2	4.3	-	1.1	5.4	-	-
E. sp.	N	-	1.1	-	-	-	-	-	-
TRICHOPTERA									
Hydropsychidae									
Arctopsyche grandis	L	-	1.1	-	-	-	-	-	-
Parapsyche elsis	L	-	-	1.1	-	1.1	-	-	3.2
Rhyacophilidae									
Rhyacophila sp.	L	-	-	-	-	1.1	-	-	1.1

TABLE 13 Cont'd: Summary of Benthic Invertebrate Identification (Mine Site)

Detailed Identification
Cadillac Mines - K4606
Surber Samples

		Mean No. Organisms/m^2							
	Life	Prairie Creek			Harrison Creek	Prairie Creek			
Taxa	Stage*	M1	M1-A	M2	M3	M4	M5	M5-A	M6
GROUP 3 ORGANISMS Cont'd.									
PLECOPTERA									
Filipalpia									
Nemouridae									
Nemoura (Zapada) sp.	EA	-	1.1	-	-	-	-	-	-
Nemoura (Zapada) sp.	N	-	1.1	-	-	-	-	-	-
Nemoura sp.	N	-	-	-	3.2	-	3.2	1.1	11.8
Capniinae	N	-	1.1	4.3	-	-	-	1.1	-
Setipalpia									
Chloroperlidae									
Hastaperla sp.	N	1.1	1.1	1.1	-	-	3.2	-	3.2
Perlodidae									
Isoperla ?fulva	N	-	1.1	-	-	-	-	-	-
Isogenus sp.	N	-	-	-	-	-	3.2	-	-
GROUP 2 ORGANISMS									
DIPTERA									
Chironomidae									
Chironominae									
Tanytarsus sp. 1	L	-	10.8	-	-	-	-	-	-

TABLE 13 Cont'd: Summary of Benthic Invertebrate Identification (Mine Site)

Detailed Identification
Cadillac Mines - K4606
Surber Samples

Taxa	Life Stage*	Prairie Creek M1	Prairie Creek M1-A	Prairie Creek M2	Harrison Creek M3	Prairie Creek M4	Prairie Creek M5	Prairie Creek M5-A	Prairie Creek M6
		Mean No. Organisms/m^2							
GROUP 2 ORGANISMS Cont'd.									
DIPTERA Cont'd.									
Orthocladiinae									
Eukiefferiella sp.	L	-	8.6	-	-	-	1.1	-	-
Cricotopus (Cricotopus) or Orthocladius (Orthocladius) sp.	L	-	5.4	-	-	-	-	-	-
Rheocricotopus sp.	L	-	1.1	-	-	-	1.1	-	-
Orthocladiinae - indet.	L	-	5.4	-	-	-	-	-	-
Blephariceridae									
Bibiocephala sp.	L	-	-	1.1	-	-	-	-	-
Empididae									
Wiedemannia sp.	L	-	-	-	-	-	-	-	1.1
Empididae - indet.	I	-	1.1	-	-	1.1	-	-	-
Orthorrhaphous Brachycera - F. ?Tabanidae	L	-	-	-	-	-	1.1	-	3.2
HYDRACARINA									
Hygrobatidae	A	-	1.1	-	-	-	-	-	-
TURBELLARIA		-	1.1	-	-	-	-	-	-
NEMATODA		-	-	-	-	1.1	-	1.1	-

TABLE 13 Cont'd: Summary of Benthic Invertebrate Identification (Mine Site)

Detailed Identification
Cadillac Mines - K4606
Surber Samples

		Mean No. Organisms/m^2							
		Prairie Creek			Harrison Creek	Prairie Creek			
Taxa	Life Stage*	M1	M1-A	M2	M3	M4	M5	M5-A	M6
GROUP I ORGANISMS									
OLIGOCHAETA									
Lumbriculidae		-	-	-	-	-	1.1	-	1.1
TOTAL MEAN ORGANISMS/M^2		10.8	107.9	52.8	3.2	45.3	76.5	26.0	75.2
TOTAL TAXA/STATION		3	22	9	1	11	12	9	11

* N = nymph
L = larvae
I = immature
A = adult

TABLE 14: Summary of Benthic Invertebrate Identifications (Access Road)

Detailed Identification
Cadillac Mines - K4606
Surber Samples

Taxa	Life Stage*	Mean No. Organisms/m^2						
		Sundog Creek	Tetcela River				Grainger River	
		R3	R4-D	R4-U	R5-D	R5-U	R7-D	R7-U
GROUP 3 ORGANISMS								
EPHEMEROPTERA								
Heptageniidae								
Rhithrogena sp.	N	-	-	-	-	3.2	-	1.1
Cinygmula sp.	N	3.2	-	-	3.2	4.3	-	-
Heptagenia ?flavescens	N	-	-	-	-	-	4.3	-
Baetidae								
Baetis sp.	N	-	-	-	1.1	1.1	-	-
Ephemerellidae								
Ephemerella (Ephemerella) inermis	N	-	-	-	6.5	1.1	-	-
E. (Drunella) grandis ingens	N	-	-	-	-	1.1	-	-
Baetiscidae								
Baetisca sp.	N	-	-	-	-	-	1.1	-
TRICHOPTERA								
Brachycentridae								
Brachycentrus americanus	N	-	-	1.1	-	-	-	-
B. sp.	N	-	-	1.1	-	-	-	-

TABLE 14 Cont'd: Summary of Benthic Invertebrate Identifications (Access Road)

Detailed Identification
Cadillac Mines - K4606
Surber Samples

Taxa	Life Stage*	Sundog Creek R3	Tetcela River R4-D	Tetcela River R4-U	Tetcela River R5-D	Tetcela River R5-U	Grainger River R7-D	Grainger River R7-U
			Mean No. Organisms/m^2					
GROUP 3 ORGANISMS Cont'd.								
TRICHOPTERA Cont'd.								
Glossosomatidae								
Glossosoma sp.	N	-	-	1.1	-	-	-	-
Lepidostomatidae								
Lepidostoma sp.	L	-	-	-	1.1	1.1	-	-
Hydropsychidae								
Arctopsyche ladogensis	L	-	-	-	-	1.1	-	-
Leptoceridae	I	-	-	-	-	-	1.1	-
PLECOPTERA								
Filipalpia								
Nemouridae								
Nemoura sp.	N	14.0	10.8	31.2	-	3.2	-	-
Taeniopterygidae								
Taenionema sp.	N	-	-	-	-	1.1	-	-
Capniinae	N	-	-	-	-	1.1	-	-
Setipalpia								
Chloroperlidae								
Alloperla sp.	N	-	-	-	-	1.1	-	-
Chloroperlidae (wing pads absent)	N	-	-	1.1	-	-	-	-

TABLE 14 Cont'd: Summary of Benthic Invertebrate Identifications (Access Road)

Detailed Identification
Cadillac Mines - K4606
Surber Samples

Taxa	Life Stage*	Sundog Creek R3	Tetcela River R4-D	Tetcela River R4-U	Tetcela River R5-D	Tetcela River R5-U	Grainger River R7-D	Grainger River R7-U
		Mean No. Organisms/m^2						
GROUP 3 ORGANISMS Cont'd.								
COLEOPTERA								
Chrysomelidae								
Galerucella sp.	L	-	-	1.1	-	-	-	-
GROUP 2 ORGANISMS								
DIPTERA								
Chironomidae								
Chironominae								
Demicryptochironomus sp.	L	-	-	-	-	-	-	1.1
Tanytarsus sp. 1	L	1.1	-	-	-	-	-	-
Stictochironomus sp.	L	-	1.1	-	-	-	-	1.1
Microtendipes pedellus	L	-	-	-	-	-	1.1	-
Orthocladiinae								
Diplocladius cultriger	L	4.3	-	-	-	-	-	-
Cricotopus (Cricotopus) or *Orthocladius (Orthocladius)* sp.	L	10.8	-	-	-	-	-	-
Cricotopus sp.	L	-	-	1.1	-	1.1	-	-
Smittia group	L	-	-	-	1.1	-	-	-

TABLE 14 Cont'd: Summary of Benthic Invertebrate Identifications (Access Road)

Detailed Identification
Cadillac Mines - K4606
Surber Samples

Taxa	Life Stage*	Sundog Creek	Tetcela River				Grainger River	
		Mean No. Organisms/m²						
		R3	R4-D	R4-U	R5-D	R5-U	R7-D	R7-U
GROUP 2 ORGANISMS Cont'd.								
DIPTERA Cont'd.								
Orthocladiinae - indeterminate	L	4.3	-	1.1	-	-	1.1	-
Empididae								
?Chelifera sp.	L	17.2	-	-	3.2	-	-	-
Tipulidae								
Tipula sp.	L	5.4	-	-	-	-	-	-
Dicranota sp.	L	1.1	-	-	-	-	-	-
Limnophila sp.	L	-	-	-	1.1	-	-	-
Muscidae	P	4.3	-	-	-	-	-	-
Simuliidae	L	-	-	-	3.2	-	1.1	-
Athericidae								
Atherix sp.	L	-	-	-	-	4.3	-	-
NEMATODA		1.1	-	-	-	3.2	1.1	1.1
GROUP 1 ORGANISMS								
OLIGOCHAETA								
Tubificidae		-	1.1	-	-	-	-	-

TABLE 14 Cont'd: Summary of Benthic Invertebrate Identifications (Access Road)

Detailed Identification
Cadillac Mines - K4606
Surber Samples

		Mean No. Organisms/m^2						
		Sundog Creek	Tetcela River				Grainger River	
Taxa	Life Stage*	R3	R4-D	R4-U	R5-D	R5-U	R7-D	R7-U
TOTAL MEAN ORGANISMS/M^2		66.8	13.0	38.9	20.5	28.1	10.9	4.4
TOTAL TAXA/STATION		11	3	8	8	14	7	4

* N = nymph
L = larvae
I = immature
P = pupae

SECTION A

BENTHIC INVERTEBRATE IDENTIFICATIONS

MINE SITE

TABLE 15: Benthic Invertebrate Identifications (Mine Site)

Detailed Identification
Cadillac Mines - K4606
Surber Samples
Station: Prairie Ck. - M1

Taxa	Life Stage*	Replicate 1	2	3	4	5	6	7	8	Total No. organisms	Mean No./ sample	Mean No./ m^2
GROUP 3 ORGANISMS												
EPHEMEROPTERA												
Heptageniidae												
Rhithrogena sp.	N	-	3	1	-	-	-	1	-	5	0.6	6.5
Cinygmula sp.	N	2	-	-	-	-	-	-	-	2	0.3	3.2
PLECOPTERA												
Setipalpia												
Chloroperlidae												
Hastaperla sp.	N	-	-	-	-	-	-	-	1	1	0.1	1.1
TOTAL NUMBER OF ORGANISMS		2	3	1	0	0	0	1	1	8	1.0	10.8
TOTAL NUMBER OF TAXA		1	1	1	0	0	0	1	1	3		

* N = nymph

TABLE 16: Benthic Invertebrate Identifications (Mine Site)

Detailed Identification
Cadillac Mines - K4606
Surber Samples
Station: Prairie Ck. - MI-A

Taxa	Life Stage*	Replicate 1	2	3	4	5	6	7	8	Total No. organisms	Mean No./ sample	Mean No./ m^2
GROUP 3 ORGANISMS												
EPHEMEROPTERA												
Heptageniidae												
Rhithrogena sp.	N	-	1	3	-	-	-	1	3	8	1.0	10.8
Cinygmula sp.	N	2	2	3	1	3	1	4	10	26	3.3	35.5
Epeorus (Iron) sp.	N	-	-	1	-	-	-	-	1	2	0.3	3.2
Baetidae												
Baetis sp. - damaged	N	2	-	-	-	-	-	-	-	2	0.3	3.2
B. insignificans	N	-	-	-	-	-	-	-	2	2	0.3	3.2
Siphlonuridae												
Ameletus sp.	N	3	-	-	-	-	-	1	-	4	0.5	5.4
Ephemerellidae												
Ephemerella (Ephemerella) inermis	N	-	-	-	-	-	-	-	1	1	0.1	1.1
Ephemerella (Drunella) doddsi	N	-	1	1	-	-	-	-	-	2	0.3	3.2
Ephemerella sp.	N	-	1	-	-	-	-	-	-	1	0.1	1.1
TRICHOPTERA												
Hydropsychidae												
Arctopsyche grandis	L	-	1	-	-	-	-	-	-	1	0.1	1.1

TABLE 16 Cont'd: Benthic Invertebrate Identifications (Mine Site)

Detailed Identification
Cadillac Mines - K4606
Surber Samples
Station: Prairie Ck. - M1-A

Taxa	Life Stage*	Replicate 1	2	3	4	5	6	7	8	Total No. organisms	Mean No./ sample	Mean No./ m^2
GROUP 3 ORGANISMS Cont'd												
PLECOPTERA												
Filipalpia												
Nemouridae												
Nemoura (Zapada) sp.	N	1	-	-	-	-	-	-	-	1	0.1	1.1
Nemoura (Zapada) sp.	EA	-	-	-	-	-	1	-	-	1	0.1	1.1
Capniinae	N	-	-	-	-	-	-	-	1	1	0.1	1.1
Setipalpia												
Chloroperlidae												
Hastaperla sp.	N	-	-	1	-	-	-	-	-	1	0.1	1.1
Perlodidae												
Isoperla ?fulva	N	-	-	-	-	-	-	-	1	1	0.1	1.1
GROUP 2 ORGANISMS												
DIPTERA												
Chironomidae												
Chironominae												
Tanytarsus sp. 1	L	-	-	-	-	-	-	-	8	8	1.0	10.8

TABLE 16 Cont'd: Benthic Invertebrate Identifications (Mine Site)

Detailed Identification
Cadillac Mines - K4606
Surber Samples
Station: Prairie Ck. - MI-A

Taxa	Life Stage*	Replicate 1	2	3	4	5	6	7	8	Total No. organisms	Mean No./ sample	Mean No./ m^2
DIPTERA Cont'd.												
Orthocladiinae												
Eukiefferiella sp.	L	-	1	-	-	-	-	-	5	6	0.8	8.6
Cricotopus (Cricotopus) or *(Orthocladius)* sp.	L	-	-	-	-	-	-	-	4	4	0.5	5.4
Rheocricotopus sp.	L	-	-	1	-	-	-	-	-	1	0.1	1.1
Orthocladiinae - indeterminate												
Empididae	I	-	-	-	-	-	-	-	1	1	0.1	1.1
HYDRACARINA												
Hygrobatidae	A	-	-	-	-	-	-	-	1	1	0.1	1.1
TURBELLARIA		-	-	-	-	-	-	-	1	1	0.1	1.1
TOTAL NUMBER OF ORGANISMS		8	8	10	1	3	2	6	42	80	10.0	107.9
TOTAL NUMBER OF TAXA		4	7	6	1	1	2	3	14	22	5	
Also Present: Pisces larvae		-	-	1	-	-	-	-	-	1		

* N = nymph
L = larvae
A = adult
EA = emergent adult

TABLE 17: Benthic Invertebrate Identifications (Mine Site)

Detailed Identification
Cadillac Mines - K4606
Surber Samples
Station: Prairie Ck. - M2

Taxa	Life Stage*	Replicate 1	2	3	4	5	6	7	8	Total No. organisms	Mean No./ sample	Mean No./ m^2
GROUP 3 ORGANISMS												
EPHEMEROPTERA												
Heptageniidae												
Rhithrogena sp.	N	1	1	2	2	7	3	4	-	20	2.5	26.9
Cinygmula sp.	N	-	1	-	1	-	1	3	1	7	0.9	9.7
Epeorus (Iron) sp.	N	-	-	-	-	-	-	1	-	1	0.1	1.1
Baetidae												
Baetis insignificans	N	-	-	2	-	-	-	-	-	2	0.3	3.2
Ephemerellidae												
Ephemerella (Drunella) doddsi	N	-	-	-	-	1	1	1	-	3	0.4	4.3
TRICHOPTERA												
Hydropsychidae												
Parapsyche elsis	L	-	-	-	-	-	1	-	-	1	0.1	1.1
PLECOPTERA												
Filipalpia												
Capniinae	N	1	-	-	-	-	-	1	1	3	0.4	4.3
Setipalpia												
Chloroperlidae												
Hastaperla sp.	N	-	-	-	-	-	1	-	-	1	0.1	1.1

TABLE 17 Cont'd: Benthic Invertebrate Identifications (Mine Site)

Detailed Identification
Cadillac Mines - K4606
Surber Samples
Station: Prairie Ck. - M2

Taxa	Life Stage*	Replicate 1	2	3	4	5	6	7	8	Total No. organisms	Mean No./ sample	Mean No./ m2
GROUP 2 ORGANISMS												
DIPTERA												
Blephariceridae												
Bibiocephala sp.	L	-	-	-	-	-	-	1	-	1	0.1	1.1
TOTAL NUMBER OF ORGANISMS		2	2	4	3	8	7	11	2	39	4.9	52.8
TOTAL NUMBER OF TAXA		2	2	2	2	2	5	6	2	9	3	
Also Present: Diptera - Nematocera	A	1	-	-	-	-	-	-	-	1		
Homoptera	A	-	-	-	-	-	-	1	-	1		

* N = nymph
L = larvae
A = adult

TABLE 18: Benthic Invertebrate Identifications (Mine Site)

Detailed Identification
Cadillac Mines - K4606
Surber Samples
Station: Harrison Creek - M3

Taxa	Life Stage*	Replicate 1	2	3	4	5	6	7	8	Total No. organisms	Mean No./ sample	Mean No./ m2
GROUP 3 ORGANISMS												
PLECOPTERA												
Filipalpia												
Nemouridae												
Nemoura sp.	N	1	-	-	-	-	-	1	-	2	0.3	3.2
TOTAL NUMBER OF ORGANISMS		1	0	0	0	0	0	1	0	2	0.3	3.2
TOTAL NUMBER OF TAXA		1	0	0	0	0	0	1	0	1		

* N = nymph

TABLE 19: Benthic Invertebrate Identifications (Mine Site)

Detailed Identification
Cadillac Mines - K4606
Surber Samples
Station: Prairie Creek - M4

Taxa	Life Stage*	Replicate 1	2	3	4	5	6	7	8	Total No. organisms	Mean No./ sample	Mean No./ m^2
GROUP 3 ORGANISMS												
EPHEMEROPTERA												
Heptageniidae												
Rhithrogena sp.	N	8	8	1	1	-	1	-	-	19	2.4	25.8
Epeorus (Iron) sp.	N	1	-	-	-	1	-	-	-	2	0.3	3.2
Cinygmula sp.	N	-	1	-	-	1	-	1	-	3	0.4	4.3
Baetidae												
Baetis insignificans	N	-	-	3	-	-	-	-	-	3	0.4	4.3
B. sp.	N	-	-	-	-	-	-	1	-	1	0.1	1.1
Siphlonuridae												
Ameletus sp.	N	-	-	-	-	1	-	-	-	1	0.1	1.1
Ephemerellidae												
Ephemerella (Drunella) doddsi	N	1	-	-	-	-	-	-	-	1	0.1	1.1
TRICHOPTERA												
Hydropsychidae												
Parapsyche elsis	L	-	1	-	-	-	-	-	-	1	0.1	1.1
Rhyacophilidae												
Rhyacophila sp.	L	-	1	-	-	-	-	-	-	1	0.1	1.1

TABLE 19 Cont'd: Benthic Invertebrate Identifications (Mine Site)

Detailed Identification
Cadillac Mines - K4606
Surber Samples
Station: Prairie Creek - M4

Taxa	Life Stage*	Replicate 1	2	3	4	5	6	7	8	Total No. organisms	Mean No./ sample	Mean No./ m^2
GROUP 2 ORGANISMS												
DIPTERA												
Empididae	I	-	-	-	-	-	1	-	-	1	0.1	1.1
NEMATODA		-	-	1	-	-	-	-	-	1	0.1	1.1
TOTAL NUMBER OF ORGANISMS		10	11	5	1	3	2	2	0	34	4.3	45.3
TOTAL NUMBER OF TAXA		3	4	3	1	3	2	2	0	11	2	

* N = nymph
L = larvae
I = immature

TABLE 20: Benthic Invertebrate Identifications (Mine Site)

Detailed Identification
Cadillac Mines - K4606
Surber Samples
Station: Prairie Creek - M5

Taxa	Life Stage*	Replicate 1	2	3	4	5	6	7	8	Total No. organisms	Mean No./ sample	Mean No./ m^2
GROUP 3 ORGANISMS												
EPHEMEROPTERA												
Heptageniidae												
Rhithrogena sp.	N	9	8	6	-	-	3	2	-	28	3.5	37.6
Cinygmula sp.	N	1	2	2	-	2	-	1	-	8	1.0	10.8
Epeorus (Iron) sp.	N	-	-	2	-	-	-	2	1	5	0.6	6.5
Baetidae												
Baetis insignificans	N	-	-	1	-	-	1	1	-	3	0.4	4.3
Ephemerellidae												
Ephemerella (Drunella) doddsi	N	1	2	1	-	-	-	-	-	4	0.5	5.4
PLECOPTERA												
Filipalpia												
Nemouridae												
Nemoura sp.	N	-	-	1	-	-	-	1	-	2	0.3	3.2
Setipalpia												
Perlodidae												
Isogenus sp.	N	-	1	-	-	-	-	-	-	1	0.1	1.1
Chloroperlidae												
Hastaperla sp.	N	-	-	-	-	1	-	-	1	2	0.3	3.2

TABLE 20 Cont'd: Benthic Invertebrate Identifications (Mine Site)

Detailed Identification
Cadillac Mines - K4606
Surber Samples
Station: Prairie Creek - M5

Taxa	Life Stage*	Replicate 1	2	3	4	5	6	7	8	Total No. organisms	Mean No./ sample	Mean No./ m2
GROUP 2 ORGANISMS												
DIPTERA												
Chironomidae												
Orthocladiinae												
Eukiefferella sp.	L	1	-	-	-	-	-	-	-	1	0.1	1.1
Rheocricotopus sp.	L	1	-	-	-	-	-	-	-	1	0.1	1.1
Orthorrhaphous Brachycera - F. ?Tabanidae	L	-	-	-	-	1	-	-	-	1	0.1	1.1
GROUP 1 ORGANISMS												
OLIGOCHAETA												
Lumbriculidae		-	-	1	-	-	-	-	-	1	0.1	1.1
TOTAL NUMBER OF ORGANISMS		13	13	14	0	4	4	7	2	57	7.1	76.5
TOTAL NUMBER OF TAXA		5	4	7	0	3	2	5	2	12	4	

* N = nymph
L = larvae

TABLE 21: Benthic Invertebrate Identifications (Mine Site)

Detailed Identification
Cadillac Mines - K4606
Surber Samples
Station: Prairie Creek - M5-A

Taxa	Life Stage*	Replicate 1	2	3	4	5	6	7	8	Total No. organisms	Mean No./ sample	Mean No./ m^2
GROUP 3 ORGANISMS												
EPHEMEROPTERA												
Heptageniidae												
Rhithrogena sp.	N	-	4	-	-	4	-	1	-	9	1.1	11.8
Cinygmula sp.	N	-	1	-	-	-	-	-	-	1	0.1	1.1
Epeorus (Iron) sp.	N	-	-	-	1	-	-	-	-	1	0.1	1.1
E. (Ironopsis) sp.	N	1	-	-	-	-	-	-	-	1	0.1	1.1
Baetidae												
Baetis insignificans	N	3	-	-	-	-	-	2	-	5	0.6	6.5
Siphlonuridae												
Ameletus sp.	N	-	-	-	1	-	-	-	-	1	0.1	1.1
PLECOPTERA												
Filipalpia												
Capniinae	N	-	-	-	1	-	-	-	-	1	0.1	1.1
Nemouridae												
Nemoura sp.	N	-	-	-	-	-	-	1	-	1	0.1	1.1
NEMATODA		-	-	-	1	-	-	-	-	1	0.1	1.1

TABLE 21 Cont'd: Benthic Invertebrate Identifications (Mine Site)

Detailed Identification
Cadillac Mines - K4606
Surber Samples
Station: Prairie Creek - M5-A

Taxa	Life Stage*	Replicate 1	2	3	4	5	6	7	8	Total No. organisms	Mean No./ sample	Mean No./ m^2
TOTAL NUMBER OF ORGANISMS		4	5	0	4	4	0	4	0	21	2.4	26.0
TOTAL NUMBER OF TAXA		2	2	0	4	1	0	3	0	9	2	
Also Present: Hymenoptera - F. Formicidae	A	-	-	-	1	-	-	-	-	1		
Diptera - Brachycera	A	-	-	-	-	1	-	-	1	2		

* N = nymph
A = adult

TABLE 22: Benthic Invertebrate Identifications (Mine Site)

Detailed Identification
Cadillac Mines - K4606
Surber Samples
Station: Prairie Creek - M6

Taxa	Life Stage*	Replicate 1	2	3	4	5	6	7	8	Total No. organisms	Mean No./ sample	Mean No./ m^2
GROUP 3 ORGANISMS												
EPHEMEROPTERA												
Heptageniidae												
Rhithrogena sp.	N	2	2	2	-	8	3	-	2	19	2.4	25.8
Cinygmula sp.	N	2	1	-	-	1	-	-	-	4	0.5	5.4
Epeorus (Iron) sp.	N	3	-	-	-	4	5	-	-	12	1.5	16.1
Baetidae												
Baetis insignificans	N	-	-	-	-	1	-	1	-	2	0.3	3.2
TRICHOPTERA												
Hydropsychidae												
Parapsyche elsis	L	-	-	-	1	1	-	-	-	2	0.3	3.2
Rhyacophilidae												
Rhyacophila sp.	L	-	-	-	-	1	-	-	-	1	0.1	1.1
PLECOPTERA												
Filipalpia												
Nemouridae												
Nemoura sp.	N	2	-	-	1	4	-	2	-	9	1.1	11.8
Setipalpia												
Chloroperlidae												
Hastaperla sp.	N	1	-	1	-	-	-	-	-	2	0.3	3.2

TABLE 22 Cont'd: Benthic Invertebrate Identifications (Mine Site)

Detailed Identification
Cadillac Mines - K4606
Surber Samples
Station: Prairie Creek - M6

Taxa	Life Stage*	Replicate 1	2	3	4	5	6	7	8	Total No. organisms	Mean No./ sample	Mean No./ m2
GROUP 2 ORGANISMS												
DIPTERA												
Empididae												
Wiedemannia sp.	L	-	-	-	1	-	-	-	-	1	0.1	1.1
Orthorrhaphous Brachycera - F. ?Tabanidae	L	1	-	-	-	1	-	-	-	2	0.3	3.2
GROUP 1 ORGANISMS												
OLIGOCHAETA												
Lumbriculidae		-	-	-	-	1	-	-	-	1	0.1	1.1
TOTAL NUMBER OF ORGANISMS		11	3	3	3	22	8	3	2	55	7.0	75.2
TOTAL NUMBER OF TAXA		6	2	2	3	9	2	2	1	11	3	
Also Present: Egg sac		-	-	-	-	1	-	-	-	1		

* N = nymph
L = larvae

SECTION B

BENTHIC INVERTEBRATE IDENTIFICATIONS

WINTER ROAD SITES

TABLE 23: Benthic Invertebrate Identifications (Winter Road Sites)

Detailed Identification
Cadillac Mines - K4606
Surber Samples
Station: Sundog Creek - R3

Taxa	Life Stage*	Replicate 1	2	3	4	5	6	7	8	Total No. organisms	Mean No./ sample	Mean No./ m^2
GROUP 3 ORGANISMS												
EPHEMEROPTERA												
Heptageniidae												
Cinygmula sp.	N	-	1	-	-	1	-	-	-	2	0.3	3.2
PLECOPTERA												
Filipalpia												
Nemouridae												
Nemoura sp.	N	1	3	1	1	-	1	1	2	10	1.3	14.0
GROUP 2 ORGANISMS												
DIPTERA												
Chironomidae												
Chironominae												
Tanytarsus sp. I	L	-	1	-	-	-	-	-	-	1	0.1	1.1
Orthocladiinae												
Diplocladius cultriger	L	-	3	-	-	-	-	-	-	3	0.4	4.3
Cricotopus (Cricotopus) or *Orthocladius (Orthocladius)* sp.	L	-	8	-	-	-	-	-	-	8	1.0	10.8

TABLE 23 Cont'd: Benthic Invertebrate Identifications (Winter Road Sites)

Detailed Identification
Cadillac Mines - K4606
Surber Samples
Station: Sundog Creek - R3

Taxa	Life Stage*	Replicate 1	2	3	4	5	6	7	8	Total No. organisms	Mean No./ sample	Mean No./ m^2
GROUP 2 ORGANISMS Cont'd.												
DIPTERA Cont'd.												
Orthocladiinae - damaged	L	-	2	-	1	-	-	-	-	3	0.4	4.3
Empididae												
?Chelifera sp.	L	1	1	-	2	-	2	6	1	13	1.6	17.2
Tipulidae												
Tipula sp.	L	-	1	-	-	-	-	-	3	4	0.5	5.4
Dicranota sp.	L	-	1	-	-	-	-	-	-	1	0.1	1.1
Muscidae	P	-	-	-	2	1	-	-	-	3	0.4	4.3
NEMATODA		-	-	-	-	-	1	-	-	1	0.1	1.1
TOTAL NUMBER OF ORGANISMS		2	21	1	6	2	4	7	6	49	6.2	66.8
TOTAL NUMBER OF TAXA		2	9	1	4	2	3	2	3	11	3	
Also Present: Nematocera	A	-	-	-	-	1	-	-	-	1		

* N = nymph
L = larvae
P = pupae
A = adult

TABLE 24: Benthic Invertebrate Identifications (Winter Road Sites)

Detailed Identification
Cadillac Mines - K4606
Surber Samples
Station: Tetcela River - R4-D

Taxa	Life Stage*	Replicate 1	2	3	4	5	6	7	8	Total No. organisms	Mean No./ sample	Mean No./ m^2
GROUP 3 ORGANISMS												
PLECOPTERA												
Filipalpia												
Nemouridae												
Nemoura sp.	N	-	2	1	2	-	-	-	3	8	1.0	10.8
GROUP 2 ORGANISMS												
DIPTERA												
Chironomidae												
Chironominae												
Stictochironomus sp.	L	1	-	-	-	-	-	-	-	1	0.1	1.1
GROUP 1 ORGANISMS												
OLIGOCHAETA												
Tubificidae		1	-	-	-	-	-	-	-	1	0.1	1.1
TOTAL NUMBER OF ORGANISMS		2	2	1	2	0	0	0	3	10	1.2	13.0
TOTAL NUMBER OF TAXA		2	1	1	1	0	0	0	1	3		

TABLE 24 Cont'd: Benthic Invertebrate Identifications (Winter Road Sites)

Detailed Identification
Cadillac Mines - K4606
Surber Samples
Station: Tetcela River - R4-D

Taxa	Life Stage*	Replicate 1	2	3	4	5	6	7	8	Total No. organisms	Mean No./ sample	Mean No./ m2
Also Present:												
DIPTERA - F. ?Bombyliidae	A	-	1	-	-	-	-	-	-	1		
- F. Phoridae	A	-	1	-	-	-	-	-	-	1		
HOMOPTERA	A	-	1	-	-	-	-	1	-	2		
ARACHNIDA	A	-	-	-	1	-	-	-	-	1		

* N = nymph
L = larvae
A = adult

TABLE 25: Benthic Invertebrate Identifications (Winter Road Sites)

Detailed Identification
Cadillac Mines - K4606
Surber Samples
Station: Tetcela River - R4-U

Taxa	Life Stage*	Replicate 1	2	3	4	5	6	7	8	Total No. organisms	Mean No./ sample	Mean No./ m^2
GROUP 3 ORGANISMS												
TRICHOPTERA												
Brachycentridae												
Brachycentrus sp.	L	-	-	-	-	1	-	-	-	1	0.1	1.1
B. americanus	L	-	-	-	-	-	-	-	1	1	0.1	1.1
Glossosomatidae												
Glossosoma sp.	L	-	-	-	-	-	-	-	1	1	0.1	1.1
PLECOPTERA												
Filipalpia												
Nemouridae												
Nemoura sp.	N	1	-	1	-	4	9	5	3	23	2.9	31.2
Setipalpia												
Chloroperlidae (wing pads absent)	N	-	-	-	-	-	1	-	-	1	0.1	1.1
COLEOPTERA												
Chrysomelidae												
Galerucella sp.	L	-	-	-	-	-	-	-	1	1	0.1	1.1

TABLE 25 Cont'd: Benthic Invertebrate Identifications (Winter Road Sites)

Detailed Identification
Cadillac Mines - K4606
Surber Samples
Station: Tetcela River - R4-U

Taxa	Life Stage*	Replicate 1	2	3	4	5	6	7	8	Total No. organisms	Mean No./ sample	Mean No./ m^2
GROUP 2 ORGANISMS												
DIPTERA												
Chironomidae												
Orthocladiinae												
Cricotopus sp.	L	-	-	-	-	-	-	1	-	1	0.1	1.1
Orthocladiinae - damaged	L	-	-	-	-	-	-	1	-	1	0.1	1.1
TOTAL NUMBER OF ORGANISMS		1	0	1	0	5	10	7	6	30	3.6	38.9
TOTAL NUMBER OF TAXA		1	0	1	0	2	2	3	4	8	2	
Also Present:												
Homoptera	A	1	-	-	-	-	-	-	-	1		
Arachnida	A	-	-	1	-	-	-	-	1	2		
Nemoura sp. nymph exuviae		-	3	-	-	-	-	-	-	3		

* N = numph
L = larvae
A = adult

TABLE 26: Benthic Invertebrate Identifications (Winter Road Sites)

Detailed Identification
Cadillac Mines - K4606
Surber Samples
Station: Tetcela River - R5-D

Taxa	Life Stage*	Replicate 1	2	3	4	5	6	7	8	Total No. organisms	Mean No./ sample	Mean No./ m^2
GROUP 3 ORGANISMS												
EPHEMEROPTERA												
Heptageniidae												
Cinygmula sp.	N	1	-	-	-	-	-	-	1	2	0.3	3.2
Ephemerellidae												
Ephemerella (Ephemerella) inermis	N	1	-	1	-	-	1	1	1	5	0.6	6.5
Baetidae												
Baetis sp.	N	-	-	1	-	-	-	-	-	1	0.1	1.1
TRICHOPTERA												
Lepidostomatidae												
Lepidostoma sp.	L	-	-	-	-	-	1	-	-	1	0.1	1.1
GROUP 2 ORGANISMS												
DIPTERA												
Chironomidae												
Orthocladiinae												
Smittia group	L	-	-	-	-	-	-	1	-	1	0.1	1.1
Empididae												
?*Chelifera* sp.	L	-	-	1	1	-	-	-	-	2	0.3	3.2

TABLE 26 Cont'd: Benthic Invertebrate Identifications (Winter Road Sites)

Detailed Identification
Cadillac Mines - K4606
Surber Samples
Station: Tetcela River - R5-D

Taxa	Life Stage*	Replicate 1	2	3	4	5	6	7	8	Total No. organisms	Mean No./ sample	Mean No./ m2
GROUP 2 ORGANISMS Cont'd.												
DIPTERA Cont'd.												
Tipulidae												
Limnophila sp.	L	-	-	-	-	-	1	-	-	1	0.1	1.1
Simuliidae	L	-	-	-	-	-	2	-	-	2	0.3	3.2
TOTAL NUMBER OF ORGANISMS		2	0	3	1	0	5	2	2	15	19	20.5
TOTAL NUMBER OF TAXA		2	0	3	1	0	4	2	2	8	2	

* N = nymph
L = larvae

TABLE 27: Benthic Invertebrate Identifications (Winter Road Sites)

Detailed Identification
Cadillac Mines - K4606
Surber Samples
Station: Tetcela River - R5-U

Taxa	Life Stage*	Replicate 1	2	3	4	5	6	7	8	Total No. organisms	Mean No./ sample	Mean No./ m^2
GROUP 3 ORGANISMS												
EPHEMEROPTERA												
Heptageniidae												
Cinygmula sp.	N	1	1	-	-	1	-	-	-	3	0.4	4.3
Rhithrogena sp.	N	-	-	-	-	1	-	-	1	2	0.3	3.2
Ephemerellidae												
Ephemerella (Drunella) grandis ingens	N	1	-	-	-	-	-	-	-	1	0.1	1.1
E. inermis	N	-	-	-	-	-	-	-	1	1	0.1	1.1
Baetidae												
Baetis sp.	N	-	-	-	-	-	-	-	1	1	0.1	1.1
TRICHOPTERA												
Hydropsychidae												
Arctopsyche ladogensis	L	-	-	1	-	-	-	-	-	1	0.1	1.1
Lepidostomatidae												
Lepidostoma sp.	L	-	-	-	1	-	-	-	-	1	0.1	1.1
PLECOPTERA												
Filipalpia												
Taeniopterygidae												
Taenionema sp.	N	1	-	-	-	-	-	-	-	1	0.1	1.1
Nemouridae												
Nemoura sp.	N	-	-	-	-	2	-	-	-	2	0.3	3.2

TABLE 27 Cont'd: Benthic Invertebrate Identifications (Winter Road Sites)

Detailed Identification
Cadillac Mines - K4606
Surber Samples
Station: Tetcela River - R5-U

Taxa	Life Stage*	Replicate 1	2	3	4	5	6	7	8	Total No. organisms	Mean No./ sample	Mean No./ m^2
GROUP 3 ORGANISMS Cont'd												
PLECOPTERA Cont'd.												
Capniinae	N	-	-	-	1	-	-	-	-	1	0.1	1.1
Setipalpia												
Chloroperlidae												
Alloperla sp.	N	-	-	-	-	-	-	-	1	1	0.1	1.1
GROUP 2 ORGANISMS												
DIPTERA												
Chironomidae												
Orthocladiinae												
Cricotopus sp.	L	-	1	-	-	-	-	-	-	1	0.1	1.1
Athericidae												
Atherix sp.	L	1	-	-	1	-	-	1	-	3	0.4	4.3
NEMATODA		-	-	-	1	-	-	1	-	2	0.3	3.2
TOTAL NUMBER OF ORGANISMS		4	2	1	4	4	0	2	4	21	2.6	28.1
TOTAL NUMBER OF TAXA		4	2	1	4	3	0	2	4	14	3	

* N = nymph
L = larvae

TABLE 28: Benthic Invertebrate Identifications (Winter Road Sites)

Detailed Identification
Cadillac Mines - K4606
Surber Samples
Station: Grainger River - R7-D

Taxa	Life Stage*	Replicate 1	2	3	4	5	6	7	8	Total No. organisms	Mean No./ sample	Mean No./ m2
GROUP 3 ORGANISMS												
EPHEMEROPTERA												
Heptageniidae												
Heptagenia ?flavescens	N	1	1	-	-	-	1	-	-	3	0.4	4.3
Baetiscidae												
Baetisca sp.	N	-	1	-	-	-	-	-	-	1	0.1	1.1
TRICHOPTERA												
Leptoceridae	I	-	-	-	-	-	-	1	-	1	0.1	1.1
GROUP 2 ORGANISMS												
DIPTERA												
Chironomidae												
Chironominae												
Microtendipes pedellus	L	-	-	-	-	1	-	-	-	1	0.1	1.1
Orthocladiinae - indet.	L	-	-	-	-	1	-	-	-	1	0.1	1.1
Simuliidae	L	-	-	1	-	-	-	-	-	1	0.1	1.1

TABLE 28 Cont'd: Benthic Invertebrate Identifications (Winter Road Sites)

Detailed Identification
Cadillac Mines - K4606
Surber Samples
Station: Grainger River - R7-D

Taxa	Life Stage*	Replicate 1	2	3	4	5	6	7	8	Total No. organisms	Mean No./ sample	Mean No./ m^2
NEMATODA		-	-	-	-	1	-	-	-	1	0.1	1.1
TOTAL NUMBER OF ORGANISMS		1	2	1	0	3	1	1	0	9	1.0	10.9
TOTAL NUMBER OF TAXA		1	2	1	0	3	1	1	0	7	1	

* N = nymph
I = immature
L = larvae

TABLE 29: Benthic Invertebrate Identifications (Winter Road Sites)

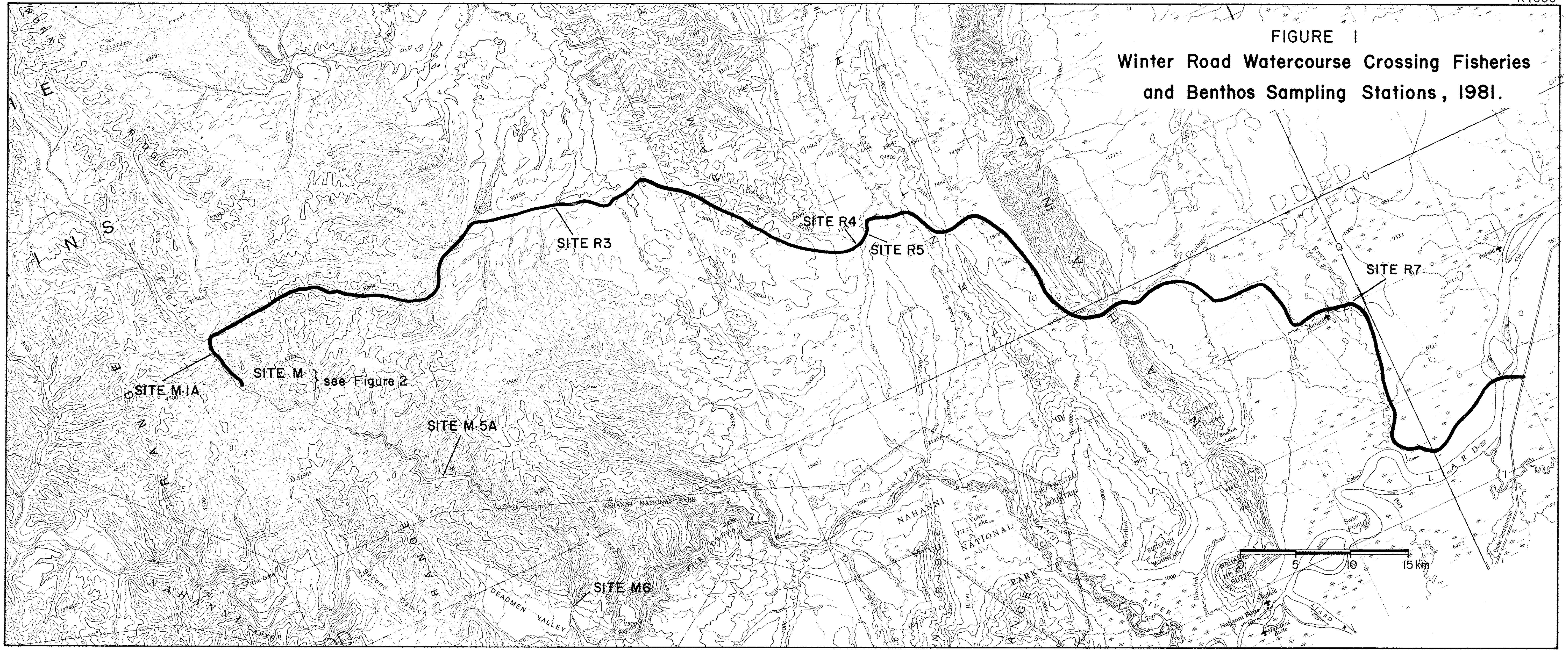
Detailed Identification
Cadillac Mines - K4606
Surber Samples
Station: Grainger River - R7-U

Taxa	Life Stage*	Replicate 1	2	3	4	5	6	7	8	Total No. organisms	Mean No./ sample	Mean No./ m^2
GROUP 3 ORGANISMS												
EPHEMEROPTERA												
Heptageniidae												
Rhithrogena sp.	N	-	-	-	-	-	-	1	-	1	0.1	1.1
GROUP 2 ORGANISMS												
DIPTERA												
Chironomidae												
Chironominae												
Demicryptochironomus sp.	L	-	1	-	-	-	-	-	-	1	0.1	1.1
Stictochironomus sp.	L	-	-	-	1	-	-	-	-	1	0.1	1.1
NEMATODA		-	-	-	-	1	-	-	-	1	0.1	1.1
TOTAL NUMBER OF ORGANISMS		0	1	0	1	1	0	1	0	4	0.4	4.4
TOTAL NUMBER OF TAXA		0	1	0	1	1	0	1	0	4		

* N = nymph
L = larvae

PLATES

FIGURE 1
Winter Road Watercourse Crossing Fisheries and Benthos Sampling Stations, 1981.



K4606

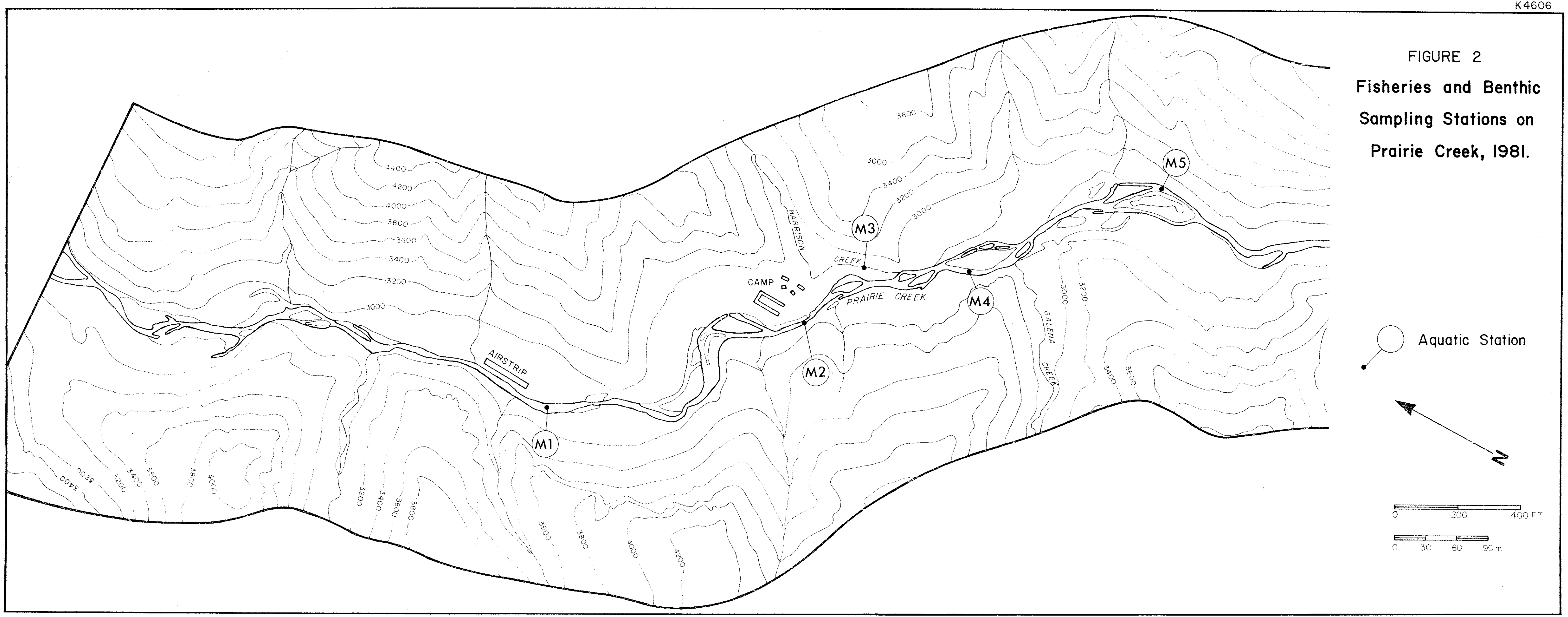


FIGURE 2
Fisheries and Benthic Sampling Stations on Prairie Creek, 1981.

PLATE 1: Looking west on winter road crossing Grainger River at Site R7 before ice-out on 8 April and during spring, 21 May 1981.

PLATE 2: Looking west on winter road crossing Tetcela River at Site R5 before ice-out on 8 April and during spring, 21 May 1981.

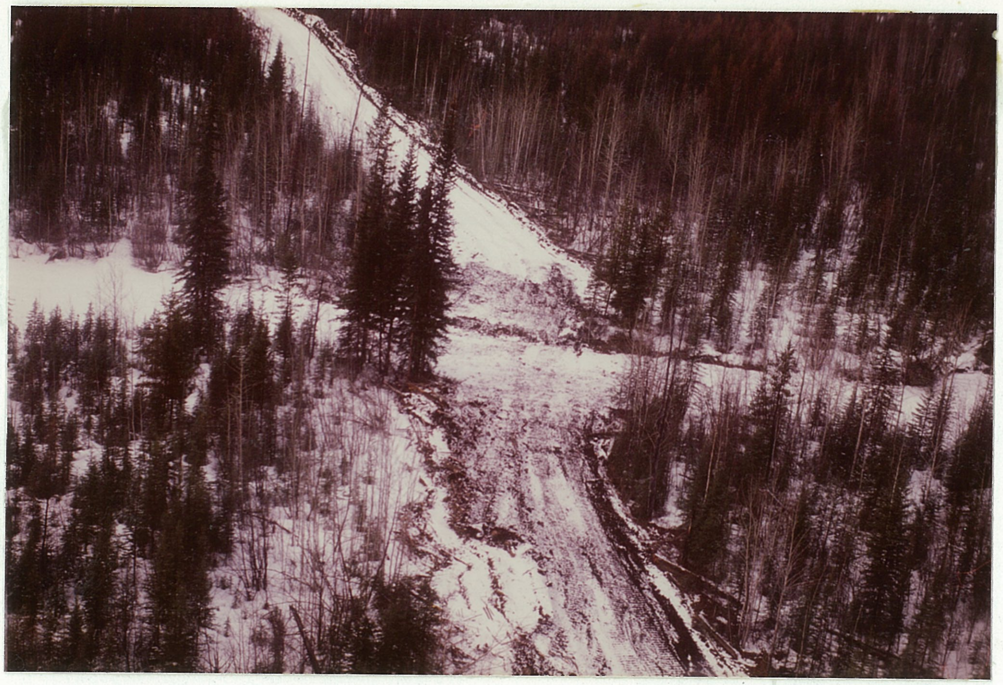


PLATE 3: Looking west on winter road crossing Tetcela River at Site R4 before ice-out on 8 April and during spring, 21 May 1981.

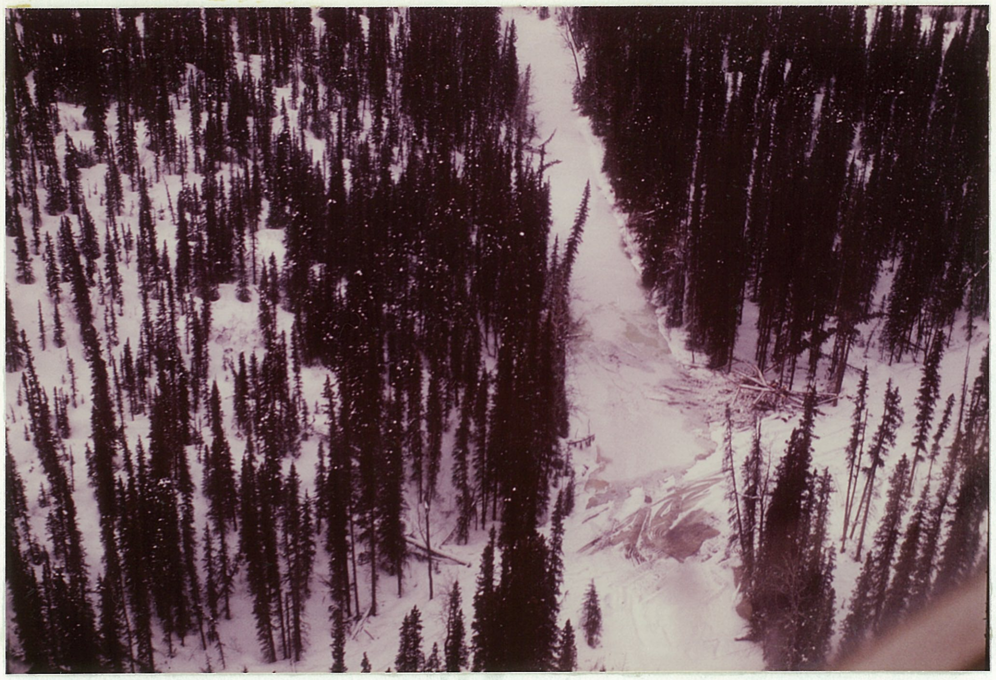


PLATE 4: Looking west on winter road crossing the Sundog Creek tributary at Site R3 before ice-out on 8 April and during spring, 22 May 1981.