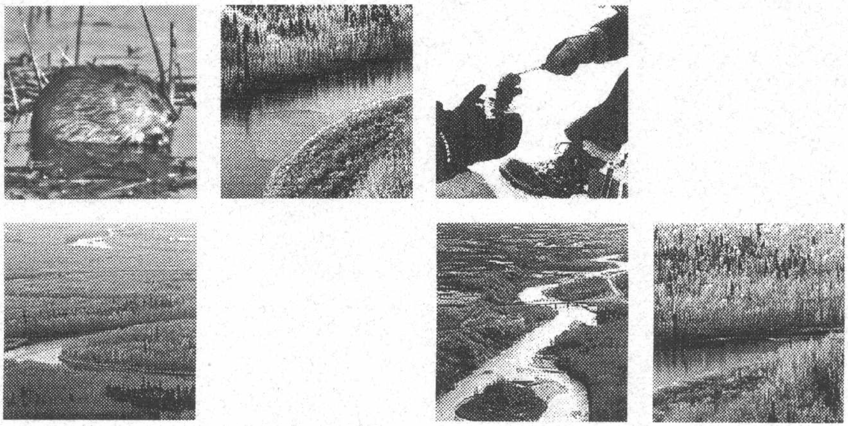
Canada Alberta Northwest Territories

Northern River Basins Study



Prepared for the
Northern River Basins Study
under Project 2371-B2

by
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NORTHERN RIVER BASINS STUDY PROJECT REPORT NO. 21

BENTHOS FIELD COLLECTIONS UNDER-ICE SAMPLING ATHABASCA RIVER FEBRUARY AND MARCH, 1993

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PREFACE:

The Northern River Basins Study was initiated through the "Canada-Alberta-Northwest Territories Agreement Respecting the Peace-Athabasca-Slave River Basin Study, Phase II - Technical Studies" which was signed September 27, 1991. The purpose of the Study is to understand and characterize the cumulative effects of development on the water and aquatic environment of the Study Area by coordinating with existing programs and undertaking appropriate new technical studies.

This publication reports the method and findings of particular work conducted as part of the Northern River Basins Study. As such, the work was governed by a specific terms of reference and is expected to contribute information about the Study Area within the context of the overall study as described by the Study Final Report. This report has been reviewed by the Study Science Advisory Committee in regards to scientific content and has been approved by the Study Board of Directors for public release.

It is explicit in the objectives of the Study to report the results of technical work regularly to the public. This objective is served by distributing project reports to an extensive network of libraries, agencies, organizations and interested individuals and by granting universal permission to reproduce the material.

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Whereas the above publication is the result of a project conducted under the Northern River Basins Study and the terms of reference for that project are deemed to be fulfilled,
IT IS THEREFORE REQUESTED BY THE STUDY OFFICE THAT;
this publication be subjected to proper and responsible review and be considered for release to the public.

4 Oct 93

(Dr. F. J. Wrona, Ph.D., Science Director) (Date)

Whereas it is an explicit term of reference of the Science Advisory Committee "to review, for scientific content, material for publication by the Board",
IT IS HERE ADVISED BY THE SCIENCE ADVISORY COMMITTEE THAT;
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SUPPLEMENTAL COMMENTARY HAS BEEN ADDED TO THIS PUBLICATION: ☐ Yes ☐ No

P Larkin 3 Dec 93

(Dr. P. A. Larkin, Ph.D., Chair) (Date)

Whereas it is the duty of the Operations Committee to attend to the day-to-day management of the Study on behalf of the Study Board,
IT IS THEREFORE RECOMMENDED BY THE OPERATIONS COMMITTEE THAT;
this publication be released to the public and it is reported that
THIS PUBLICATION HAS BEEN REVIEWED BY THE HEALTH ASSESSMENT COMMITTEE AND SUBSEQUENTLY FORWARDED TO APPROPRIATE HEALTH AUTHORITIES: ☐ Yes ☐ No

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3/11/93

(Bev Burns, Co-chair) (Date)

Lucille Partington 3 Nov /93

(Lucille Partington, Co-chair) (Date)

BENTHOS FIELD COLLECTIONS, UNDER-ICE SAMPLING
ATHABASCA RIVER
FEBRUARY AND MARCH, 1993

STUDY PERSPECTIVE

Fundamental to understanding the effects of industrial, agricultural, and municipal-related contaminants within an aquatic ecosystem is understanding their origin, pathway, fate, and effects on biological communities. The Northern River Basins Study is investigating the presence, absence, and distribution of these contaminants within the basins. Also being considered is how they enter the food chain, at what level, if they are being transferred upwards within the food chain, and if they are accumulating to concentrations of potential concern to humans and wildlife. Detailed information is therefore being assembled on the kinds and abundance of invertebrates in rivers, and the importance of these invertebrates in the food chain.

This report identifies and describes all field sampling methodologies, observations, schedules, and a listing of samples delivered to Northern River Basins Study as a result of conducting under-ice sampling of benthic aquatic macroinvertebrates, biofilm, and forage fish as part of a synoptic survey on the Athabasca River. The late winter timing of the survey was chosen because organisms would be exposed to low, stable flows and relatively greater concentrations of effluent than during any other time of the year.

The analysis of these samples will provide key information for modelling the fate of pulp mill contaminants, for determining levels of contaminants in forage fish, and for assessing the impact of municipal and industrial effluents on species composition and health of aquatic macroinvertebrate communities. The results of analysing these samples will be documented in other reports.

Related Study Questions

1a) *How has the aquatic ecosystem, including fish and/or other aquatic organisms, been affected by exposure to organochlorines or other toxic compounds?*

2) *What is the current state of water quality in the Peace, Athabasca, and Slave river basins, including the Peace-Athabasca Delta?*

4a) *What are the contents and nature of the contaminants entering the system and what is their distribution and toxicity in the aquatic ecosystem with particular reference to water, sediments, and biota?*

13b) *What are the cumulative effects of man made discharges on the water and aquatic environment?*

14) *What long term monitoring programs and predictive models are required to provide an ongoing assessment of the state of the aquatic ecosystems. These programs must ensure that all stakeholders have the opportunity for input.*

EXECUTIVE SUMMARY

Under-ice sampling for bottom dwelling biota and forage fish was undertaken in the Athabasca River during late winter 1993. The objective of this project was to obtain samples of selected aquatic biota (i.e., invertebrates, "biofilm", and forage fish) from nine sites in the Athabasca River for contaminants analyses and quantitative analyses of invertebrate and biofilm abundance and biomass. Samples for contaminant analyses were destined for organic contaminant (e.g., dioxins, furans, chlorophenols, and polyaromatic hydrocarbons), metal (e.g., arsenic, vanadium, copper, chromium lead, zinc, and methyl mercury) and stable isotope (e.g., carbon, nitrogen, sulphur analyses). Quantitative samples of aquatic invertebrates were required for estimates of abundance and biomass. Quantitative biofilm samples were collected for chlorophyll *a* and loss on ignition; samples were also retained for taxonomic identification.

All sampling was conducted in February and March 1993 when low, stable flows created potentially greater concentrations of contaminants. Extensive ice-removal was performed in order to expose enough river bottom for completion of required tasks. Nine sites were sampled over 29 days. All requested samples were collected except for invertebrate tissues for trace contaminant analyses. Some sites had relatively low densities of invertebrates and/or were difficult to sample, thus complete complements of invertebrate tissue for contaminant analyses were not obtained at all sites.

ACKNOWLEDGEMENTS

The authors would like to thank Drs. Anne-Marie Anderson (Alberta Environment, Environmental Assessment Division) and Garry Scrimgeour (National Hydrology Research Institute) for providing information during the study. The field assistance provided at various sites by Dr. Garry Scrimgeour and Mr. Mark Spafford (Alberta-Pacific Corporation) is gratefully acknowledged.

Field collections were conducted by Mike Braeuer, Mark Dunnigan, Rob Durack, Howard Larson, Scott Millar and Rob Stack of R.L. & L. Environmental Services Ltd. Terry Clayton, Bruce Cole, Curtiss McLeod, Scott Morrison and Chantal Pattenden assisted in the acquisition and expedition of equipment and samples to and from the field. Figures were drafted by Mike Braeuer. Discharge data were supplied by Alberta Environment, Technical Services Division. Ms. Frances Baker assisted with report production.

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SECTION 1
INTRODUCTION

The growing demand for supply and use of new chemicals in the industrialized society during the twentieth century has placed increasing stress on the natural environment (Jaffé 1991). Diverse contaminants (organic compounds and metals) enter the environment through industrial discharges and other anthropogenic activities. The toxicological characteristics and the ability of contaminants to accumulate in the environment are of particular concern. Many models explaining bioaccumulation (the ability of a living organism to concentrate, accumulate, and magnify a contaminant within it, either directly from surrounding medium or indirectly through the food chain) in aquatic systems have been developed (e.g., Norstrom *et al.* 1976, Thomann and Connolly 1984; Swackhammer and Hites 1988; Connolly and Pedersen 1988).

The objective of this project was to obtain under-ice samples of benthic aquatic macroinvertebrates, biofilm (algae, bacteria, and fungi that cover stones in aquatic systems) and fish from selected sites along the length of the Athabasca River (see Terms of Reference in Appendix A). The late winter timing of sampling was chosen because organisms would be exposed to low, stable, flows and relatively greater concentrations of effluent than during any other time of the year. Qualitative samples of aquatic invertebrates and biofilm were collected for analysis of organic contaminants (e.g., dioxins, furans, chlorophenols, and PCBs), resin acids, metals (e.g., arsenic, vanadium, copper, chromium, lead, zinc, and methyl mercury) and stable isotopes (e.g., carbon, nitrogen, and sulphur). Quantitative samples of aquatic invertebrates were collected to document differences among sites in species composition, numeric density and other relevant population or community characteristics. Quantitative biofilm samples will be analyzed for loss on ignition (LOI), chlorophyll *a* (Chl*a*), and taxonomic identification. Biomass data from all quantitative samples will also be used to assess contaminant loads in aquatic invertebrates from the Athabasca River. All sites were sampled in an attempt to collect forage fish. Fish samples were dissected to provide liver tissue for multi-function oxidase (MFO) determination, while the remainder of the fish was retained for contaminant analysis.

This data report identifies and describes all field sampling methodologies, observations, schedules, and a listing of samples delivered to Northern Rivers Basins Study (NRBS).

SECTION 2
METHODS

2.1 COLLECTION SITES

Nine benthic and fisheries sampling sites were established on the Athabasca River (Figure 2.1). Sites were situated both upstream and downstream of industrial (i.e., Millar Western Pulp Mill) and municipal (i.e., the Town of Athabasca) effluent discharge points. Sites were primarily located on the left upstream bank (left side looking upstream). After consultation with NRBS, two (upstream of Berland River and Windfall Bridge) of the original ten sampling sites described in the Terms of Reference were not sampled because of time constraints. One other site (downstream of Athabasca Town) was added to the sampling list. Photographs of all sample locations are provided in Appendix B.

2.1.1 Sample Locations

Sample locations are referenced by kilometre (km) and by Universal Transverse Mercator Grid System (UTM). The kilometre reference for a location is based on the upstream distance from the mouth of the Athabasca River at Lake Athabasca (Km 0). Sample locations referenced according to the Universal Transverse Mercator Grid (UTM) were obtained in the field with the use of a Global Positioning System instrument (Trimble Transpak).

The sampling locations were as follows:

Site 1 - Control (Location 1: km=1248.0, UTM=11U 446000E 5909990N, and
Location 2: km=1235.6, UTM=11U 455000E 5914850N)

Site 1 was divided into two sampling locations in order to capitalize on open water availability and reduce ice-removal effort. Sampling Location 1 was located immediately downstream of the outlet of Brûle Lake along the right upstream bank (RUB) (Figure 2.2). Sampling Location 2 was located 1.25 km downstream of the Highway 40 bridge and 1.75 km upstream of the confluence with Maskuta Creek, along the left upstream bank (LUB) (Figure 2.3). Three holes were cut at this location. The purpose of the control site was to provide reference data from an area that was minimally influenced by effluent discharge.

Site 2 - Weldwood Haul Bridge (km=1226.7, UTM=11U 463150E 5919658N)

Site 2 was located approximately 1.0 km downstream of Weldwood Pulp Mill and the Town of Hinton combined effluent discharge point, and approximately nine km downstream of control site Location 2. Sampling was conducted on the LUB and immediately downstream of the Weldwood Haul Bridge (Figure 2.4). This was an open water site.

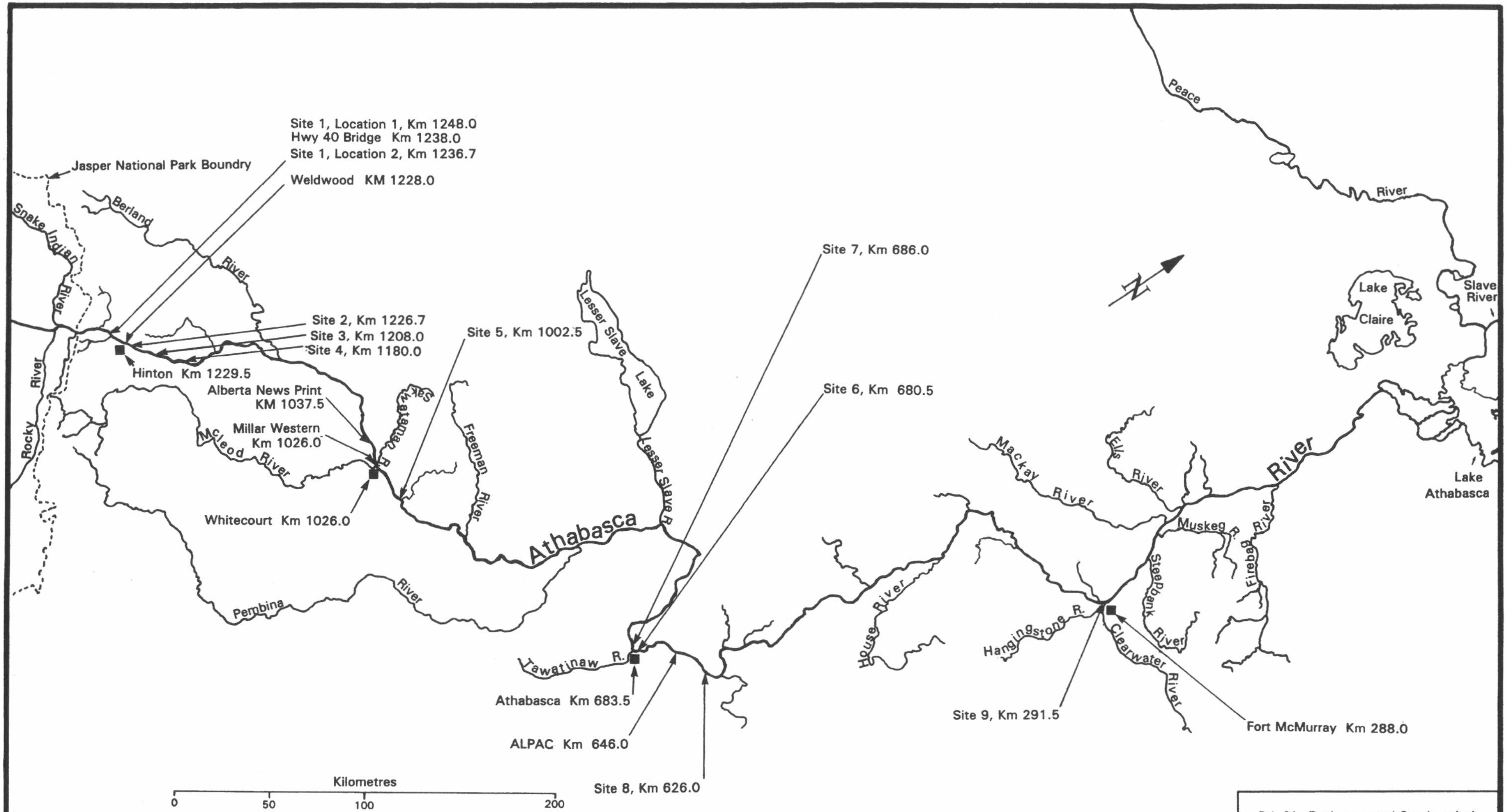

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Figure 2.1

Baseline map of the Athabasca River.

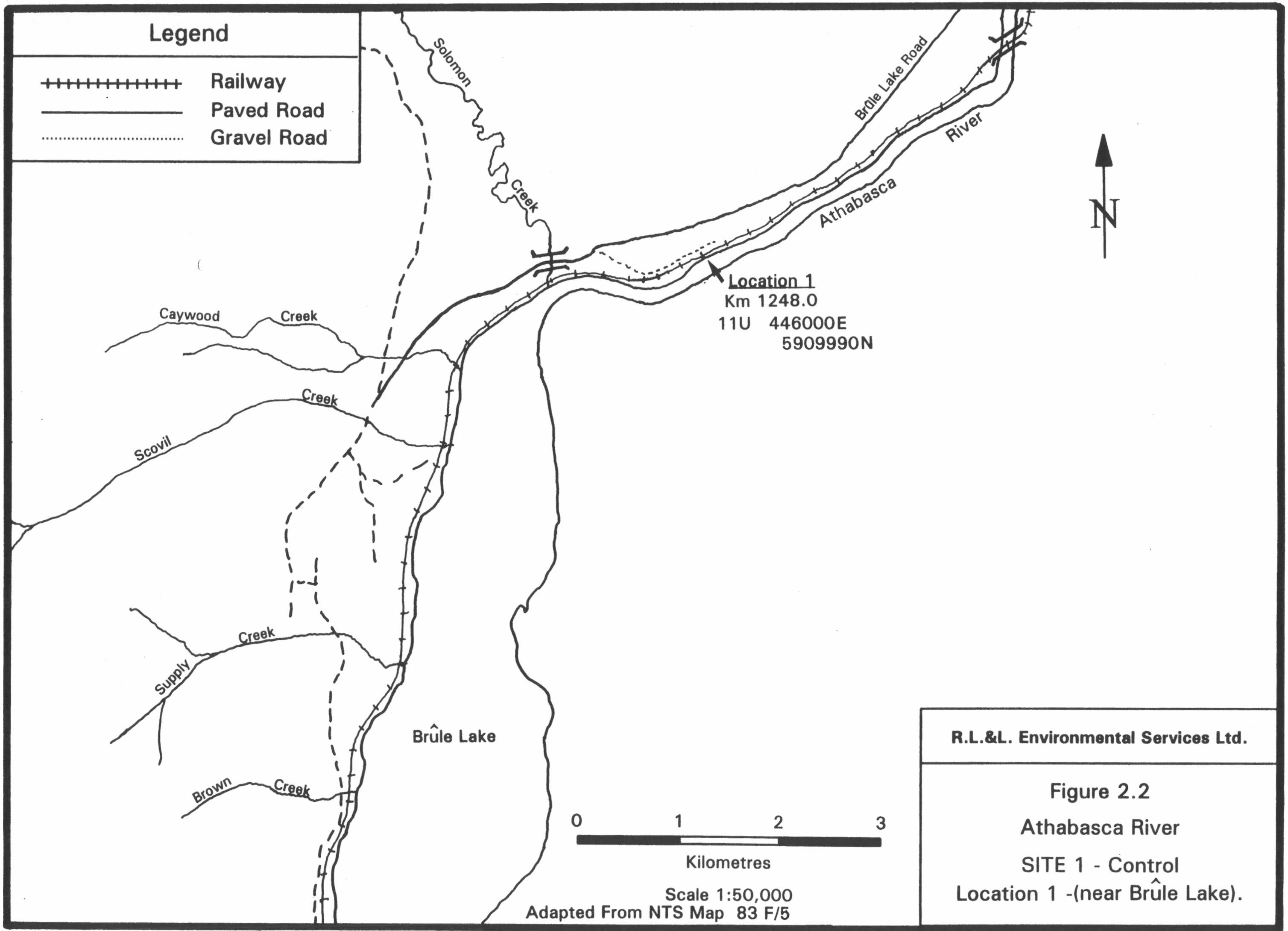

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Figure 2.2
Athabasca River
SITE 1 - Control
Location 1 -(near Brûle Lake).

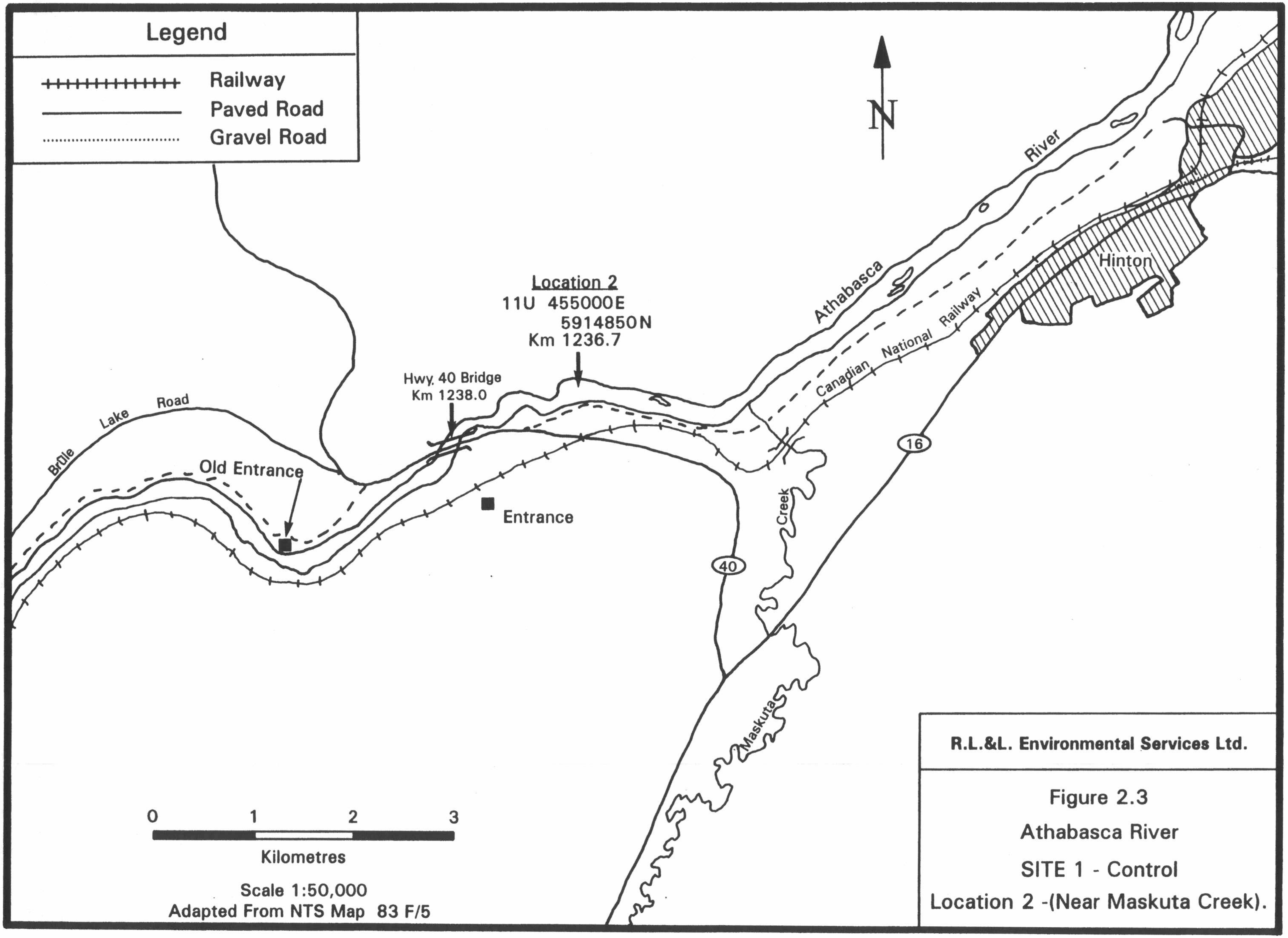

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Figure 2.3
Athabasca River
SITE 1 - Control
Location 2 -(Near Maskuta Creek).

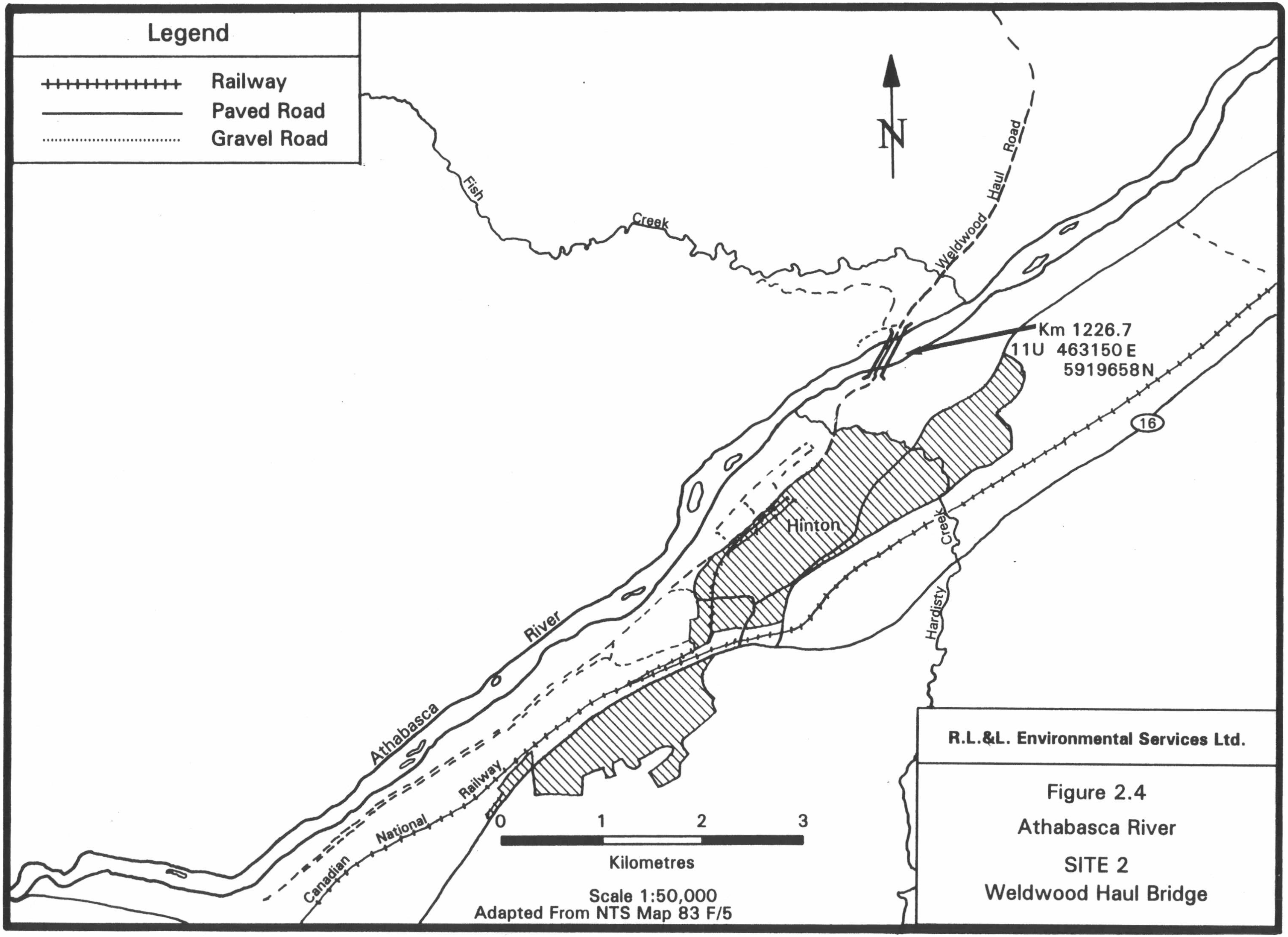

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Figure 2.4
Athabasca River
SITE 2
Weldwood Haul Bridge

Site 3 - Obed Mountain Coal Bridge (km=1208.0, UTM=11U 476450E 5930929N)

This site was located approximately 27.6 km downstream of control site Location 2. All sampling was near bank (LUB) and immediately upstream of the bridge (Figure 2.5). Four holes were cut at this site.

Site 4 - Emerson Lakes Road Bridge (km=1180.0, UTM=11U 489010E 5959000N)

Site 4 was located approximately 55.6 km downstream of control site Location 2. All sampling was conducted on the LUB and 0.8 km downstream of the bridge (Figure 2.6). One hole was cut.

Site 5 - Blue Ridge (Hole 1: km=1002.5, UTM=11U 605600E 6002450N, and
Hole 2: km=1002.0, UTM=11U 606195E 6002500N)

Site 5 was situated approximately 233 km downstream of control site Location 2. Hole 1 was situated near an island point (RUB) and hole 2 was located on the LUB. Both holes were downstream of the bridge where Highway 658 crosses the Athabasca River (Figure 2.7).

Site 6 - Downstream of Athabasca Town (Hole 1: km=681.9, UTM=12U 353956E 6067400N, and
Hole 2: km=680.5, UTM=12U 353956E 6068500N)

This site was established approximately 554 km downstream of control site Location 2. All sampling was near bank (LUB), 0.75 and 2.3 km downstream of Highway 813 bridge and below the Town of Athabasca's sewage treatment facility effluent outflow (Figure 2.8).

Site 7 - Upstream of Athabasca Town (km=686.0, UTM=12U 350900E 6068187N)

This site was situated approximately 549.6 km downstream of control site Location 2. Sampling occurred along the LUB, approximately 3.4 km upstream of Highway 813 bridge (Figure 2.8). Two holes were cut.

Site 8 - Poacher's Landing (km=626.0, UTM=12U 394505E 6093795N)

Site 8 was located 609.6 km downstream of control site Location 2. Sampling was near bank (LUB), and approximately 8.0 km downstream of Poacher's Landing boat launch (Figure 2.9). Two holes were cut at this site.

Site 9 - Upstream of Fort McMurray (km=291.5, UTM=12V 473500E 6285600N)

Site 9 was established approximately 944.1 km downstream of control site Location 2. All sampling was near the LUB, and approximately 2.0 km upstream of Fort McMurray's water treatment plant (Figure 2.10). One hole was cut.

2.1.2 Sample Schedule

Sampling was conducted in late winter when low, stable, flows existed. Figure 2.11 depicts discharge rates in the Athabasca River at Hinton, Town of Athabasca, and upstream of Fort McMurray during 1992 and part of 1993 (raw data are presented in Appendix C). Benthic invertebrate, biofilm, and fish samples were collected

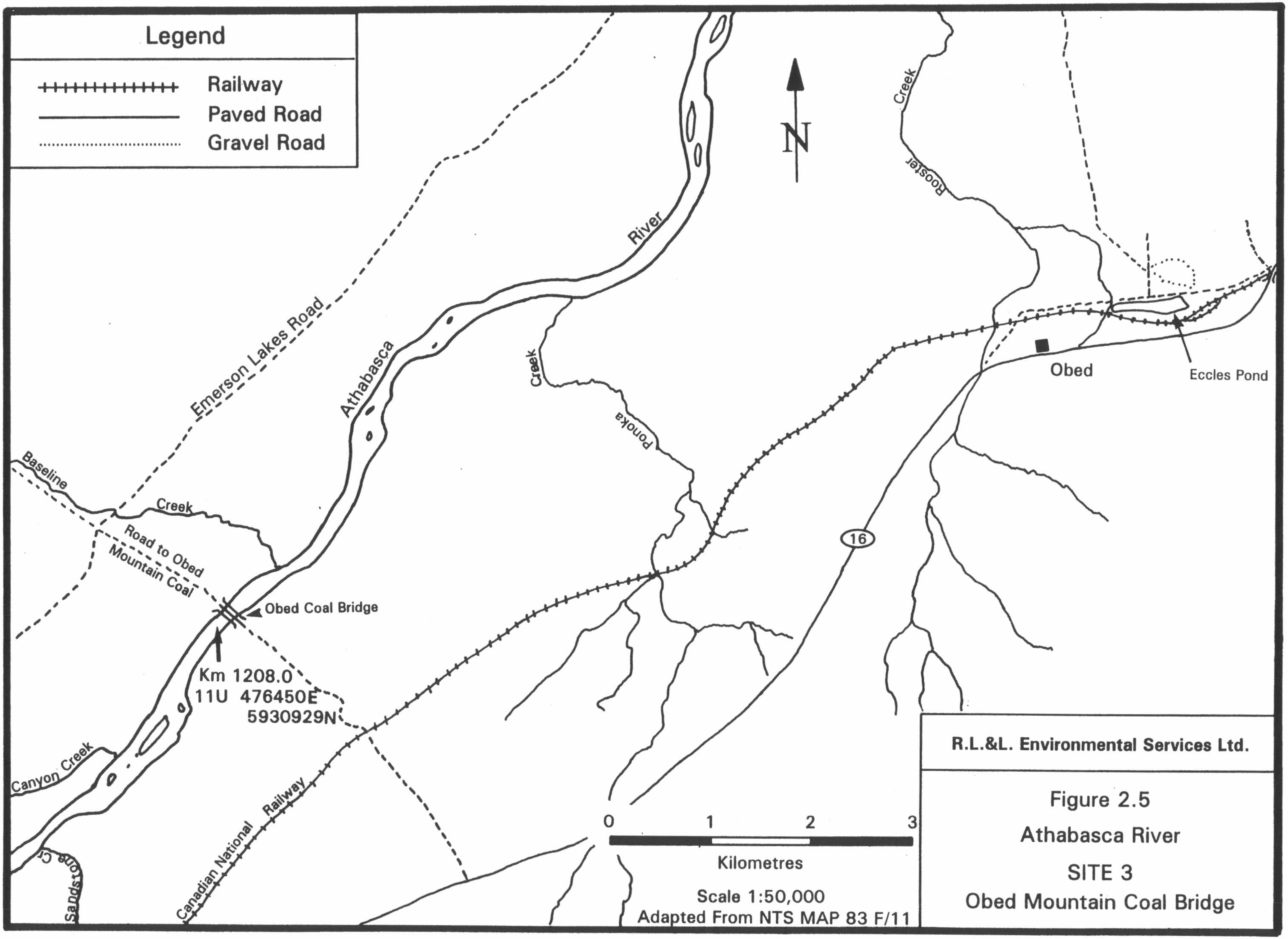

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Figure 2.5

Athabasca River

SITE 3

Obed Mountain Coal Bridge

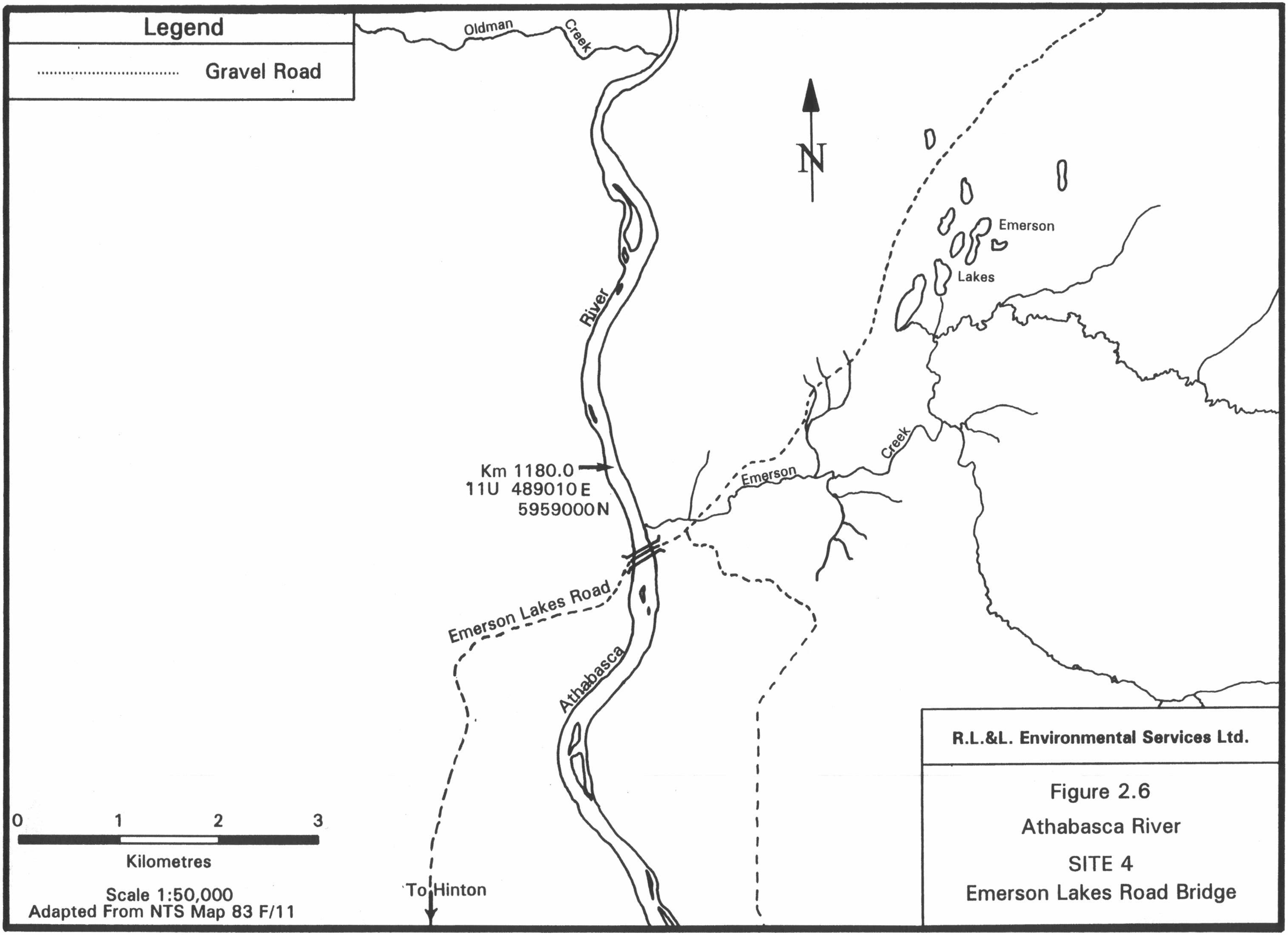

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Figure 2.6
Athabasca River
SITE 4
Emerson Lakes Road Bridge

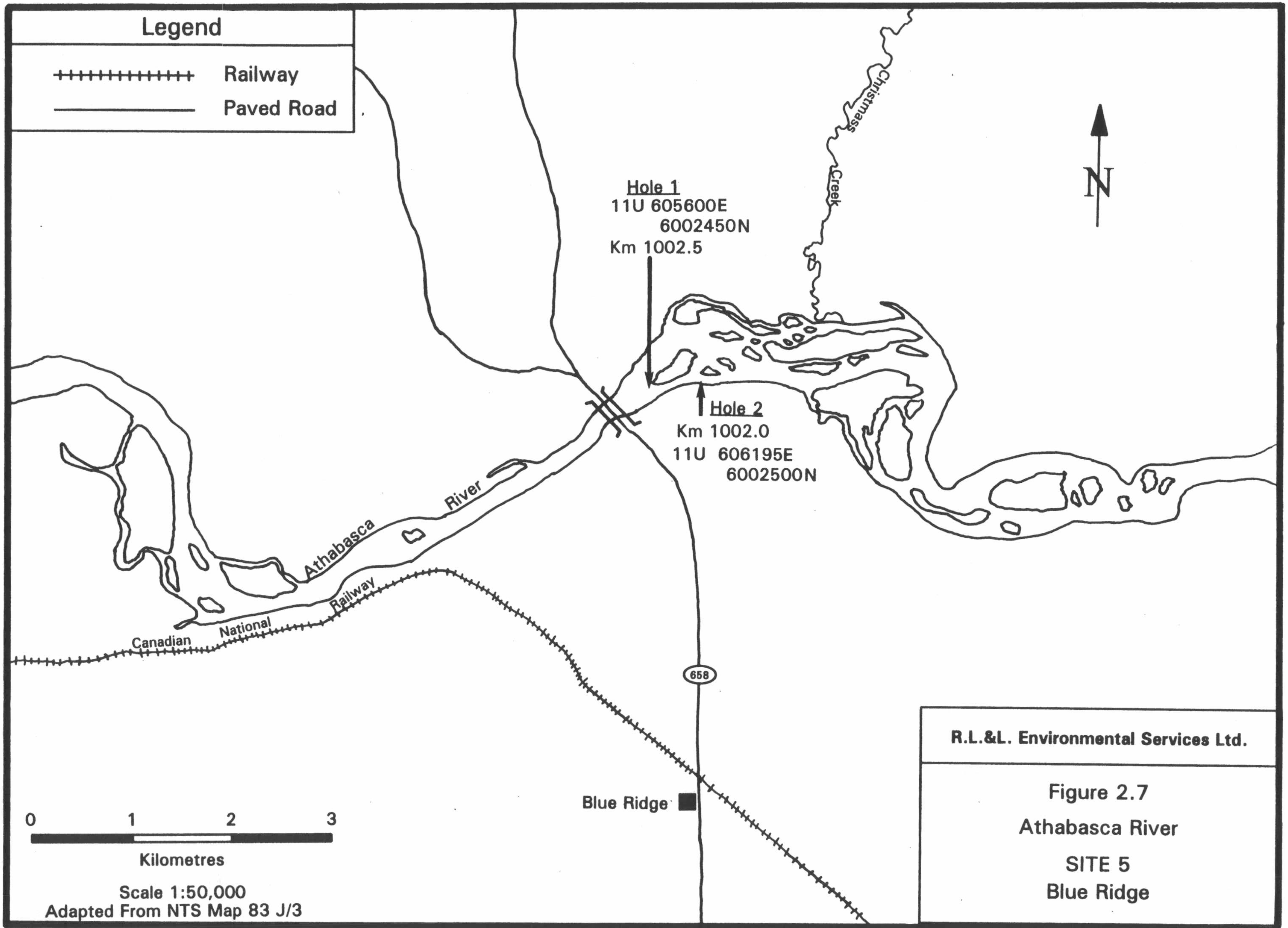

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Figure 2.7
Athabasca River
SITE 5
Blue Ridge

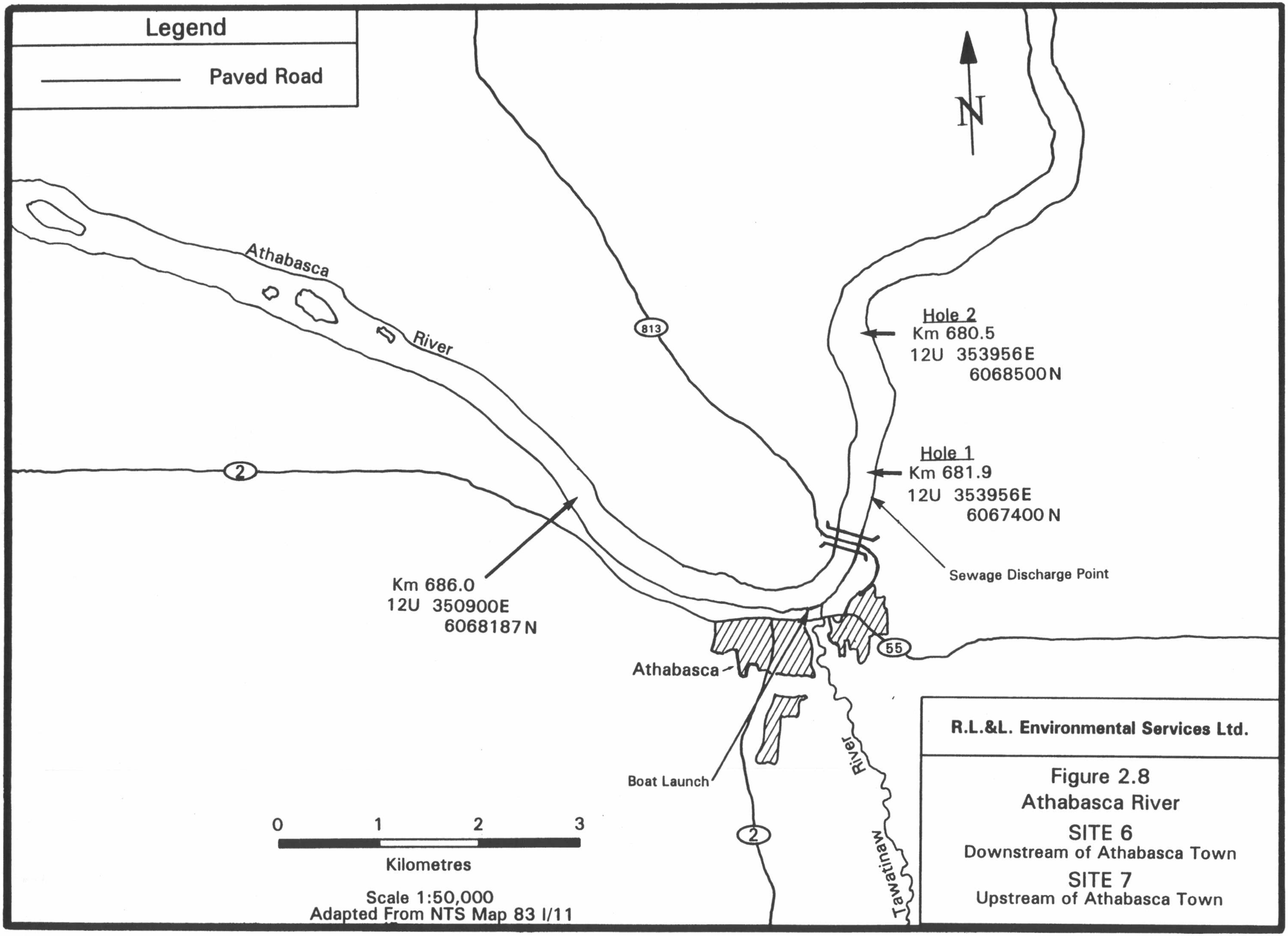

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Figure 2.8
Athabasca River
SITE 6
Downstream of Athabasca Town
SITE 7
Upstream of Athabasca Town

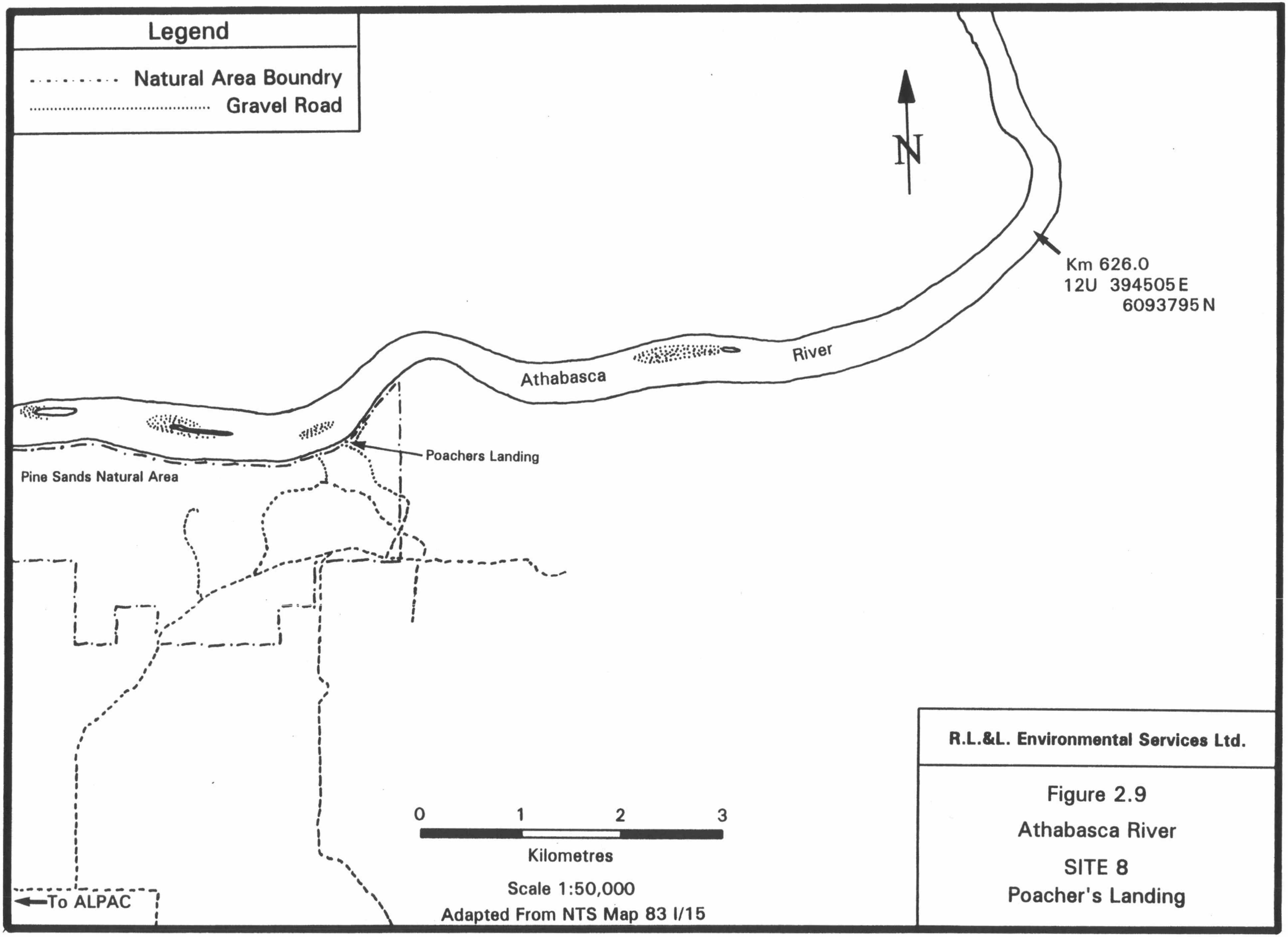

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Figure 2.9
Athabasca River
SITE 8
Poacher's Landing

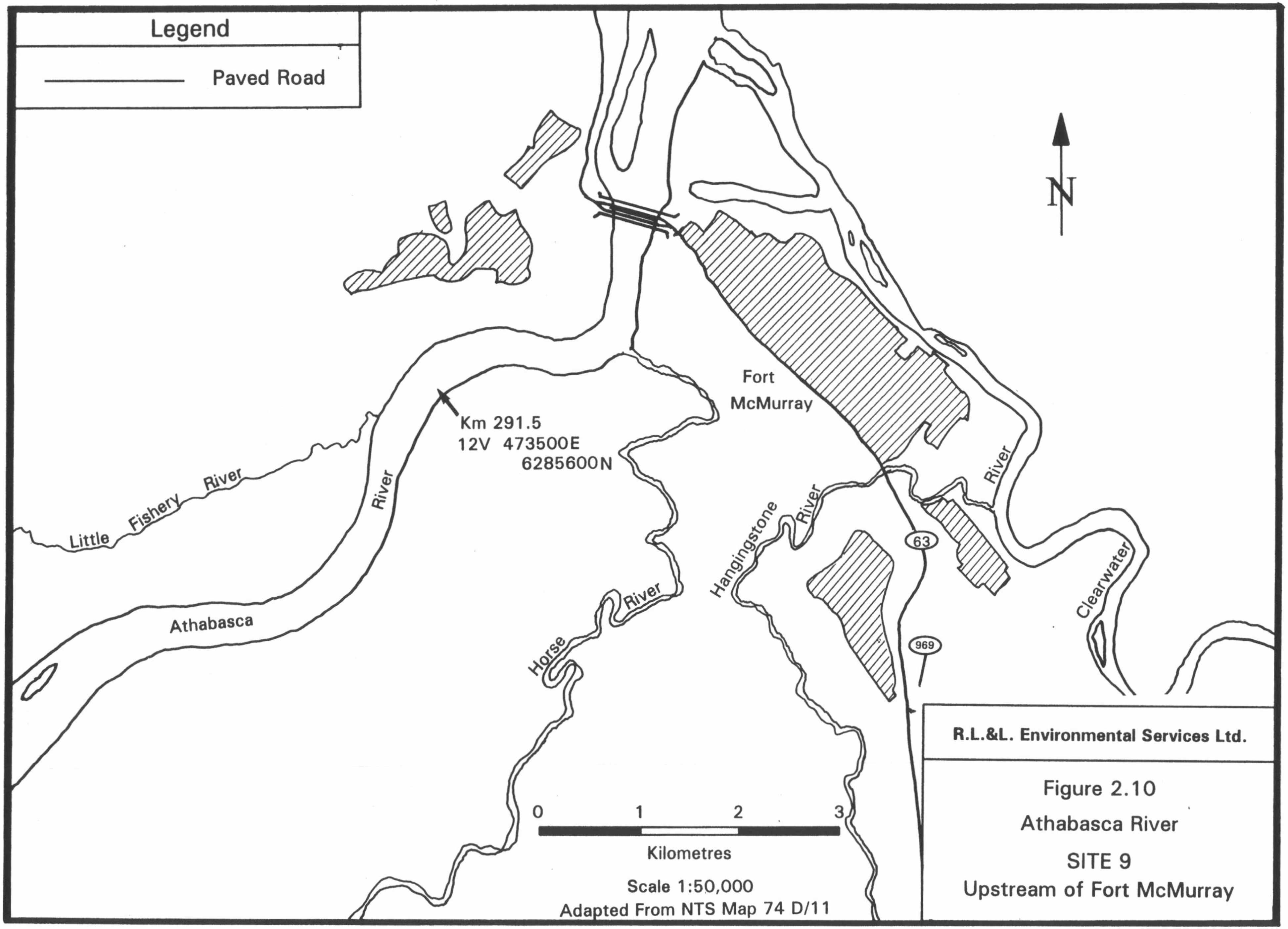

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Figure 2.10
Athabasca River
SITE 9
Upstream of Fort McMurray

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Figure 2.11

Mean daily discharge rates in the Athabasca River at Hinton.

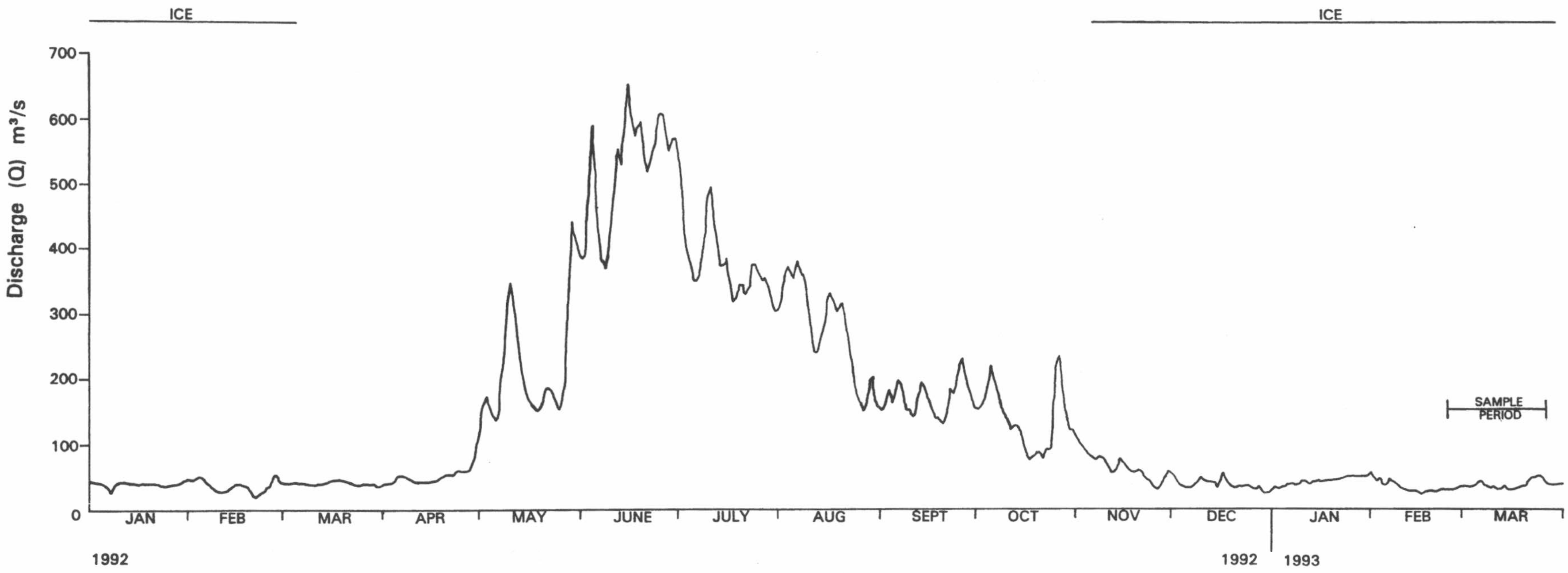

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Figure 2.11 Continued.

Mean daily discharge rates in the Athabasca River at Town of Athabasca.

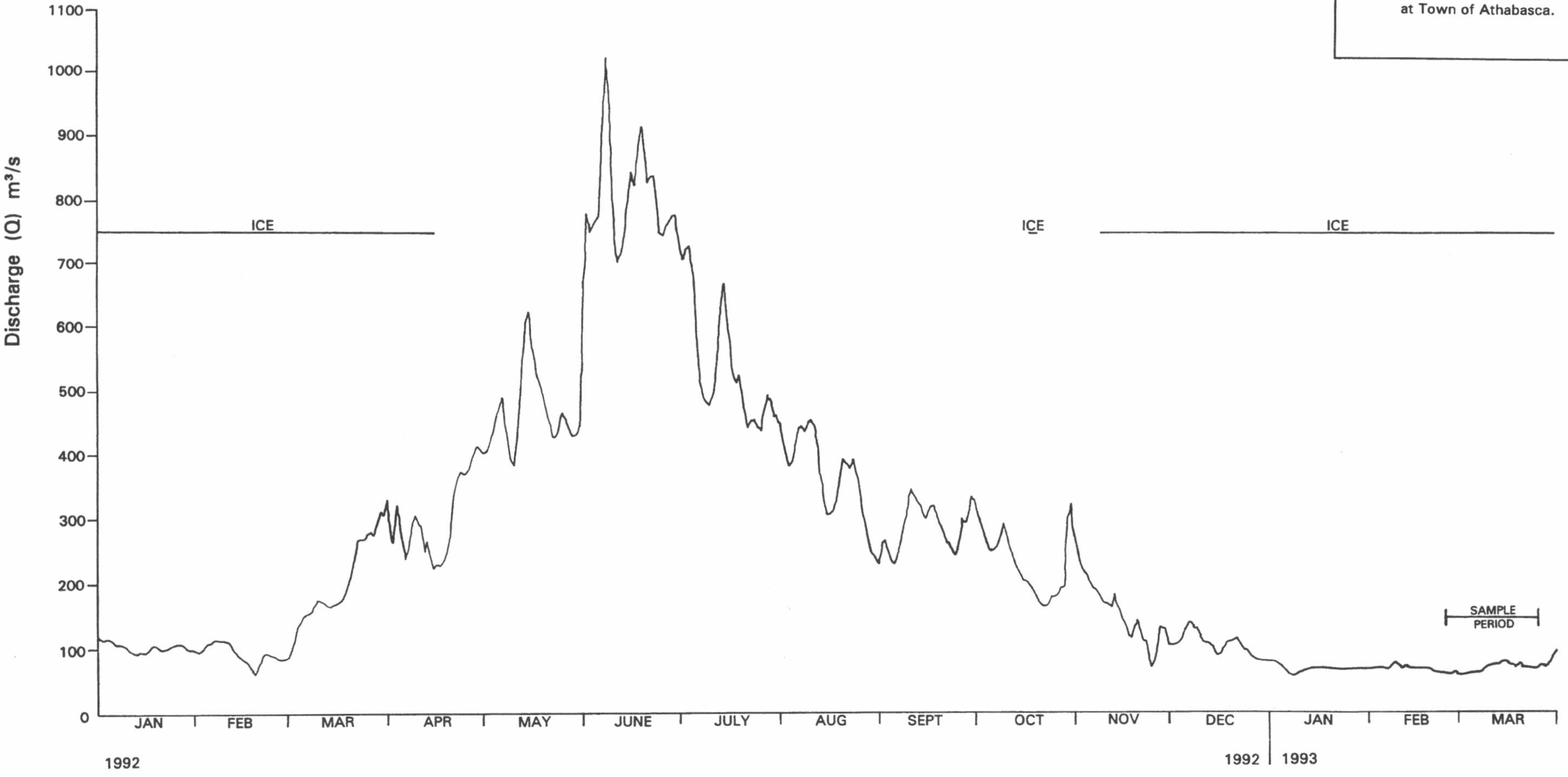

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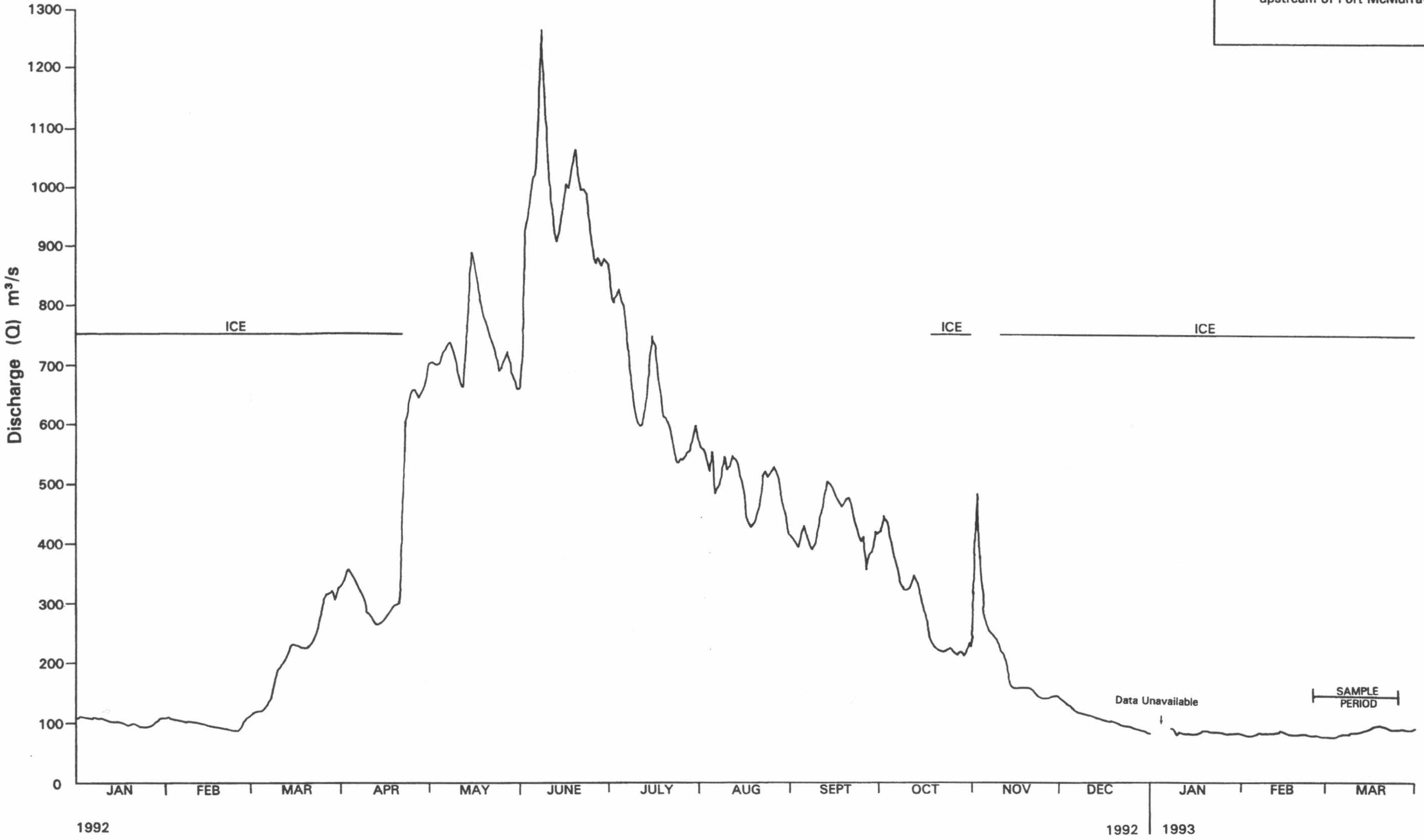
Figure 2.11 Continued.
Mean daily discharge rates
in the Athabasca River
upstream of Fort McMurray.



from 23 February to 27 March 1993. Two short breaks from the work schedule were taken during cold weather periods from 10 to 11 March and 16 to 17 March 1993.

2.2 ICE REMOVAL AND SAMPLE ACQUISITION

Benthic invertebrate, biofilm, and fish sampling necessitated the removal of large amounts of ice over areas of suitable habitat. Parameters used to select suitable sample areas included moderate water depth (<1.5 m), mostly cobble substrate, velocities from 0.25 to 0.80 m/s, and ice cover thickness of ≤ 1 m. To locate prime sampling areas, reconnaissance was conducted using a gasoline powered ice auger with a 10" auger stem. Under-ice flows, using a Marsh-M^{c}Birney Inc. Model 2000 current meter, substrate type, and depths were evaluated prior to any large scale ice removal. Chainsaws with 37" chain bars were used to cut the ice into approximately 0.3 m^2 (surface area) blocks for removal. All power equipment was serviced and refuelled away from sample holes to alleviate potential contamination. Vegetable oil was used as a chain lubricant to prolong chain life for all sites, except at Site 3 (the initial sample site), where chain lubricants were not used. Ice blocks were removed from the holes using ice tongs and pry bars.

Owing to the nature of the ice removal techniques, a number of safety precautions were taken. All crew members were equipped with spike boots for traction on wet ice. Chainsaw operators wore hard hats with ear and eye protection, Kevlar® chaps, and Kevlar® fronted chainsaw boots. In areas with questionable ice conditions (i.e., thin ice), chainsaw operators also wore safety harnesses and a tie-line. All chainsaw operators worked with a partner to ensure safety.

After ice was removed, samples were collected by entering the water while wearing a dry suit and/or neoprene chest waders. A six foot step ladder was used to climb in and out of the water. Only one person entered the water at any given time, and collected benthic samples while attending crew members processed samples on the ice. For safety (i.e., prevention of being swept downstream and under the ice), the person that entered the water wore a harness with a properly secured tie line. One crew member monitored the sampler and tie line, which was secured to a solid structure (e.g., a tree or snow machine). Slack on the tie line was not allowed to exceed 1 m beyond the downstream end of a hole.

2.3 TRACE CONTAMINANT SAMPLING

2.3.1 Handling and Quality Control

The following collection and handling procedures were taken to avoid contamination of samples:

1. To avoid contamination of stable isotope samples, liquids high in nitrogen, carbon, or sulphur were not used.

2. All equipment that came in contact with the samples for trace organic contaminants was first rinsed in ultra-pure acetone, then in ultra-pure (pesticide grade) hexane.

3. All equipment that came in contact with the samples for trace metal analysis were soaked in a 10% acid bath made of reagent grade HCL.

4. Aluminum foil was baked at 350 °C for 6 to 12 h before being used to line lids and protect equipment.

5. Metal, Teflon®, or glass equipment was used for trace organic contaminant samples; plastic, Teflon®, or glass equipment was used for trace metal samples.

6. All reusable equipment was thoroughly cleaned between sites. This included scrubbing all debris off of forceps and scrapers prior to washing in acid (for metals) or rinsing with acetone and hexane (for organics).

7. All expendable equipment was replaced between sites. This included replacing all mesh screens between sites with lab prepared plastic and metal screen material, as well as using new scalpels and instruments for fish dissection.

8. All samples were stored in clean containers (glass jars with lids lined with treated aluminum foil for organic and stable isotope analyses; Teflon® coated or plastic containers for metals; Federal Department of Agriculture (FDA) approved, resin free bags for fish samples). **N.B.** Amber glass jars were not available in time for the scheduled field trip. Therefore, clear glass jars were used; precautions were taken to keep these samples out of direct light (e.g., placed in a box or cooler).

9. Precautions were taken so that samples were not contaminated during sampling or sample preparation. Combustion exhaust from running motors, smoke, dust, paper products, etc. was minimized (i.e. generators running downwind).

10. Blank (fish) tissue samples were provided by the Northern River Basins Study and subjected to routine handling procedures for benthic invertebrate, biofilm, and fisheries samples.

11. Additional sets (duplicates) of all types of samples were collected from various sites, and

12. All residual chemical solutions (e.g., acetone, hexane, and acid) were collected, stored and disposed of in a manner consistent with the Alberta Occupational Health and Safety Act.

Analytical laboratories required the following minimum amounts for tissue analyses:

Trace organic contaminants:	
- dioxins and furans:	10 g wet weight
- chlorophenols:	5 g wet weight
- PAHs, PCBs, resin acids:	10 g wet weight
Trace metals:	5 g wet weight
Stable isotopes:	2 g wet weight
Fish samples	10 fish (of same species)

2.3.2 Collection of Macroinvertebrate Tissue

Macroinvertebrate tissue samples for trace contaminant analyses were collected from erosional habitats (Table 2.1). Three taxa were to be sampled (ephemeropterans, plecopterans, and trichopterans). Caddisfly (Trichoptera) and mayfly (Ephemeroptera) densities varied among sites. Thus, a full complement of wet weights required for contaminant analyses was not collected for these taxa at all sites. Stonefly (Plecoptera) larvae were more abundant at all sites, thus, a larger complement of contaminant samples was collected for this taxon. Although some brachycentrid caddisflies were present, only hydropsychids were collected.

Trace Organic Contaminants and Stable Isotope Sampling Methods

To collect invertebrate tissue samples, a coarse square mesh (1.5 x 1.5 mm) barrier net (metal mesh fastened between two wooden dowels) was used. The barrier was positioned downstream of a person overturning stones with their feet. Dislodged invertebrates were swept by the river current into the barrier mesh. Owing to the limited amount of sampling area within the hole, one person in waders or a dry suit and wearing a safety harness, held the barrier and disturbed the substrate. Surface personnel removed organisms from the mesh screens with metal forceps and placed each taxonomic group into properly prepared glass jars. Samples were then placed in appropriately prepared containers (scintillation vials with lined lids), fully labelled, and frozen on dry ice immediately after collection. Samples were kept frozen at all times. Labels on containers displayed the following information: river, site, taxon, date, number of replicate, wet weight in grams, and type of analysis (i.e., dioxins and furans, chlorophenols, etc.).

In addition, a representative sub-sample of approximately 10 to 20 organisms from each taxonomic group was collected for identification at each site except at Upstream of Athabasca Town, Downstream of Athabasca Town, and Poacher's Landing. At these sites, invertebrates were low in density and all specimens collected were allocated for contaminant analyses. These samples were preserved in 4% formaldehyde and labelled appropriately.

Trace Metal Contaminant Sampling Methods

Macroinvertebrates sampled for trace metal contaminants were collected using the methods outlined previously for organic contaminants. However, a plastic mesh (mesh size=1.5 mm) barrier was used instead of a metal mesh and Teflon® coated forceps were used during removal of organisms from the screen. Samples were stored in labelled 30 mL polyethylene vials.

Table 2.1 Summary of benthic invertebrate trace contaminant tissue samples collected under ice from the Athabasca River, February-March 1993.

SITE	DATE COLLECTED	CONTAMINANT ANALYSIS*	WET WEIGHT COLLECTED (g)							
			Plecoptera		Trichoptera		Ephemeroptera		Blank	
			Rep. 1	Rep.2	Rep.1	Rep. 2	Rep. 1	Rep. 2	Rep.1	Rep.2
1 Control - Near Entrance	4 to 6 March	Dioxins and Furans	12		10	11	12		11	11
		Isotopes	2		2	2	2		3	5
		Chlorophenols	5		6	5	5		8	8
		PAH, PCB, etc.	10		11	10	10		12	15
		Metals	6		6	5	4	3	7	11
		Organic Agregate**			5					
2 Weldwood Haul Bridge	24 to 25 February	Dioxins and Furans	10	11	10		10		10	10
		Isotopes	2	3	3		3		2	2
		Chlorophenols	5	6	7		6		5	5
		PAH, PCB, etc.	10	11	10		10		10	10
		Metals	11	8	4		5		5	5
		Organic Agregate**								
3 Obed Mountain Coal Bridge	28 February, 1 to 2 March	Dioxins and Furans	10							
		Isotopes	2		2		2			
		Chlorophenols	5		5					
		PAH, PCB, etc.								
		Metals								
		Organic Agregate**	2		2		3			
4 Emerson Lakes Bridge	7 to 9 March	Dioxins and Furans	10	11	12		10		10	
		Isotopes	3	3	2		2		7	
		Chlorophenols	5	5	5		5		11	
		PAH, PCB, etc.	11	14	10		10		11	
		Metals	6	6	11	5	5		12	
		Organic Agregate**								
5 Blue Ridge	13 to 14 March	Dioxins and Furans	10	11	10					
		Isotopes	2	2			2			
		Chlorophenols	6	6	5					
		PAH, PCB, etc.	10		10					
		Metals	7		3		<1			
		Organic Agregate**					<2			
6 Downstream of Athabasca Town	18 March	Dioxins and Furans								
		Isotopes								
		Chlorophenols								
		PAH, PCB, etc.								
		Metals								
		Organic Agregate**	2	2	8	2	<2	<1		
7 Upstream of Athabasca Town	20 to 21 March	Dioxins and Furans								
		Isotopes								
		Chlorophenols								
		PAH, PCB, etc.								
		Metals								
		Organic Agregate**	7	7	9	10	<1	<1		
8 Poacher's Landing	23 March	Dioxins and Furans								
		Isotopes								
		Chlorophenols								
		PAH, PCB, etc.								
		Metals								
		Organic Agregate**	7	2	8		<1			
9 Upstream of Fort McMurray	26 to 27 March	Dioxins and Furans	10		10				10	
		Isotopes	4		4				7	
		Chlorophenols	5		8				6	
		PAH, PCB, etc.	11		10				12	
		Metals	4		4			<1	7	
		Organic Agregate**	6				2/2***	<1		

* Samples for metal analyses were placed in 30 ml polyethylene vials. All other sample types were placed in 20 mL glass scintillation vials.

** Organic agregate indicates a sample collected, but not designated to a specific contaminant analysis.

*** x/x indicates two seperate samples. Three samples were collected for emphemeroptera and not designated to a specific analysis.

Blank Tissue Handling Methods

Northern River Basins Study provided blank (fish) tissue. This tissue was handled using the same equipment and procedures as were the macroinvertebrate tissue samples. A full complement of blank samples, including duplicates, were processed at Sites 1 and 2. Blank tissue samples also were processed at Sites 4 and 9 (Table 2.1).

2.3.3 Collection of Biofilm Tissue

Biofilm refers to the assemblage of algae and associated organisms (algae, fungi, bacteria, protozoans, etc. and their secretions) that surround solid surfaces in aquatic systems. Biofilm was sampled at the nine sites, within the same general area as benthic invertebrates (Table 2.2). Samples were collected from a least 10 stones chosen at random from erosional areas at each site. Scrapings from the stones were combined and mixed to form a composite sample for each site and type of analysis (organic or metal contaminants). Care was taken to avoid inclusion of macroinvertebrates and large organic debris in the composite samples. Aliquots were withdrawn and apportioned to the appropriate sample containers as described in Section 2.3.1.

Additional biofilm samples were reserved for taxonomic identification. At each site, two aliquots from the composite organic contaminant sample were preserved; one with a modified Lugol's solution and the other with 4% formaldehyde. At sites 1 and 2, identification samples were replicated for both Lugol's and formaldehyde preservation methods.

2.3.4 Collection of Fish Tissues

Fish sampling was carried out at all nine sites. Mountain whitefish were captured at four of nine sites (Sites 1 to 4) and dissected to obtain liver tissue for MFO determination (Table 2.3). All remaining fish tissue was individually bagged (in FDA approved, resin free bags), labelled, and frozen for contaminant analysis. Data collected on individual fish are in Appendix D.

Gee-traps for small fish were used with a variety of baits (i.e., cheese, crackers, and Lunker® lights) at open water Site 2 and ice covered Site 3. No fish were caught using Gee-traps. All sites were electrofished using a Smith-Root Type XII backpack electrofisher, and all fish caught were obtained by this method.

Table 2.2 Summary of biofilm trace contaminant tissue samples collected under ice from the Athabasca River, February-March 1993.

Site	DATE COLLECTED	CONTAMINANT ANALYSIS*	WET WEIGHT COLLECTED (g)	
			Rep. 1	Rep.2
1 Control - near Entrance	3 &5 March	Dioxins and Furans	15	11
		Isotopes	3	5
		Chlorophenols	9	5
		PAH, PCB, etc.	12	12
		Metals	9	8
2 Weldwood Haul Bridge	24 February	Dioxins and Furans	11	11
		Isotopes	7	7
		Chlorophenols	8	8
		PAH, PCB, etc.	15	16
		Metals	17	25
3 Obed Mountain Coal Bridge	26 to 28 February, 1 March	Dioxins and Furans	10	
		Isotopes	2	
		Chlorophenols	5	
		PAH, PCB, etc.	10	
		Metals	6	
4 Emerson Lakes Bridge	7 to 8 March	Dioxins and Furans	15	12
		Isotopes	17	9
		Chlorophenols	12	15
		PAH, PCB, etc.	10	14
		Metals	11	24
5 Blue Ridge	14 March	Dioxins and Furans	10	
		Isotopes	4	
		Chlorophenols	6	
		PAH, PCB, etc.	14	
		Metals	7	
6 Downstream of Athabasca Town	19 March	Dioxins and Furans	12	14
		Isotopes	4	3
		Chlorophenols	8	7
		PAH, PCB, etc.	12	12
		Metals	10	11
7 Upstream of Athabasca Town	20 March	Dioxins and Furans	11	12
		Isotopes	3	4
		Chlorophenols	6	7
		PAH, PCB, etc.	11	11
		Metals	8	7
8 Poacher's Landing	23 March	Dioxins and Furans	13	12
		Isotopes	5	5
		Chlorophenols	7	7
		PAH, PCB, etc.	12	12
		Metals	10	8
9 Upstream of Fort McMurray	26 March	Dioxins and Furans	11	12
		Isotopes	3	5
		Chlorophenols	9	7
		PAH, PCB, etc.	13	12
		Metals	17	9

* Samples for metal analysis were placed in 30 ml polyethylene vials. All other samples were placed in 20 ml glass scintillation vials.

Table 2.3 Summary of fish collected under ice for Multi-function oxidase and contaminant analysis from sites on the Athabasca River, February-March 1993.

SITE	SAMPLE DATE	SAMPLE NUMBERS	CATCH (#'s)				BLANK
			CONTAMINANT ANALYSIS		MFO ANALYSIS		
			MW*	SCUL**	MW*	SCUL**	
1 Control - near Entrance	4 to 5 March	15 to 44	30		30		1
2 Weldwood Haul Bridge	24 February	1 to 10	9	1	9		1
3 Obed Mountain Bridge	27 February	11 to 14	4		4		
4 Emerson Lakes Bridge	8 March	45 to 46	2		2		1
5 Blue Ridge	13 March						
6 Downstream of Athabasca Town	21 March						
7 Upstream of Athabasca Town	21 March						
8 Poacher's Landing	24 March						
9 Upstream of Fort McMurray	27 March						

* MW = mountain whitefish

** SCUL = sculpin

2.4 AQUATIC COMMUNITY SAMPLING

2.4.1 Invertebrate Sampling

Aquatic macroinvertebrate community samples were collected from the Athabasca River concurrent with the collection of invertebrate tissue samples for trace contaminant analyses. Ten replicate samples were collected from erosional habitats at each of sites 4 to 9. Additional samples were collected at Site 1 (14 Neills), as well as sites 2 and 3 (13 Neills each). Sampling occurred prior to disturbance by previous sampling programs. All methods used in sampling aquatic invertebrates followed procedures outlined in Alberta Environment (1990). A modified Neill (1938) cylinder sampler (0.1 m^2 and 0.210 mm mesh) and a deep-water sock secured over the top of the cylinder were used to collect animals from erosional habitats. The deep water sock was used to enclose the top of the cylinder because combined ice and water depths for areas of appropriate flow averaged 1 m, well above the top of the cylinder (approximately 60 cm high). Areas with shallower depths could not be sampled because they were frozen from surface to substrate. Large surface substrate (boulder, cobble, large gravel) delineated by the Neill cylinder was removed by an individual completely submerging in a dry suit to hand pick stones from the river bottom. These stones were then scrubbed with a small brush to remove adhering organisms into a 20 L bucket. Individual samples were stored in labelled, 1.5 L, wide-mouthed plastic bottles and preserved, in the field, with 4% formaldehyde. Prior to placement in these bottles, the samples were elutriated and sieved (212 μm mesh) to separate organic and inorganic materials. The inorganic portion was visually scanned for animals before it was discarded. Variables that may influence invertebrate distribution (e.g., current velocity, substrate characteristics, depth, etc.) were recorded and are described below in Section 3. Mean current velocity (0.6 depth from the substrate to the bottom of the ice) over sampling locations was measured with a Marsh-M^{c}Birney, Inc. Model 2000 current meter. Substrate composition was visually assessed according to a modified Wentworth (1922) scale (Cummins 1962).

2.4.2 Biofilm Sampling

Biofilm sampling was conducted in conjunction with trace contaminant tissue sample collection. Ten replicate samples for both taxonomic identification and Chl*a*/LOI analysis were collected from all sites except sites 1 and 4. Five additional biofilm samples (total of 15) were collected for taxonomic identification at Site 1 and for Chl*a*/LOI analysis at Site 4, respectively. Each sample consisted of biofilm scraped from a 9 cm^2 area (as delineated by a circular template) and placed into labelled 20 mL, plastic scintillation vials. Samples for taxonomic identification were preserved in Lugol's solution. Samples collected for Chl*a*/LOI analysis were placed on dry ice.

2.5 FISH SAMPLING

The following handling and collection procedures were observed when sampling for MFO analysis of liver tissue:

1. A single species (i.e., mountain whitefish) at all sites was collected for MFO tissue sampling for comparable results.
2. All fish collected were transferred to a portable live well and experienced minimal handling prior to dissection.
3. Each sample fish was examined for abnormalities. A Gross Pathology Sheet was completed if any abnormalities were found.
4. Length and weight were recorded on a Fish Collection Sheet (Appendix D).
5. The dissection area was covered with FDA approved, resin-free plastic and disposable scalpels were used to process fish.

6. Any contact with gall bladder bile was avoided; all livers were rinsed in 0.15 M KCl solution prior to placement in an appropriate container.
7. Large livers were subsampled, with excess liver tissue bagged and labelled separately to be used in conjunction with whole fish tissue for contaminant analysis, and
8. Each liver was packaged in a cryovial, labelled, and immediately frozen on dry ice (-80 °C).

Liver tissue for MFO analysis was removed from all mountain whitefish captured. One sculpin was captured at Site 1, but the liver was not sampled.

SECTION 3
RESULTS

3.1 DATA COLLECTION

The field survey commenced on 24 February 1993 and terminated on 27 March 1993, with two short breaks due to cold weather (10-11 March and 16-17 March). In general, the weather was seasonably mild for the majority of the survey (Table 3.1). Water temperature at all sites (open and ice-covered) was 1 - 2 °C. Owing to the mild weather, snow on river banks and surface ice was generally non-existent. Snow was present mainly during storms. Biofilm, macroinvertebrate, and fish tissue were processed inside of an electrically heated, 14-foot cargo van that was established as a mobile lab. Electricity for heat and lighting was provided by gas generators located approximately 300 m downwind of the van. Photographs of equipment, sample sites, and procedures are included in Appendix B.

Densities of benthic macroinvertebrates varied among the nine sites. Plecoptera (stoneflies) were generally more abundant than Trichoptera (caddisflies) or Ephemeroptera (mayflies). A full complement of trace contaminant samples for all three taxa were collected at Sites 1, 2, and 4. Insufficient macroinvertebrate biomass was collected at sites 3 and 5 through 9 to complete a full complement of all contaminant analyses for all taxa. Invertebrate density appeared to be much lower at sites (downstream and upstream of Athabasca and Poacher's Landing) around the town of Athabasca.

Taxonomic composition also varied among the sampling sites. Stoneflies tended to be relatively consistent in taxonomic composition among all sites. The stoneflies, *Claassenia*, *Hesperoperla*, *Pteronarcella*, and *Isogenoides* were observed at all sites; however, *Pteronarcella* tended to be greatest in density at the Athabasca Town sties. Adult stoneflies (possibly Nemouridae) were observed at Poacher's Landing. It was also observed that capniid-chloroperlid-type stoneflies became more abundant further downstream. Hydropsychid caddisflies mainly consisted of *Arctopsyche* at Site 1, the upper-most site. *Hydropsyche* and *Cheumatopsyche* predominated as sampling progressed downstream. *Brachycentrid* caddisflies also became less abundant at downstream sites. The mayflies, *Drunella*, *Ameletus*, and *Ametropus* were mainly observed at upstream sites, while *Baetis* and *Heptegenia* were observed to be more abundant at downstream sites. Gomphid-type dragonflies were observed at Blue Ridge (Site 5) and all remaining downstream sites.

Mountain whitefish were more abundant at upstream sites. Fish were only collected at Sites 1 through 4, although sampling effort was relatively consistent at all nine sites. Of the fish collected, none were observed to have any gross pathological conditions.

Table 3.1 Summary of weather conditions measured in the field (February - March 1993).

SITE	DATE	TEMPERATURE[a] (°C)		DESCRIPTION
		WATER	AIR	
2	24 Feb	1	-8	overcast, breezy
2/3	25 Feb	1	-3	overcast, breezy
2/3	26 Feb	1	0	overcast, breezy
3	27 Feb	1	6-10	gusty wind to 120 kph
3	28 Feb	1	13	gusty wind to 80 kph
1	1 Mar	1	13	gusty wind to 120 kph
1/3	2 Mar	1	8	sunny, breezy
1/2	3 Mar	1	11	sunny, breezy
1	4 Mar	2	12	sunny, wind gusts to 100 kph
1	5 Mar	2	11	sunny, wind gust to approx. 50 kph
1/4	6 Mar	2	15	cloudy, calm, slight breeze, 10 kph
4	7 Mar	1	15	sunny, calm
4	8 mar	1	-2	snowing all day
4	9 Mar	1	-3	overcast, calm
5	12 Mar	1	5	overcast, calm
5	13 Mar	1	2	sunny, breezy to 10-15 kph
5	14 Mar	1	0	morning cold (-5°C), breezy to 25-30 kph
6	17 Mar	1	3	30-50 kph winds, sunny
6	18 Mar	1	4	breezy
7	19 Mar	1	6	breezy (15 kph), sunny
7	20 Mar	1	6	windy, 30-40 kph, overcast
7/6	21 Mar	1	10	breezy, 20-30 kph, overcast in pm
8	22 Mar	1	12	sunny, calm
8	23 Mar	1	12	sunny to overcast in pm, breezy at 10-20 kph
8	24 Mar	1	12	windy, 30-40 kph
9	25 Mar	1	8	windy, 20-60 kph
9	26 Mar	1	6	calm, sunny
9	27 Mar	1	10	calm, sunny

[a] Temperatures were recorded between 1300 to 1500 h.

Biofilm was relatively abundant at all sites. For example, duplicate biofilm contaminant samples were collected at all sites except 3 and 5, where single samples were collected (see Table 2.2). At each site, biofilm varied from encrusting diatoms to large masses of macroalgae. At the five upstream sites, macroalgae consisted of a gelatinous mass that may have been bacteria and/or a winter form of the blue-green algae *Nostoc*. At the four downstream sites, macroalgae consisted of the aforementioned gelatinous mass as well as various amounts of a filamentous green algae (possibly *Cladophora*) and mosses (Bryophytes).

Benthic macroinvertebrate and biofilm quantitative samples were collected in association of one another. In other words, quantitative biofilm replicates were collected in the same area as corresponding invertebrate quantitative replicates (i.e., Chl*a*/LOI and Lugol's replicates 1 through 3 were collected in the vicinity of Neill replicates 1 through 3).

To perform quantitative sampling of benthic invertebrates and biofilm, ice had to be removed from eight of the nine sites that were sampled. The number of holes produced at a site varied from one to four and the total area of exposed river bottom ranged from approximately 43 to 144 m^2 (Figure 3.1). The smallest single-holed site was approximately 94.5 m^2 in surface area.

Although the Terms of Reference states, and NRBS managers implied, that not less than three to five holes, approximately 3 x 5 m in size, were required for quantitative sampling, most sites were sampled through one or two large holes. Fewer holes were produced in order to save time and expedite sampling. Reconnaissance took from two to eight hours at each location to find a suitable sampling site. For example, reconnaissance at Fort McMurray took approximately four hours. Subsequently, ice cutting was undertaken while a second work crew of two people continued reconnaissance activities for more sampling locations. After expending at least six more hours and travelling approximately 500 m upstream and downstream of the original sampling location, no other sampling areas could be found, therefore, a decision was made to produce one large hole at this site. Two ice-cutting crews worked on opposite ends of the hole to ultimately expose approximately 94 m^2 of river bottom.

Cutting fewer than three holes did not compromise the total area of river bottom that was exposed at a given site. Three to five holes of 3 x 5 m size exposed 45 to 75 m^2 of river bottom. The smallest area of river bottom that was exposed in this project was 43 m^2, with two holes at Site 6 (Downstream of Athabasca Town).

Individual site observations are as follows:

Site 1 - Control - near Entrance

All ice removal and sample collections occurred at two locations from 1 to 6 March 1993. Sampling Location 1, near Brûle Lake, consisted of open water sampling in an ice-free area approximately 4 km long and along the RUB. Sampling location 2, near Maskuta Creek, involved three ice-holes (7.5 x 2.1 m, 6.2 x 2.8 m, and 7.9 x 1.8 m, respectively; Figure 3.1) in 0.6 m ice thickness. Holes were cut along the LUB and sampling occurred in 0.8 to 1.18 m of water. Biological tissue samples for trace contaminant analyses were collected from both locations and all quantitative samples were collected from Location 2. Fish samples were collected from Location 1.

Plecoptera and Trichoptera samples destined for PAH, PCB, etc. analysis may have been contaminated by water that was inadvertently added to the sorting tray. This water was from a plastic fish livewell that contained live fish. Additional replicates (five extra, n=15) of quantitative biofilm (taxonomic identification and Chl*a*/LOI) were collected due to spillage and improper storage of the original ten samples. Table 3.2 summarizes the physical variables measured at the benthic invertebrate community sample locations.

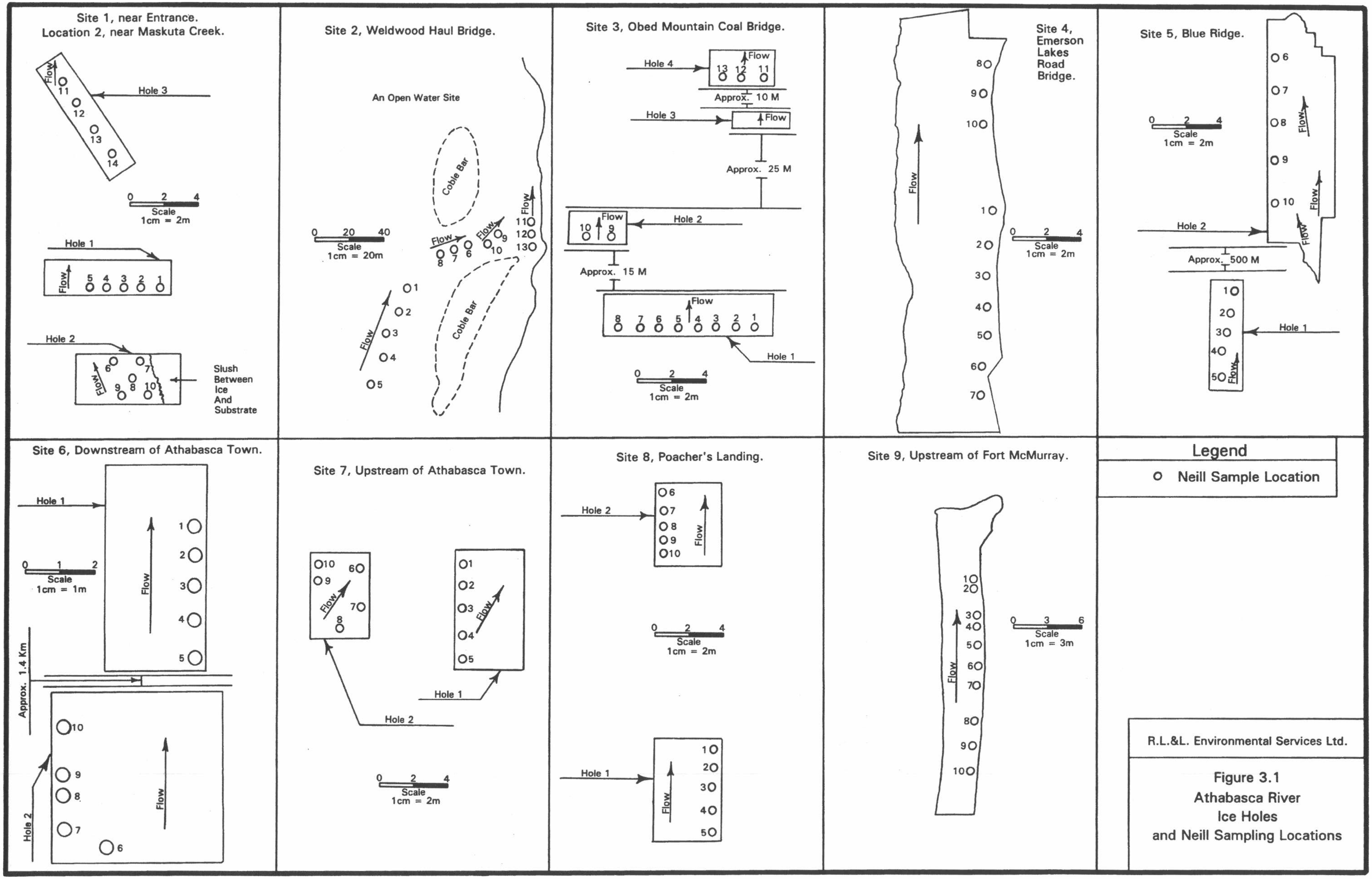


Figure 3.1
Athabasca River
Ice Holes
and Neill Sampling Locations

Table 3.2 Physical variables measured at benthic invertebrate community sample locations, Site 1.

SAMPLE	DATE COLLECTED	MEAN CURRENT VELOCITY (cm/s)	DEPTH (cm)	SUBSTRATE (% Composition)			
				Boulder	Cobble/ Pebble	Pebble/ Gravel	Sand/Silt
Neill 1	2 March	43	100		50	25	25
Neill 2	2 March	83	100		70	5	25
Neill 3	2 March	65	80		40	40	20
Neill 4	2 March	76	100		10	80	10
Neill 5	2 March	84	100		85	10	5
Neill 6	2 March	76	118			80	20
Neill 7	2 March	42	112		60	20	20
Neill 8	2 March	33	115		60	30	10
Neill 9	2 March	76	115		75	20	5
Neill 10	2 March	64	112		30	60	10
Neill 11	3 March	39	114		70	20	10
Neill 12	3 March	27	114		60	35	5
Neill 13	3 March	29	96		60	25	15
Neill 14	3 March	79	80		80	10	10

Site 2 - Weldwood Haul Bridge

Site 2 was entirely ice free with minimal shore ice (Figure 3.1). Sampling occurred on 24 and 25 February and 3 March 1993, approximately 100 to 500 m downstream of the Weldwood Haul Bridge. Baited Gee-traps and backpack electrofishing were used to collect fish. Nine fish were caught by electrofishing, while Gee-traps produced no fish even though small schools of fish were observed in areas where the Gee-traps were set. All sampling was conducted along the LUB. Physical variables measured at each benthic invertebrate sample site are summarized in Table 3.3.

Table 3.3 Physical variables measured at benthic invertebrate community sample locations, Site 2.

SAMPLE	DATE COLLECTED	MEAN CURRENT VELOCITY (cm/s)	DEPTH (cm)	SUBSTRATE (% composition)			
				Boulder	Cobble/ Pebble	Pebble/ Gravel	Sand/Silt
Neill 1	24 February	48	36	20	40	20	20
Neill 2	24 February	41	35	10	30	40	20
Neill 3	24 February	45	28	10	50	30	10
Neill 4	24 February	53	38	10	40	40	10
Neill 5	24 February	44	46	10	50	35	5
Neill 6	24 February	36	54	20	40	30	10
Neill 7	24 February	28	46	10	60	25	5
Neill 8	24 February	58	35		20	50	30
Neill 9	24 February	37	39		25	60	15
Neill 10	24 February	65	28	20	55	10	15
Neill 11	3 March	28	61	5	60	15	20
Neill 12	3 March	19	55		40	50	10
Neill 13	3 March	21	59			80	20

Site 3 - Obed Mountain Coal Bridge

All samples were collected approximately 100 to 500 m upstream of the Obed Mountain Coal Bridge on 25 to 28 February and 2 March 1993. Site 3 was the first ice removal and through ice sampling site undertaken for the study. Four holes were cut at the Obed site (10 x 1.5 m; 3.5 x 2.0 m; 3 x 1 m and 4 x 2.5 m, respectively) in 0.65 m of ice thickness along the LUB (Figure 3.1). Total water depth varied from 1.0 to 1.14 m.

Neills 1 through 3 were collected with the use of an open Neill (i.e., without a deep water sock that sealed the top of the cylinder) and a bar for substrate disturbance, while Neills 4 through 13 used a sock and substrate was removed and scrubbed as described in Section 2.4.1.

Invertebrate tissues for contaminant analysis were collected using both kick nets and the Neill cylinder. Gee-traps were set over two nights and were unsuccessful. Backpack electrofishing produced four mountain whitefish for contaminant and MFO tissue analysis. Physical variables measured at benthic invertebrate community sample points are summarized in Table 3.4.

Table 3.4 Physical variables measured at benthic invertebrate community sample locations, Site 3.

SAMPLE	DATE COLLECTED 1993	MEAN CURRENT VELOCITY (cm/s)	DEPTH (cm)	SUBSTRATE (% Composition)			
				Boulder	Cobble/ Pebble	Pebble/ Gravel	Sand/Silt
Neill 1	26 February	24	110		30	60	10
Neill 2	26 February	19	110		25	60	15
Neill 3	26 February	21	110		40	40	20
Neill 4	28 February	27	100		70	15	15
Neill 5	28 February	26	100		50	45	5
Neill 6	28 February	23	104	5	40	40	15
Neill 7	28 February	33	102		70	20	10
Neill 8	28 February	41	104		30	60	10
Neill 9	28 February	33	103		70	20	10
Neill 10	28 February	41	112		20	60	20
Neill 11	28 February	41	114		10	80	10
Neill 12	28 February	34	108		70	25	5
Neill 13	28 February	41	116	5	70	15	10

Site 4 - Emerson Lakes Bridge

Biofilm and benthic invertebrate samples were collected from 6 to 9 March 1993, approximately 800 m downstream of the Emerson Lakes Bridge. One hole, approximately 6 x 25 m in size, was cut in ice that varied from 0 to 70 cm in thickness (Figure 3.1).

Quantitative biofilm samples were collected over two days (7 and 8 March 1993). On the first day, 20 taxonomic identification and Chl*a*/LOI samples were collected from stones that had encrusting diatomaceous biofilm. The scrapings of these samples had to be washed into sample containers using unfiltered river water (2 to 5 mL). On the second day, biofilm consisting of macroalgae (gelatinous material) was found in another reach of the sampling hole; therefore, an additional five taxonomic identification and five Chl*a*/LOI samples were collected to properly represent site diversity.

Two mountain whitefish were collected by backpack electrofisher and processed for contaminant and MFO analysis. A summary of variables measured when collecting quantitative benthic invertebrate samples is presented in Table 3.5.

Table 3.5 Physical variables measured at benthic invertebrate community sample locations, Site 4.

SAMPLE	DATE COLLECTED 1993	MEAN CURRENT VELOCITY (cm/s)	DEPTH (cm)	SUBSTRATE (% Composition)			
				Boulder	Cobble/ Pebble	Pebble/ Gravel	Sand/Silt
Neill 1	7 March	23	16		60	30	10
Neill 2	7 March	24	118		65	25	10
Neill 3	7 March	29	112		65	25	10
Neill 4	7 March	32	114		70	20	10
Neill 5	7 March	44	110		75	15	10
Neill 6	7 March	24	112		80	10	10
Neill 7	7 March	31	108		70	20	10
Neill 8	8 March	25	118		70	25	5
Neill 9	8 March	25	116	40	30	15	15
Neill 10	8 March	28	130		80	10	10

Site 5 - Blue Ridge

Sampling occurred 0.5 to 1.0 km downstream of the Blue Ridge bridge (secondary highway 658) from 12 to 14 March 1993. Two large holes were cut in 0.68 m ice thickness. The upstream hole (2 x 6.5 m) was located on the RUB off the point of a large island in 1.0 to 1.10 m water depth. The downstream hole (4 x 13 m) was located 0.5 km downstream of the upstream hole, close to the LUB with sampling in 0.88 to 0.90 m water depth (Figure 3.1). Both sample holes were backpack electrofished, but no fish were captured. Physical variables measured at benthic invertebrate community sample sites are outlined in Table 3.6.

Table 3.6 Physical variables measured at benthic invertebrate community sample locations, Site 5.

SAMPLE	DATE COLLECTED 1993	MEAN CURRENT VELOCITY (cm/s)	DEPTH (cm)	SUBSTRATE (% Composition)			
				Boulder	Cobble/ Pebble	Pebble/ Gravel	Sand/Silt
Neill 1	13 March	21	110		70	20	10
Neill 2	13 March	24	100		80	10	10
Neill 3	13 March	15	106		80	10	10
Neill 4	13 March	18	102		80	10	10
Neill 5	13 March	32	100		80	10	10
Neill 6	13 March	22	90		60	30	10
Neill 7	13 March	19	100		80	10	10
Neill 8	13 March	21	90		80	10	10
Neill 9	13 March	29	90	10	70	10	10
Neill 10	13 March	26	88	50	30	10	10

Site 6 - Downstream of Athabasca Town

On 17, 18, and 21 March 1993, samples were collected downstream of the town of Athabasca, below the municipal sewage treatment discharge point. Two holes (3 x 6 m and 5 x 5 m) were cut 1.4 km apart along the LUB in 0.68 m ice thickness. Sampling occurred in 0.94 to 1.12 m water depth (Figure 3.1). A full complement of quantitative samples and biofilm contaminant tissue was collected. Substrate at this site was compacted and very difficult to turnover. Backpack electrofishing was ineffectual, and no mountain whitefish were captured. All physical measurements and variables for benthic invertebrate community samples are summarized in Table 3.7.

Table 3.7 Physical variables measured at benthic invertebrate community sample locations, Site 6.

SAMPLE	DATE COLLECTED 1993	MEAN CURRENT VELOCITY (cm/s)	DEPTH (cm)	SUBSTRATE (% Composition)			
				Boulder	Cobble/ Pebble	Pebble/ Gravel	Sand/Silt
Neill 1	18 March	27	96	70	10	10	10
Neill 2	18 March	30	94	70	10	10	10
Neill 3	18 March	28	98	80	5	5	0
Neill 4	18 March	27	96		80	10	10
Neill 5	18 March	35	98	10	70	10	10
Neill 6	21 March	29	112	10	70	15	5
Neill 7	21 March	26	110		75	20	5
Neill 8	21 March	24	110		70	20	10
Neill 9	21 March	25	110		70	20	10
Neill 10	21 March	18	108	10	70	10	10

Site 7 - Upstream of Athabasca Town

This site was included to provide an Athabasca area site that was not under the direct influence of a municipal effluent discharge. Sampling occurred on 19-21 March 1993 in two ice holes approximately 3.4 km upstream of the Highway 813 bridge. Sampling was performed in two holes (7 x 4 m and 5 x 3.5 m) cut in 0.68 m ice thickness on the LUB, in 0.88 to 1.20 m water depth (Figure 3.1). Substrate conditions were very similar to Site 6 (compacted). No fish were caught for MFO or tissue analysis. A summary of physical attributes measured or observed at Neill community sample sites is in Table 3.8.

Table 3.8 Physical variables measured at benthic invertebrate community sample locations, Site 7.

SAMPLE	DATE COLLECTED 1993	MEAN CURRENT VELOCITY (cm/s)	DEPTH (cm)	SUBSTRATE (% Composition)			
				Boulder	Cobble/ Pebble	Pebble/ Gravel	Sand/Silt
Neill 1	20 March	43	88		80	15	5
Neill 2	20 March	48	88		75	15	10
Neill 3	20 March	57	84	5	70	15	10
Neill 4	20 March	57	90		70	20	10
Neill 5	20 March	62	94	20	60	10	10
Neill 6	20 March	35	116	10	60	15	15
Neill 7	20 March	55	120		75	15	10
Neill 8	20 March	63	120		75	15	10
Neill 9	20 March	53	114		75	15	10
Neill 10	20 March	47	114		10	60	30

Site 8 - Poacher's Landing

This site was sampled from 22 to 24 March 1993 approximately 8 km downstream of the Poacher's Landing boat launch. Two large holes (6 x 4 m and 5 x 4 m) were cut approximately 10 m apart along LUB in 0.40 to 0.50 m ice thickness (Figure 3.1). Sampling occurred in 0.9 to 1.8 m water depth. The stony substrate at this site was imbedded in a clay-silt material. Biofilm was thick and abundant, with gelatinous material especially prevalent. All sample holes were backpack electrofished, but no mountain whitefish were found. Table 3.9 summarizes all physical variables measured at benthic invertebrate community sample sites.

Table 3.9 Physical variables measured at benthic invertebrate community sample locations, Site 8.

SAMPLE	DATE COLLECTED 1993	MEAN CURRENT VELOCITY (cm/s)	DEPTH (cm)	SUBSTRATE DESCRIPTION			
				Boulder	Cobble/ Pebble	Pebble/ Gravel	Sand/Silt
Neill 1	23 March	30	140		30	30	40
Neill 2	23 March	32	120		60	20	20
Neill 3	23 March	35	120		70	20	10
Neill 4	23 March	35	90		70	20	10
Neill 5	23 March	39	100		70	20	10
Neill 6	23 March	14	160		50	20	30
Neill 7	23 March	20	170		50	10	40
Neill 8	23 March	21	180		50	10	40
Neill 9	23 March	19	114	5	50	10	35
Neill 10	23 March	20	112		70	20	10

Site 9 - Upstream of Fort McMurray

From 25 to 27 March 1993, one ice-hole upstream of the Fort McMurray water treatment plant was sampled. One very large hole (27 x 3.5 m) was cut along the left upstream side in 0.25 to 1.0 m ice thickness. Sampling was conducted in 1.02 to 1.20 m water depth (Figure 3.1). A full complement of biofilm contaminant samples and quantitative samples were collected. No fish were collected. Physical variables measured at benthic invertebrate community sites are outlined in Table 3.10.

Table 3.10 Physical variables measured at benthic invertebrate community sample locations, Site 9.

SAMPLE	DATE COLLECTED 1993	MEAN CURRENT VELOCITY (cm/s)	DEPTH (cm)	SUBSTRATE DESCRIPTION			
				Boulder	Cobble/ Pebble	Pebble/ Gravel	Sand/Silt
Neill 1	26 March	65	120	30	40	20	10
Neill 2	26 March	85	116		70	20	10
Neill 3	26 March	76	110		70	20	10
Neill 4	26 March	82	112		30	40	20
Neill 5	26 March	72	108		40	60	10
Neill 6	26 March	72	108		70	20	10
Neill 7	26 March	70	102		70	20	10
Neill 8	26 March	71	106		70	20	10
Neill 9	26 March	56	104		70	20	10
Neill 10	26 March	52	106		70	20	10

3.2 LOGISTICS SUMMARY

3.2.1 Scheduling

On average, it took 3.22 d to sample one site (nine sites over 29 days). In general, the schedule of events at a given site was as follows:

Day 1: Reconnaissance to locate prime sampling areas. Ice removal initiated to expose river bottom.

Day 2: Completed ice removal and began sampling quantitatively for benthic invertebrates. If possible, sampling quantitatively for biofilm and qualitatively for all contaminant tissue (biofilm and invertebrates) was undertaken.

Day 3: Completed all biological sampling, including electroshocking for fish.

The extra 0.22 d was expended through travelling to sites as well as maintenance and repair of equipment.

3.2.2 Personnel and Equipment

There were five field staff present on site at any given time, comprising two work crews of two and three persons each. Work was physically demanding, both removing ice and under water sampling in the river. A total of 288 tonnes of ice was removed from the Athabasca River. At a given site, a mean of 31 988 kg (range=18 186 to 54 249 kg) of ice was removed before any biophysical sampling could commence.

There was a large degree of logistical support required on this project. In addition to the equipment described above, a four wheel drive pickup and trailer for the snow machines were utilized. Other support equipment included gas generators, electric heaters, lighting fixtures, and equipment associated with the maintenance and repairs of sampling equipment. In addition, solvents, solutions, laboratory supplies, and personnel were acquired or assigned to perform QA/QC procedures prior to and during the field sampling. While in the field, support staff in Edmonton expedited samples, dry ice, and other supplies to and from the field on a weekly basis.

The study was fortunate to encounter seasonably mild weather. Work would have been extremely slow and more difficult if temperatures were below -10 to -15 °C. Wall tents were available for sampling in adverse weather; however, they were not required. The use of wall tents would have greatly increased the sampling time, as they require several hours to set up and pack away; furthermore, their size (approximately 4 x 6 m) would only allow small holes to be cut through the ice.

SECTION 4
SUMMARY AND CONCLUSION

Aquatic insects play an important role in energy transfer through trophic levels in fresh water habitats (Resh and Rosenberg 1984). Larvae feed on a variety of materials, including detritus, bacteria, algae, plant material, and other invertebrates. Aquatic insect larvae in polluted water bodies may be exposed to high concentrations of contaminants through uptake from water and feeding (Landrum and Poore 1988; Novak et al. 1988). By converting food materials and potentially associated contaminants into readily available living tissue, benthic invertebrates allow organisms at higher trophic levels (fish and invertebrate predators) to bioaccumulate pollutants.

In this project, quantitative benthic community samples (Neills, biofilm identification, and Chl*a*/LOI) and qualitative benthic tissue (contaminants) samples were collected in late winter. At this time, the winter flora and fauna that was sampled would have been subjected to low flow volumes and potentially greater concentrations of contaminants. Industrial and municipal effluent may have the greatest impact on benthic community structure and contaminant loadings in biological tissues at this time of year.

All quantitative community samples were collected at all sites; however, complete complements of invertebrate tissue samples for contaminant analyses were not obtained (see Table 2.1). Success of field collections of aquatic invertebrates for contaminant monitoring is often limited in large rivers (Kovats and Ciborowski 1989; Kovats 1990), even during optimal, open-water conditions. Benthic invertebrates are difficult to sample because they are patchy in distribution (Downing 1979) and require specialized collection equipment; furthermore, aquatic invertebrates are often collected with large amounts of sediment that requires extensive processing prior to analysis (Kovats & Ciborowski 1989) and may make the collection of adequate biomass (i.e., 32 g in this study) impractical. For example, at seven of the nine sampling sites, ice was removed to expose at least 43 m^3 of river bottom. At these ice removal sites, all of the exposed area was sampled for invertebrate tissue after quantitative community samples were collected. The mass of invertebrate tissue collected at a site reflected the relative density of animals and ease of sampling. Some sites had substrate that was difficult to sample because it was imbedded in sand/clay or had relatively greater numbers of boulders that could not be overturned.

This project required extensive effort to sample one site (mean=3.22 d; five crew members). A large amount of time (>1 d) and effort (mean=36 tonnes/site) was invested in ice removal so that enough river bottom could be exposed for biological sampling. Extensive time (>1 d) also was required to perform all biological sampling. Weather conditions confounded all work and equipment and personal gear had to be modified to function in a harsh environment (cold and wet).

In future projects of this nature, it is important that the difficulty, and costs, of under-ice sampling be realized prior to project initiation, with sufficient time and contingencies allowed to meet the objectives.

SECTION 5
LITERATURE CITED

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APPENDIX A

Terms of Reference

SCHEDULE A - TERMS OF REFERENCE

PROJECT 2371-B2: BENTHIC FIELD COLLECTIONS (SYNOPTIC SURVEY)

I. GENERAL OBJECTIVES

The objective of this project is to obtain samples of selected aquatic biota (i.e., invertebrates, "biofilm" and forage fish) from eleven sites in the Athabasca River for contaminants analyses and quantitative analyses of invertebrate and biofilm abundance and biomass. Samples for contaminant analyses will be analyzed for organic contaminants (e.g. dioxins, furans, chlorophenols and PAH), metals (e.g. arsenic, vanadium, copper, chromium, lead, zinc and methyl mercury) and stable isotopes (e.g., carbon, nitrogen, sulphur). Quantitative samples of aquatic invertebrates are required for estimates of abundance and biomass. Quantitative biofilm samples will be analyzed for chlorophyll-a and loss on ignition; samples will also be retained for taxonomic identification.

II. REQUIREMENTS

A. SAMPLES FOR CONTAMINANT ANALYSES

A1 Benthic Invertebrates

1. The study area stretches from the outfall of Jasper Lake to Windfall bridge west of Whitecourt. See attached Northern River Basins Study map of the upper Athabasca River. Sampling sites should be chosen for their suitability, but should be located in the vicinity of the following ten sites:

   - near Entrance (near Highway #40 Bridge) (1)
   - Weldwood Haul Bridge (1)
   - Obed Mountain Coal Bridge (2)
   - Emerson Lakes Bridge (1)
   - upstream of Berland River (2)
   - Windfall Bridge (2)
   - Blue Ridge (2)
   - at Athabasca (2)
   - Downstream of ALPAC site (2)
   - upstream of Fort McMurray (2)

   Note: (1): high priority
   (2): medium priority

   Sampling should be initiated in mid-February and most of the sampling will have to be carried out under ice. Recognizing the potential logistic difficulties that may be encountered under such sampling conditions, two sampling scenarios are to be considered.

   Scenario 1

   - Initiate sampling in mid-February. Sampling dates may be adjusted because of unfavourable weather, but sampling must be carried out under ice conditions.

1a - Sample high priority sites as defined above, first.
- If sampling of these sites can be carried out successfully, proceed with medium priority sites (sites flagged as (2), above).

1b - If sampling of high priority sites far exceeds the time allotment or is impractical for other logistic reasons, interrupt sampling, preferably after completion of all sampling at high priority sites. Assess the feasibility of collecting the quantitative invertebrate and biofilm samples described in part B of the Terms of Reference. If practical collect these samples at all medium priority sites; else, proceed with scenario 2.

Scenario 2

- Conduct sampling at all sites in April, shortly after ice-breakup, but before flows increase in mid-spring (normally before late April - early May). If quantitative invertebrate and biofilm samples have been collected under 1b., only tissue samples for contaminant analyses would have to be collected at this time.

Decisions about shifts in sampling schedules should be made after communication with NRBS scientific staff (Dr. Anne-Marie Anderson, Alberta Environmental Protection, Edmonton and Dr. Gary Scrimgeour, National Hydrology Research Institute, Saskatoon) and the NRBS Project Liaison Officer (Greg Wagner).

2. Sufficiently large numbers of invertebrates should be collected from erosional habitats to carry out analyses. Under scenario 1 as defined above, several invertebrate taxa may be combined to yield the required sample weight unless it is practical to collect tissue samples for individual taxa. Under scenario 2, tissue samples must consist of individual taxa. Hydropsychid caddisflies, mayflies, and stoneflies will likely be selected. Up to 39 samples would be collected from erosional habitats (i.e. 3 taxa, 3 sites, aborted scenario 1; 3 taxa, 10 sites, scenario 2).

The analytical laboratories require the following <u>minimum</u> amounts for analysis as follows:

- trace organic contaminants:

  dioxins and furans: 10 gram wet weight (ww)
  chlorophenols: 5 gram ww
  PAH's: 10 gram ww

- trace metals: 5 gram ww
- stable isotopes: 2 gram ww

Specimens for each analysis must be kept in separate containers.

3. A variety of sampling methods may be employed to collect specimens. These may include the use of pole mounted screens, dipnets, Ekman or Ponar dredges, air lift samplers and hand-picking. Field sorting will likely be required for practical reasons.

Drift samples are not recommended because they may contain organisms which have travelled a long distance downstream and which may have a chemical composition which does not reflect that of the local fauna.

Specimens must not be damaged during sorting and handling as this will result in loss of body fluids and possibly of contaminants.

Organic debris and fine sediments must be removed from samples.

Specimens must be placed in appropriate, fully labelled containers and frozen on dry ice immediately after collection. Samples must remain frozen at all times until they are analyzed. Sample labels should have a consistent format and must include river, site and taxon name, date, number of replicate, type of analysis required.

4. A representative sub-sample of 10 to 20 organisms from each sample should be retained for taxonomic identification. Preserve these samples in 4% formaldehyde. <u>Do not freeze</u>. Label appropriately.

5. Sampling and sample handling procedures must be appropriate for trace organic compounds and trace metals. Precautions must be taken at all times to avoid contamination of the samples, namely:

   - To avoid contamination of stable isotope samples, liquids high in nitrogen, carbon or sulphur must not be used.
   - Clean all equipment that will contact the samples for trace organics by rinsing first in ultra-pure acetone then in ultra-pure (pesticide grade) hexane.
   - Soak equipment that will contact the samples for trace metal analysis in an acid bath made of high grade acid.
   - Bake aluminium foil at 350°C for 6 to 12 hours before using it to line lids or protect equipment, or rinse in ultra-pure acetone , then in ultra-pure (pesticide grade) hexane.
   - Use metal or teflon coated equipment for trace organic samples and plastic or teflon coated equipment for trace metal samples.
   - Clean equipment between sites.
   - Store tissue samples in clean containers (glass jars with baked aluminum foil or teflon lid liners for trace organics and stable isotopes; teflon coated or plastic containers for trace metals).
   - Ensure that samples do not get contaminated during sampling or sample preparation especially by combustion sources such as running motors; smoke, dust, paper products, etc. may also contribute contaminants.

6. Collect samples for quality control and quality assurance.

- Blank tissue samples will be provided by the Project Manager and should be subjected to routine handling procedures. Include a blank sample for each contaminant group at each site.

- At least two additional sets (i.e. a sample for each group of contaminants) should be obtained from a taxon which is easiest to sample. Duplicate samples should be obtained from a different location at the sampling site. These samples will be used as replicates or for spiking as directed by the Project Manager.

A2. Epilithic "Biofilm"

The "biofilm" refers to the assemblies of algae and associated organisms (fungi, bacteria, protozoans, etc.) growing on the river bottom. Varying amounts of this biofilm occur in the Athabasca in the study area. The biofilm tends to be more abundant downstream of the Hinton combined effluent. In that area tufts and mats of benthic algae are also more abundant. The biofilm needs to be sampled at the same time as benthic invertebrates.

1. Sample the biofilm on rocks (epilithic) at the ten river sites, in the same general location as for benthic invertebrates in Part A1. Collect samples from at least 10 rocks or spots distributed within each site and combine them to form the composite sample for that site. Sample weight requirements are similar to Part A1. Minimize the amount of inorganic sediment collected with the biofilm as much as possible. Handling of equipment and sampling procedures should follow those of Part A1 with respect to avoiding contamination of the samples.

2. The composite sample should be well mixed; macroinvertebrates and large organic debris should be removed. Withdraw aliquots allowing excess water to drain out, and apportion them to the appropriate sample containers as described in Part A. Freeze samples. Reserve 2 aliquots of at least 5 mL for subsequent taxonomic examination. Preserve one with Lugol's solution, the other with formaldehyde.

3. Collect additional samples for quality assurance as per Part A1.

A3. Forage fish

Forage fish (true minnows, salmonid minnows or young suckers) are to be collected at each of the ten sampling sites. Fish will be used for tissue analyses of contaminants and for MFO determination.

1. Fish may be collected using a variety of techniques including:

- Electro-fishing
- Trap nets
- Gill nets
- Seines
- Set lines
- Angling

It would be preferable to use fish tissue to bait traps or lines.

2. Follow protocols outlined in A1 for samples destined for tissue analysis. However, instead of using separate containers for the various analyses, store all fish from one site in a single DFO approved plastic bag. These bags can be obtained from the Project Liaison Officer. Fish will be homogenized at a later date and aliquots apportioned to the various types of analyses.

3. Protocols for MFO sampling are listed below:

   1. **It is important to obtain liver tissue samples for analyses from freshly killed fish only, which have experienced minimum handling stress.**

   2. A sample numbering system must be designed and used to facilitate tracking of samples from the same fish (see note about salmonid forage fish).

   3. Captured fish may be stunned by a knock on the head before removing the liver.

   4. Record the fish length and weight to nearest mm and 0.1 g, respectively. Also record sex, degree of maturity and species.

   5. Examine fish for external lesions and record any abnormalities. Complete the Gross Pathology Sheet (Appendix 1).

   6. Open fish ventrally and examine fish for internal lesions and record any abnormalities.

   7. Remove liver and place in specially labelled cryovial. Freeze on dry, weigh and record weight to nearest 0.1 gm. Livers must be sub-sampled immediately. Mixed-function oxidase (MFO) activity decreases and the variability increases within 15 minutes of death, depending on external temperatures. **Livers must be removed carefully, avoiding the rupture of the gall bladder and avoiding contact with bile.**

      For tissue storage, all MFO samples must be stored and maintained at -60°C or lower; storage at -20°C is not acceptable.

   8. Collect up to ten minnow livers per site/species and treat each liver as an individual sample (ie. do not pool livers).

   9. Ship frozen samples as soon as possible. Samples of liver tissue for MFO analysis must be stored at -60°C or colder. Closely follow shipping instructions outlined in Appendix 2.

Note: Livers for MFO analysis may be removed from salmonids, and the rest of the body, including remaining viscera can be used for tissue analyses.

B. QUANTITATIVE SAMPLES

B1. Aquatic Invertebrate Collections (Species Composition, Abundance, Biomass)

The objective of this component is to collect quantitative samples of aquatic invertebrate assemblies at eleven sites on the Athabasca River.

These samples will be used to document differences among sites in species composition, numeric density and other relevant population or community characteristics. Biomass data from this project will be used in conjunction with contaminant concentration data (component A1 samples) to assess overall contaminant loads in aquatic invertebrates.

Requirements

1. Collect aquatic invertebrate samples from the Athabasca River, concurrently to the tissue sampling described under A1. A minimum of 10 replicate samples is required from erosional habitats at each of the eleven sites specified in Section A; the exact sampling location will depend on substrate suitability and availability. The sampling location must not be disturbed by previous sampling. Individual replicate samples should be taken from not less than 5 holes through the ice along a 100 to 200 m long reach at each site.

2. The methods used in sampling aquatic invertebrates should follow procedures outlined in Alberta Environment (1990). A Neill cylinder (Hess type sampler) equipped with a collecting net (mesh size 210 um) is available from Alberta Environment for use on this project, subject to return in good working condition.

3. In addition to the procedures outlined under 2 above, further on-site processing will be required to separate invertebrates and organic material from inorganic material (e.g. gravel and sand). Samples should be swirled in a pail of water and organic material decanted onto a sieve with mesh aperture of 210 um. The sieve contents should be preserved in 10% formaldehyde. Ensure that samples preserved in formaldehyde do not freeze.

4. Obtain and record measurements of physical characteristics at each site (i.e. sampling depth, ice thickness, current velocity measured at 6/10 of total depth, substrate size). Obtain photographs of all sampling sites and substrates sampled.

B2 Biofilm Collections (Chlorophyll-a, Loss on ignition, Taxonomic Identification

1. Sample the biofilm at the ten river sites in the same general locations as for benthic invertebrates in part B1. Collect samples from ten rocks distributed within each of the eleven sites.
2. For each rock the biofilm from an area of about 9 cm^2 will be removed and preserved in Lugol's solution. Each sample is to be labelled and stored in an individual scintillation vial. Enough Lugol's should be added so that the sample is a dark brown colour). Total number of samples: 10 samples x 10 sites = 100 samples.
3. In addition, a second sample of about 9 cm^2 will be removed from each rock, labelled and placed in an individual scintillation vial.

These samples must be frozen immediately. Total number of samples: 10 samples X 10 sites= 100 samples.

Note: The National Hydrology Research Institute, Saskatoon, will supply the appropriate equipment to collect quantitative samples and a scientist to demonstrate the appropriate use of the equipment.

III. Deliverables

1. Samples

Frozen samples (packed in dry ice) of invertebrate and fish tissues, biofilm (samples for contaminant analyses, chlorophyll and ash-free dry weight determination), invertebrate samples preserved in formaldehyde and biofilm samples preserved in Lugol's solution should be returned to the project manager as directed. A detailed listing of all samples and detailed field notes should be provided with the samples. The sample listing is to include information such as sample type, sample label, estimated weight of sample material for contaminant analyses, destination of sample, (i.e., type of analysis). The field notes are to include information such as the exact sampling location, selected sampling methods, details regarding the sample handling procedures, field notes describing substrate characteristics, or any other relevant information.

2. Reporting Requirements

1) The consultant is to prepare a comprehensive data report that includes the following information: sampling methodology, sample type, sample location, sample number and label, weight of sample material for contaminant analyses, sampling handling, substrate characteristics and other relevant information. The report is to contain a number of tables and figures specifying the collections made. The report should contain high contrast black and white photographs showing, where appropriate, sampling locations.

2) Ten copies of the draft report are to be submitted to the Project Liaison Officer by March 31st, 1993.

3) Three weeks after the receipt of review comments the consultant is to submit ten cerlox bound copies and two unbound, camera-ready originals of the final report to the Project Liaison Officer. An electronic copy of the report, in Word Perfect 5.1 format, is to be submitted to the Project Liaison Officer at the same time as the final report. Data presented in tables, figures appendices, etc. in the final report are also to be submitted in electronic form (dBase IV format preferred) to the Project Liaison Officer. The final report is to contain a table of contents, list of figures, list of tables, acknowledgements, executive summary and an appendix containing the Terms of Reference for this contract. All sampling locations presented in the report and electronic format should be geo-referenced (lat./long. preferred).

IV. Additional Comments

The distribution of the Hinton Combined Effluent must be taken into account when sampling at the Weldwood Haul Bridge (sample in it), as must the Berland River Plume at the site near the Berland River (avoid it). Coordinate with water sampling crew to estimate plume locations.

V. Project Coordination

This project is being coordinated by the Nutrients Group of the Northern River Basins Study. This group is led by Dr. Patricia Chambers, National Hydrology Research Institute (NHRI), Saskatoon. Dr. Anne-Marie Anderson, Alberta Environmental Protection has been designated as the scientific authority on this project by Dr. Chambers. Dr. Gary Scrimgeour will be assisting the contractor in the field and providing advice on sampling methods and sampling design. Costs associated with Dr. Scrimgeor's involvement in this project will be assumed by the Northern River Basins Study. Greg Wagner will act as the Project Liaison Officer on behalf of the Northern River Basins Study.

VI. Literature Cited

Alberta Environment. 1990. Selected Methods for the Monitoring of Benthic Invertebrates in Alberta Rivers. 41 p.

SCHEDULE A

Page 1 of 2
Appendix 1

NORTHERN RIVER BASINS STUDY
EXAMINATION SHEETS
GROSS PATHOLOGY

DATE: ______

______

SAMPLE NO.: ________________ **LOCATION:** ____________

______

SPECIES: ________________ **CAPTURE METHOD:** ____________

______

CAPTURE TIME: ______________ **EXAMINATION TIME:** ___________

______

GROSS EXTERNAL EXAMINATION

Skin: ( ) Normal ( ) Excessive mucus ( ) Abnormal Colour ________
( ) Lesions ( ) Single ( ) Multiple ( ) Closed
( ) Open ( ) Haemorrhagic ( ) Necrotic ( ) Ulcer
( ) Blister ( ) Tumour ( ) Lost Scales ( )
Abrasions

Location: ____

Wet mount/smear: ____

Eyes: ( ) Normal ( ) Exophthalmia ( ) Cataract ( ) Haemorrhagic
( ) Opaque cornea ( ) Lens lost ( ) Parasites ( ) Bilateral

Fins: ( ) Normal ( ) Frayed____________ ( ) Haemorrhagic
__________ ( ) Eroded _______________ ( ) Deformed _________
____

Wet mount/smear: ____

Gills: ( ) Normal ( ) Pale ( ) Mottled ( ) Haemorrhagic
( ) Necrotic ( ) Excessive mucus ( ) Hyperplasia
( ) Telangiectasia ( ) Gas emboli ( ) Cysts
( ) Large Parasites _______________ ( ) Fungus Visible

Wet amount/smear: _______________________________________

_

GROSS INTERNAL EXAMINATION

Adipose Tissue:
( ) Normal ( ) Excessive ( ) Reduced ( ) Petechial
Haemorrhagic
( ) Colour _______________ ( ) Cysts

Liver: ( ) Normal ( ) Enlarge ( ) Reduced Colour: ( ) Pale ( )
Mottled
( ) Other __________ Texture: _______________
( ) Lesions: ( ) Single ( ) Multiple ( ) Tumour
( ) Necrotic ( ) Haemorrhagic ( ) Cyst (parasite) ( ) Cyst
(Fluid)

Spleen:
( ) Normal ( ) Enlarged ( ) Reduced ( ) Raspberry
surface
( ) Cyst(parasite) ( ) Cyst (fluid) ( ) Colour __________

Stained smear: ____________________________

SCHEDULE A

Intestines:

( ) Normal ( ) Distended (fluid) ( ) Distended (mucoid)
( ) Flaccid ( ) Haemorrhagic ( ) Cysts(parasite) ( ) Tumour

Kidney, Posterior:

( ) Normal ( ) Enlarge ( ) Lesions ( ) Single
( ) Multiple ( ) Gritty, white ( ) Cyst (parasite) ( ) Cyst (fluid)
( ) Tumour

Stained smear: ____

OTHER: ____

N.B. In the event that a significant number of specimen at any site have abnormalities, the contractor is asked to immediately notify the Study Office.
Phone: 427-1742 or fax to 422-3055

SCHEDULE A

NORTHERN RIVER BASINS STUDIES
SHIPPING INSTRUCTIONS FOR MFO SAMPLES

Any contractor/consultant or government personnel that is transporting fish to Edmonton must contact one of the following people before leaving place of origin:

Earle Baddaloo Work: (403) 427-6102
Home: (403) 434-8967

Sub Ramamoorthy Work: (403) 427-6102
Home: (403) 435-8137

If the above personnel are not in, a message indicating fish is on its way and approximate time of arrival in Edmonton must be left with the secretary (in office) between 8:15 a.m. and 4:30 p.m., or on an answering machine (home) after 4:30 p.m., before leaving place of origin.

Upon arrival in Edmonton with specimens from Northern River Basins Study projects, contractor(s) or consultant(s) should contact one of the above personnel again.

If the above personnel cannot be contacted on a weekday (Monday to Friday), contractor(s)/consultant(s) should proceed directly to **VERSACOLD only between 8:00 a.m. and 4:00 p.m. Drop cargo (fish) off at VERSACOLD under the name of Earle Baddaloo, Alberta Environment.** DO NOT LEAVE FISH OUTSIDE OF VERSACOLD!!

VERSACOLD IS OPEN BETWEEN 0800 AND 1600 HOURS, MONDAY THROUGH FRIDAY.

ADDRESS: 9002 - 20 Street
Edmonton, Alberta

TELEPHONE: (403) 464-1770
CONTACT: Mr. Merve Permann

If fish tissue arrive after 4:00, contractor(s)/consultant(s) must make every effort to contact Mr. Baddaloo or Dr. Ramamoorthy so that alternate storage for the night or weekend may be found.

It is, therefore, imperative to call contacts before leaving place of origin so that they (contacts) will be aware of the transport activity and can make arrangements for the arrival of the specimens.

WEEKEND TRANSPORT

If fish has to be transported to Edmonton on the weekend (Saturday, Sunday or public holiday), the contractor(s)/consultant(s) or government personnel should contact Mr. Baddaloo or Dr. Ramamoorthy on the last working day before the weekend or public holiday. (If contacts are not available, messages must be left with the secretary.) Again, before leaving place of origin, please call contacts at home and leave a message if they are not there; and upon arrival in Edmonton, please call contact again.

Any deviation from the above established protocol/procedure should be justified and accounted for in writing and a detailed description of what was done is to be submitted with the fish sample; this is to assure credibility and validity of results.

APPENDIX B

Photographic Plates

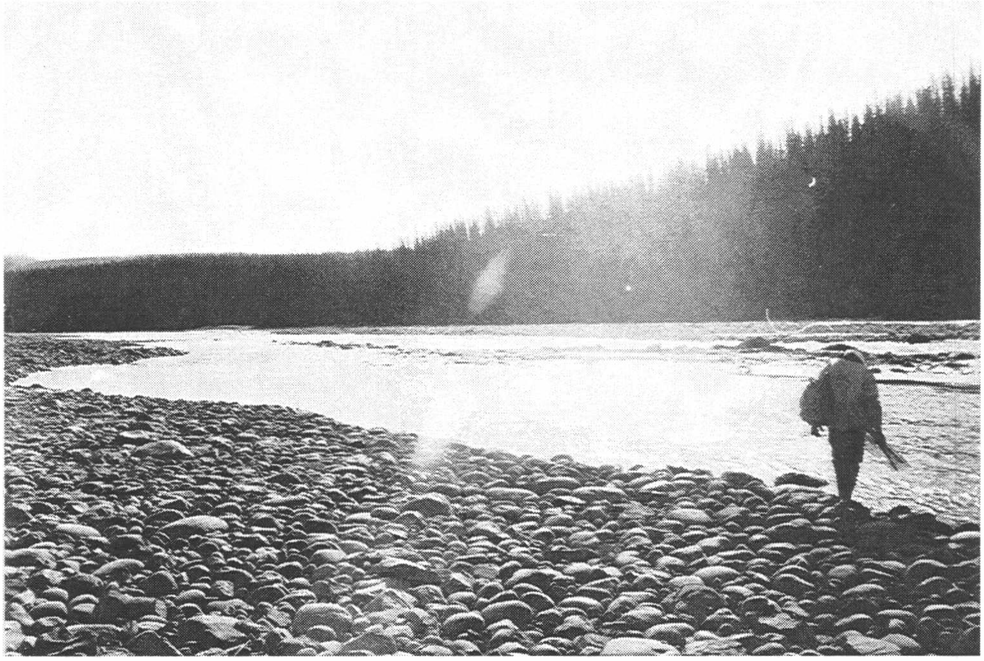

Plate 1. Downstream view from Site 1 - Control (Location 1 near Brûle Lake).

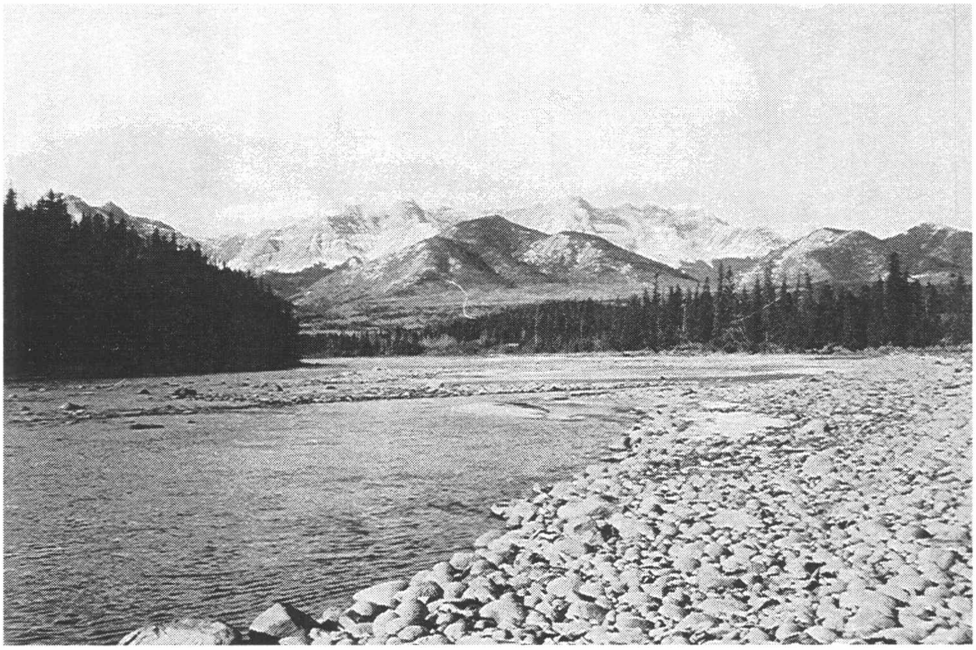

Plate 2. Upstream view from Site 1 - Control (Location 1 near Brûle Lake).

Plate 3. Upstream view of Site 1 - Control (Location 2 near Maskuta Creek).

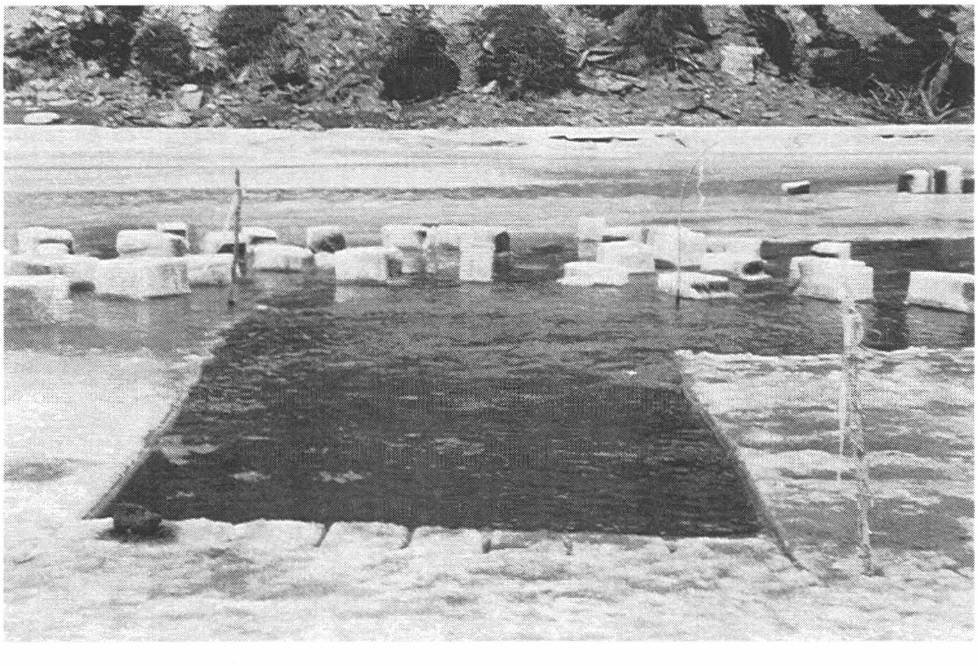

Plate 4. Sampling area exposed at Site 1 - Control (Location 2 near Maskuta Creek).

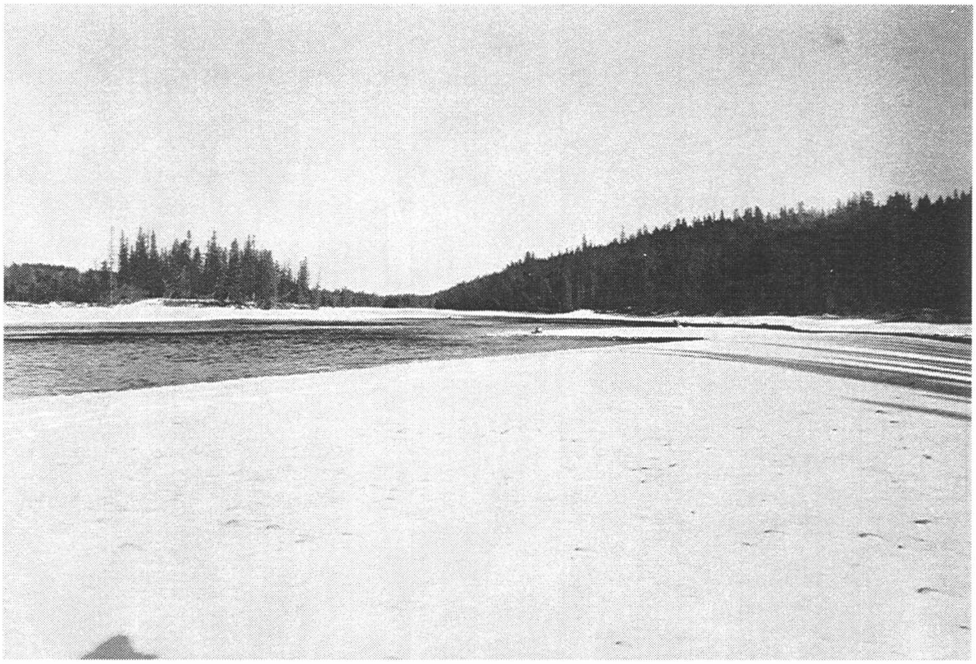

Plate 5. Downstream view of open water site at Site 2 - Weldwood Haul Bridge.

Plate 6. View from road of sample holes cut at Site 3 - Obed Mountain Coal Bridge.

Plate 7. Ice removal in progress at two of four holes cut at Site 3 - Obed Mountain Coal Bridge.

Plate 8. Upstream view from Site 4 - Emerson Lakes Road Bridge.

Plate 9. Downstream view of Site 4 - Emerson Lakes Road Bridge (during snowfall).

Plate 10. Downstream view from Blue Ridge Bridge (Site 5) towards sample areas.

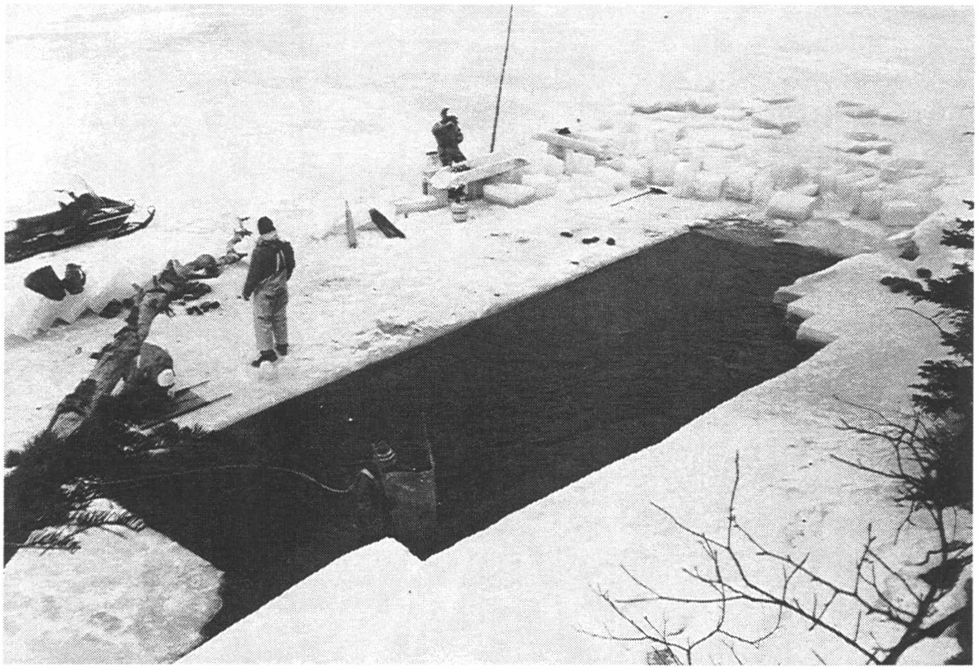

Plate 11. View of downstream hole at Site 5 - Blue Ridge. Invertebrate sampling in progress.

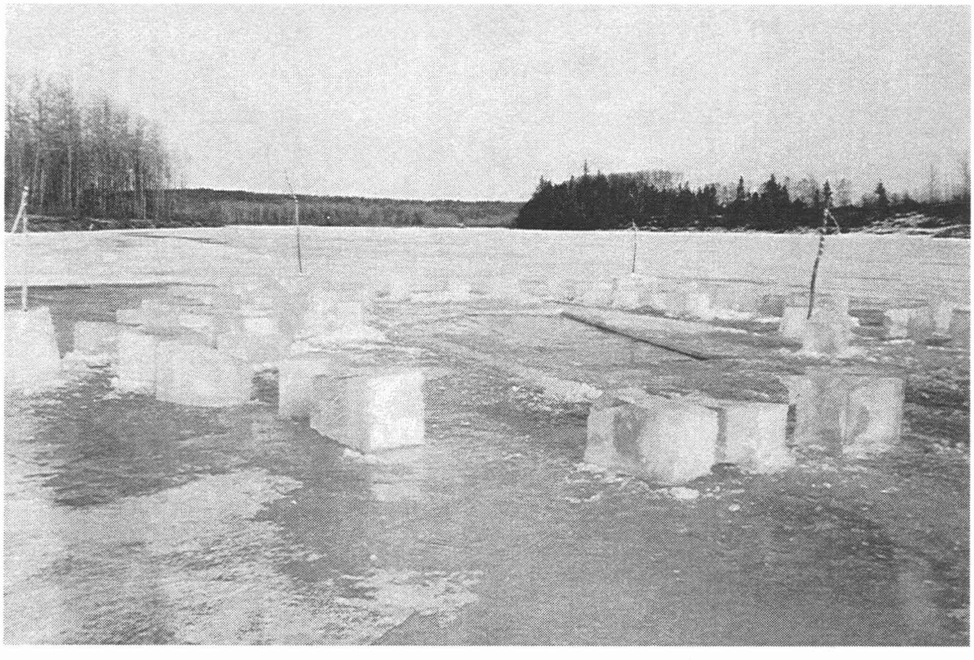

Plate 12. View of upstream hole at Site 5 - Blue Ridge.

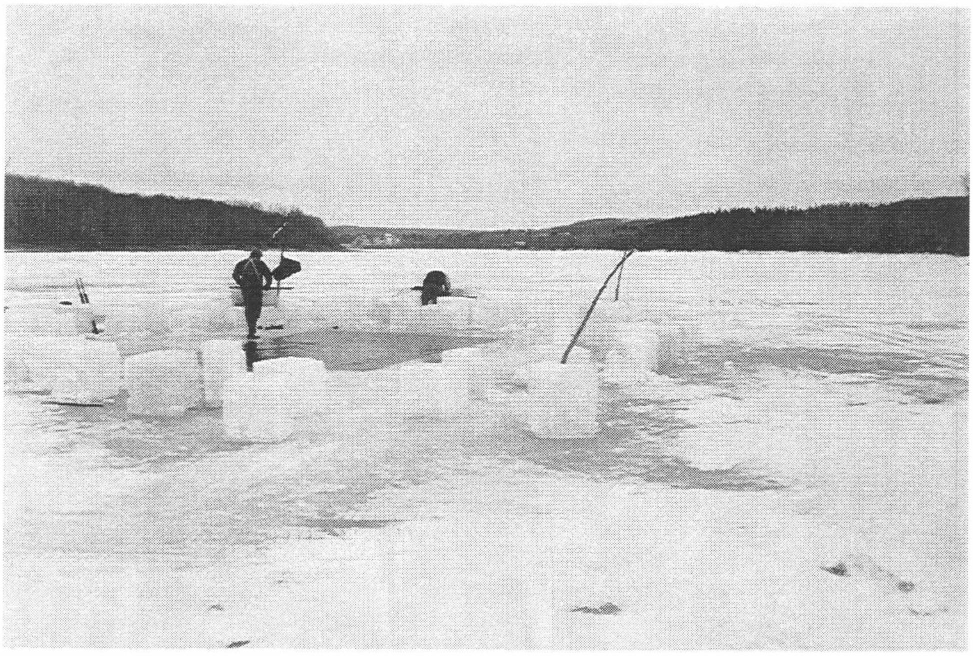

Plate 13. View of one sampling hole at Site 7 - Upstream of Athabasca Town. The town can be seen in the background.

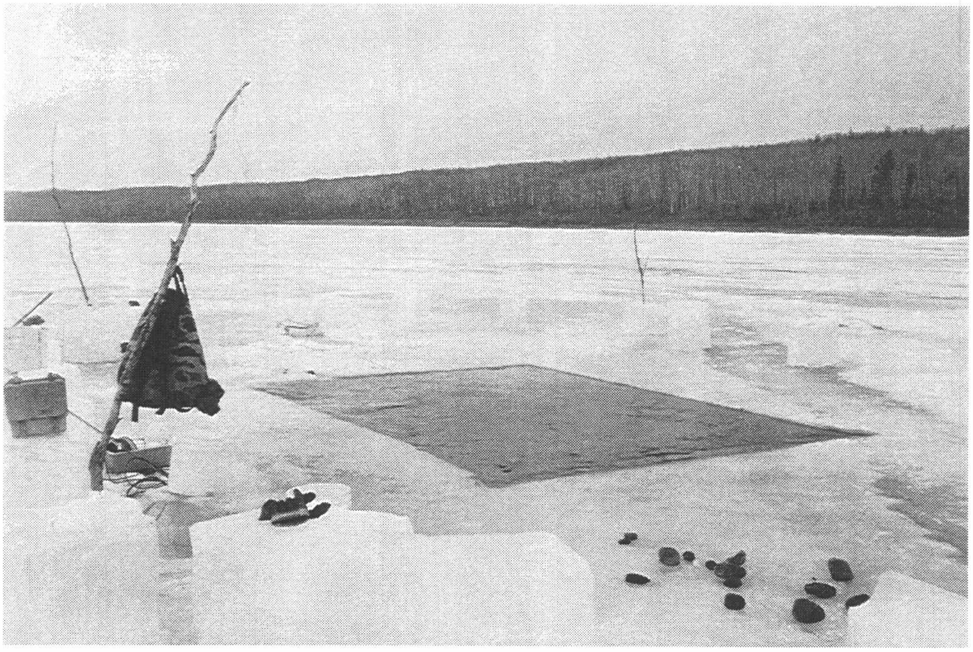

Plate 14. View of second sampling hole at Site 7 - Upstream of Athabasca Town.

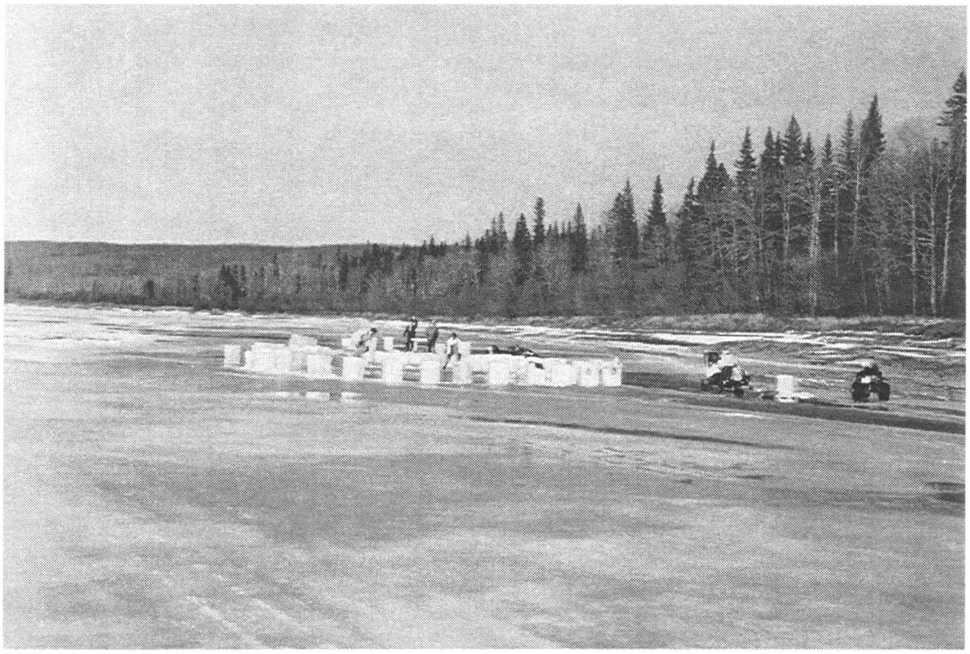

Plate 15. Upstream view at Site 8 - Poacher's Landing.

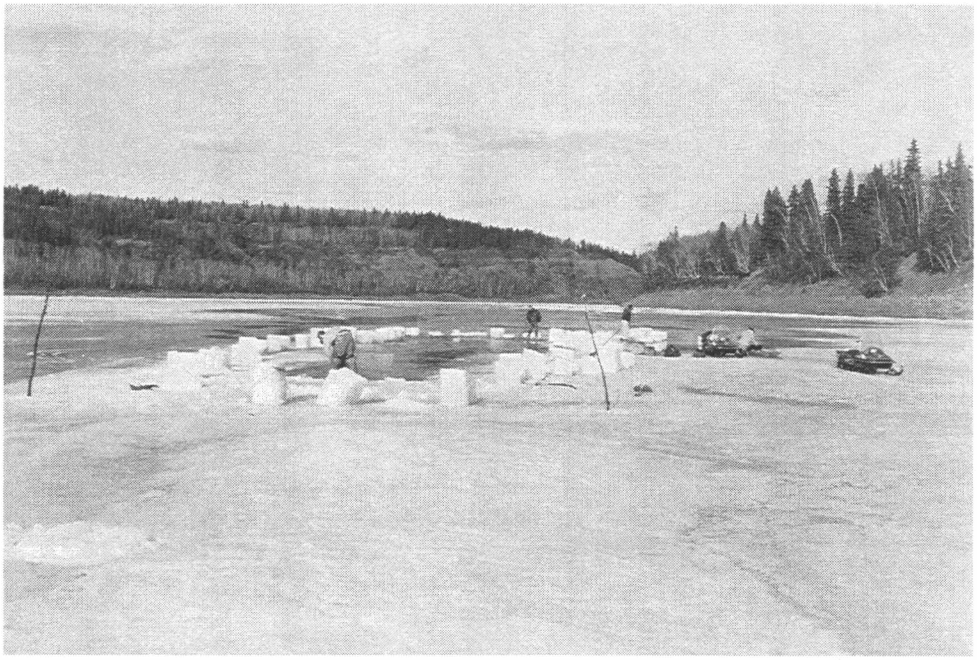

Plate 16. Downstream view at Site 9 - Upstream of Fort McMurray.

Plate 17. Downstream view of Site 9 - Upstream of Fort McMurray.

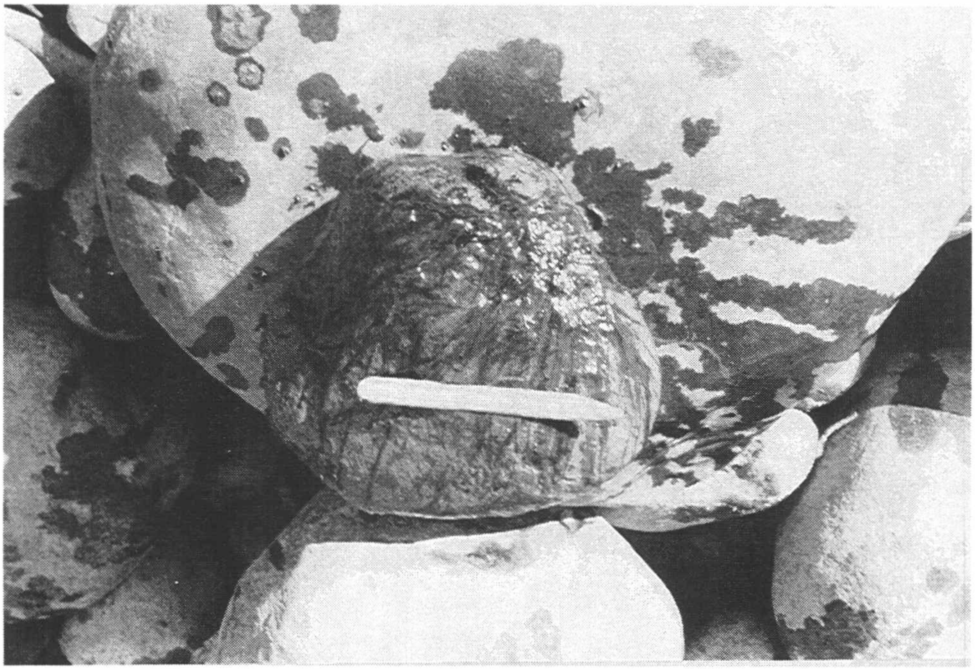

Plate 18. Biofilm cover on substrate from Site 1 - Control (Location 1 near Brûle Lake).

Plate 19. Submerged substrate at Site 1 - Control (near Brûle Lake).

Plate 20. Substrate sample removed from Site 1 - Control (Location 2 near Maskuta Creek).

Plate 21. Substrate sample from Site 3 - Obed Mountain Coal Bridge.

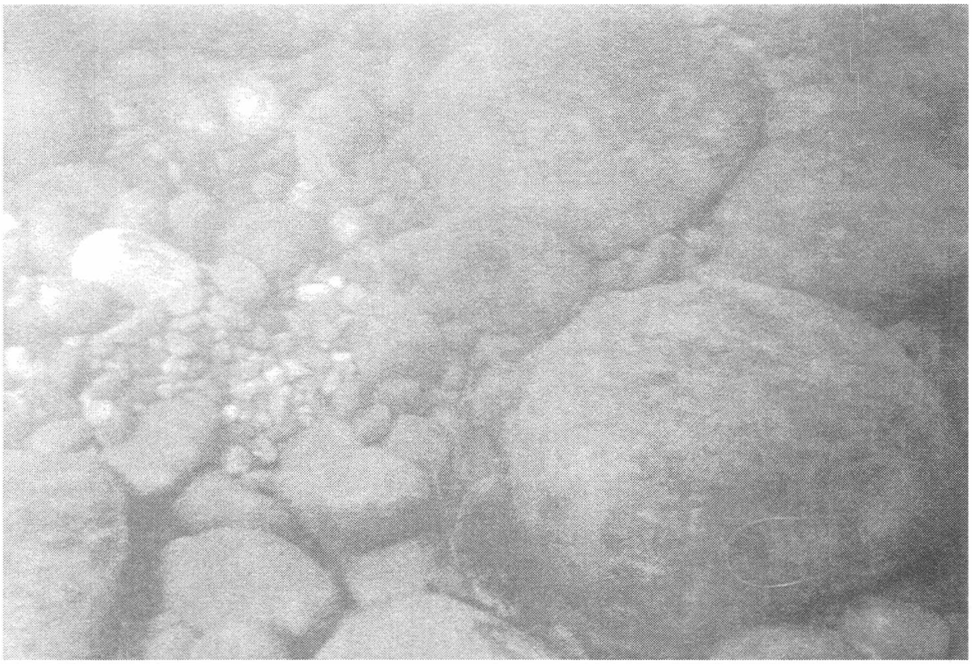

Plate 22. Underwater view of substrate at Site 5 - Blue Ridge. Note disturbed area from Neill cylinder.

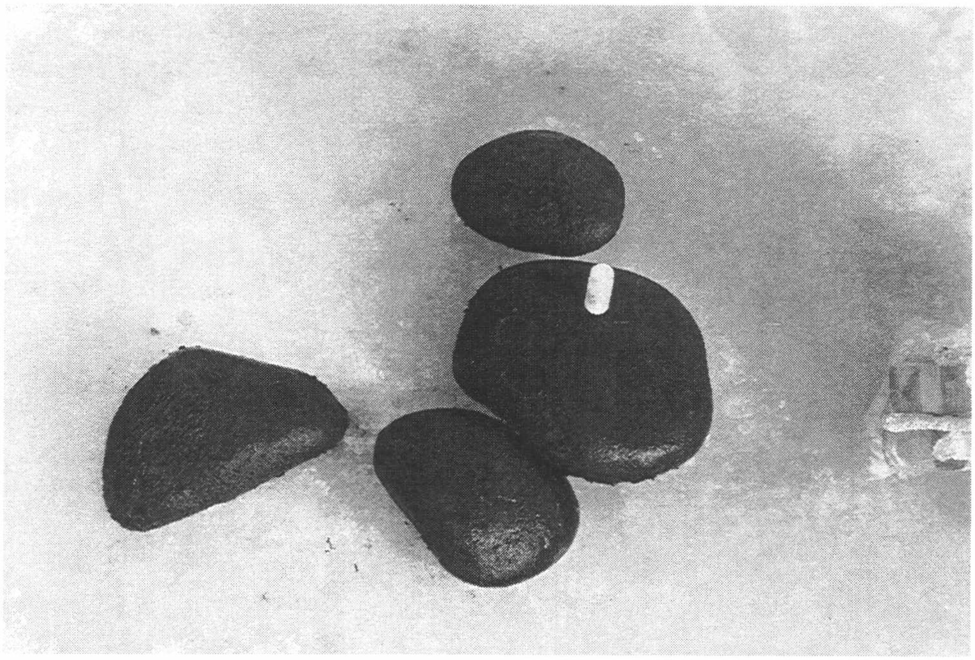

Plate 23. Substrate removed for quantitative biofilm sampling at Site 5 - Blue Ridge.

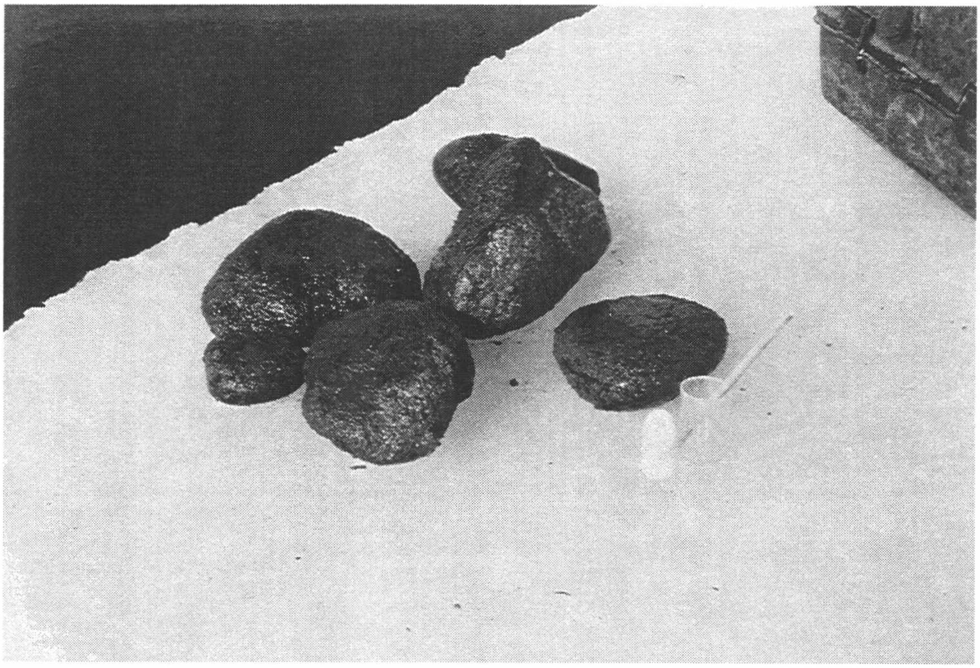

Plate 24. Substrate from Site 6 - Downstream of Athabasca Town.

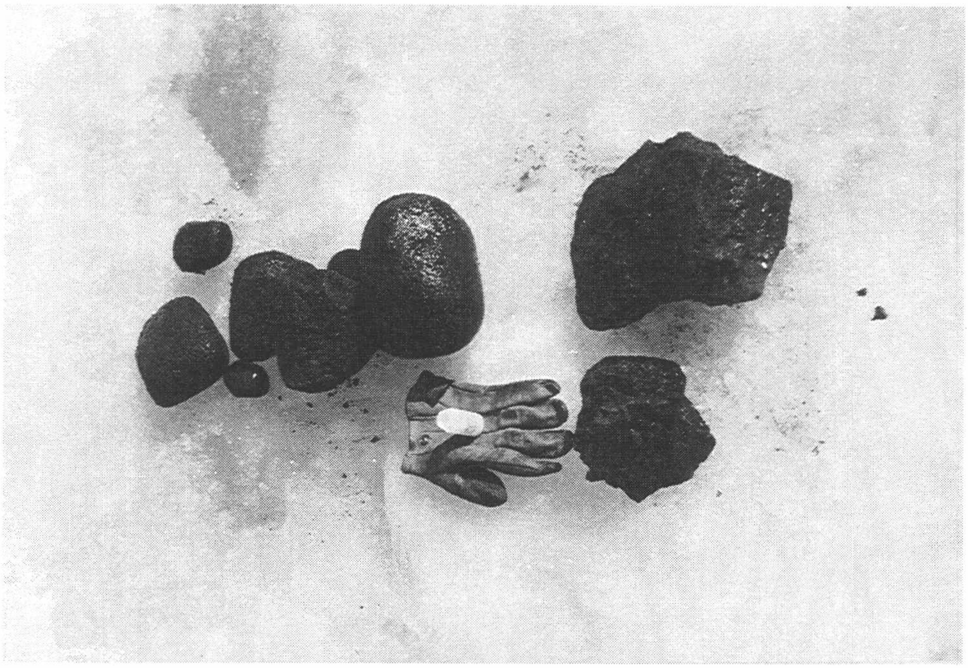

Plate 25. View of substrate removed from Site 7 - Upstream of Athabasca Town.

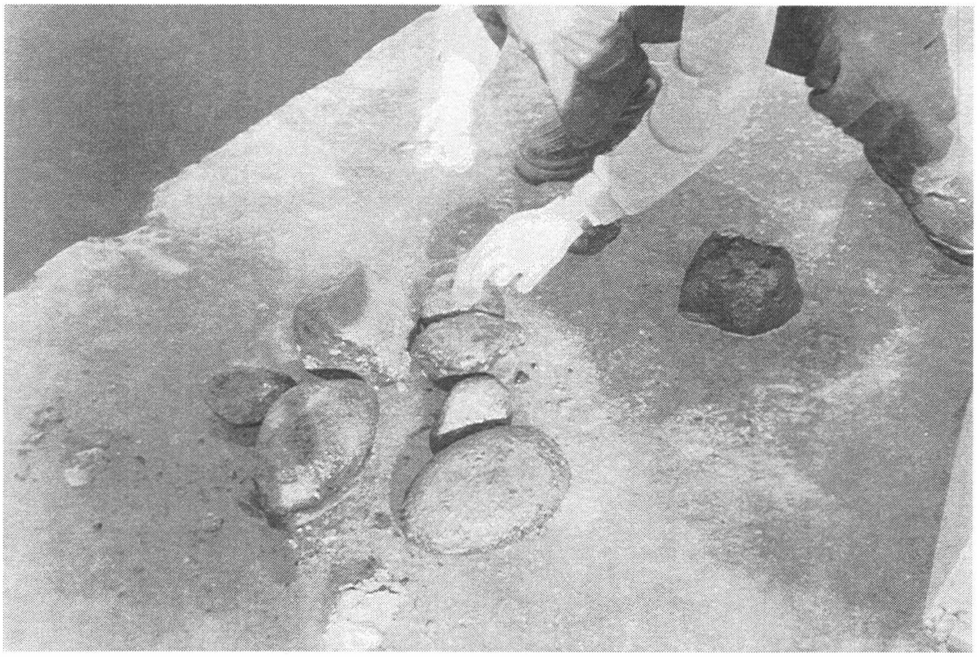

Plate 26. Substrate from Site 8 - Poacher's Landing boat launch, showing quantitative biofilm sampling in progress.

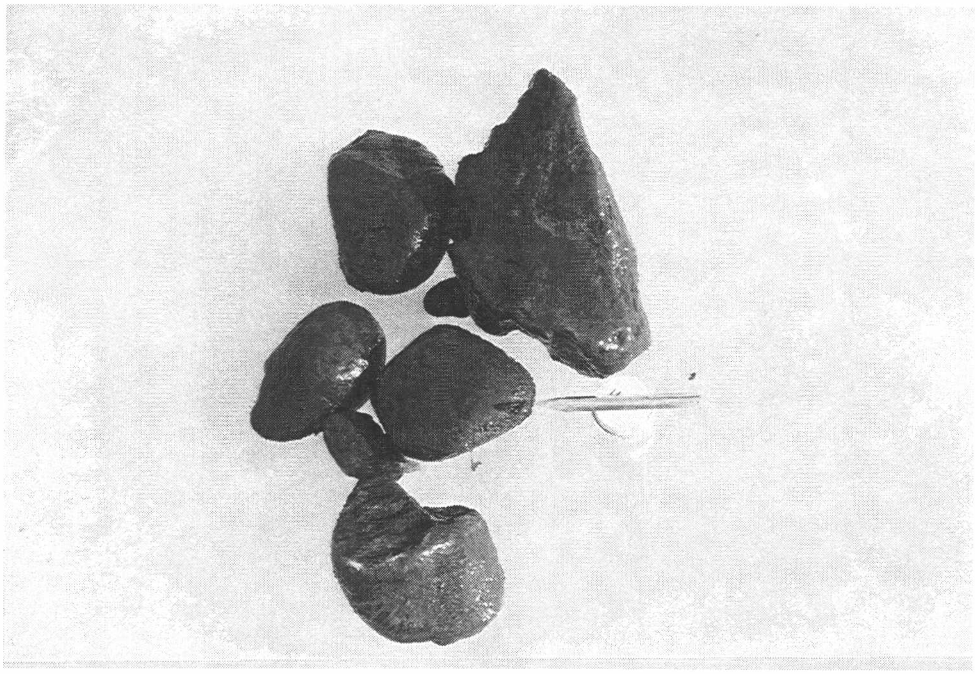

Plate 27. View of substrate from Site 9 - Upstream of Ft. McMurray.

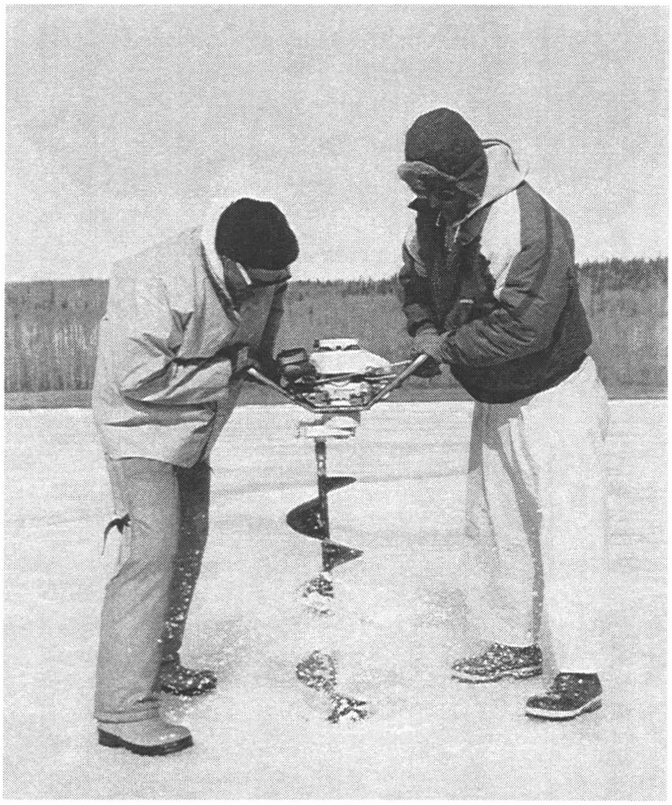

Plate 28. Auger reconnaissance team trying to locate prime sampling areas at Site 9 - Fort McMurray, using 10" power auger.

Plate 29. Checking depth and velocity with Marsh-McBirney velocity meter.

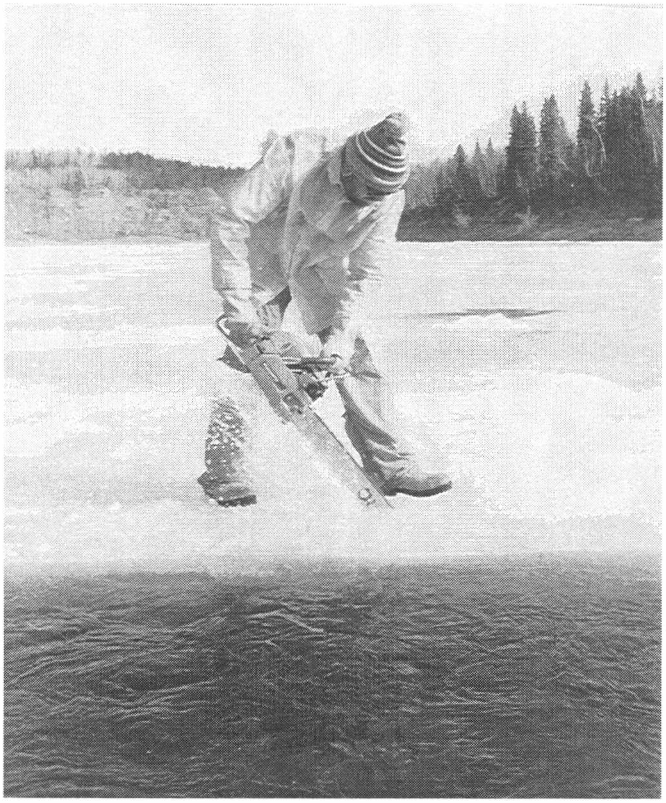

Plate 30. Ice removal at Site 7 - Upstream of Athabasca Town.

Plate 31. Ice removal from Site 8 - Poacher's Landing boat launch.

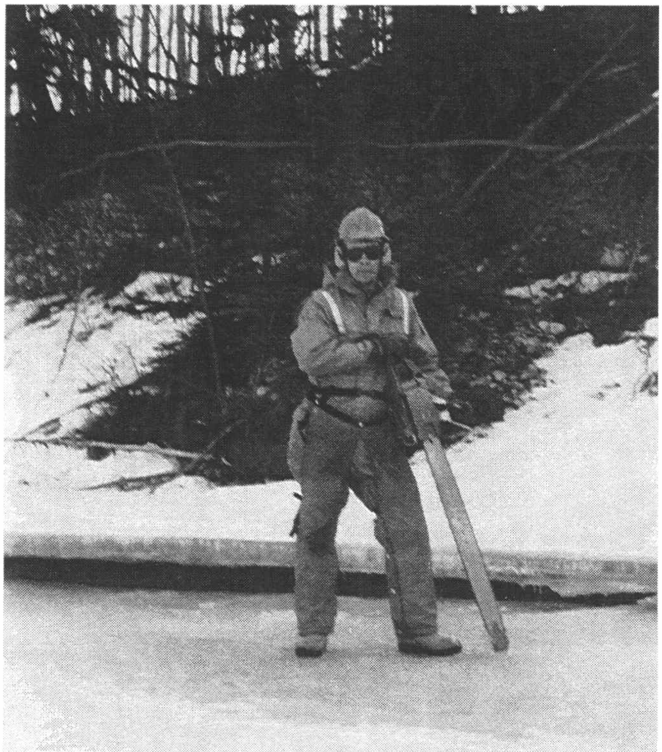

Plate 32. Safety gear: hard hat, ear and eye protection, Kevlar® chaps and boots, gloves, Mustang® survival suit and chainsaw with chain brake.

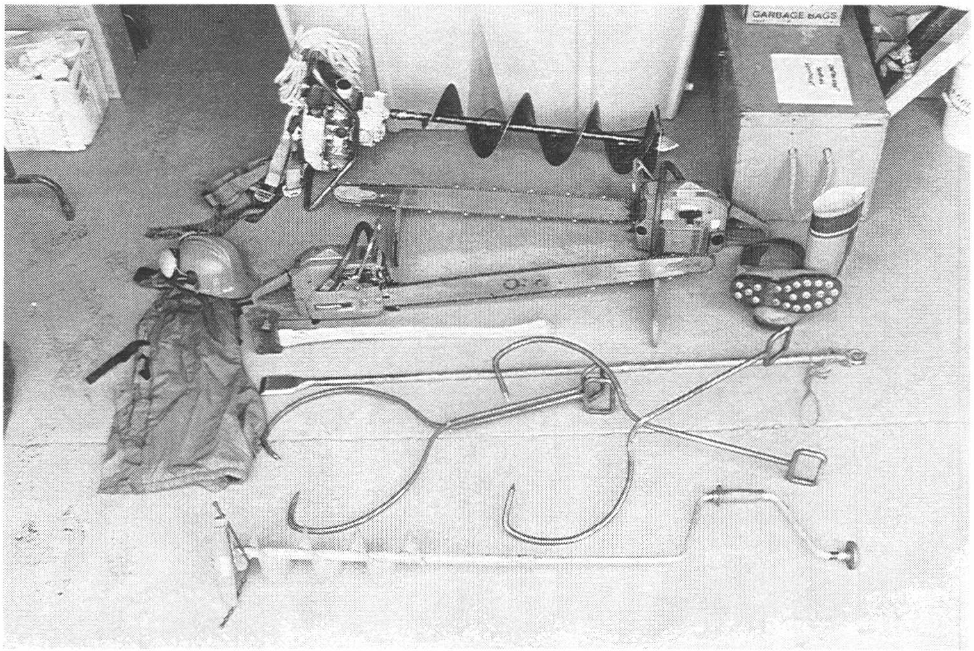

Plate 33. Ice sampling gear.

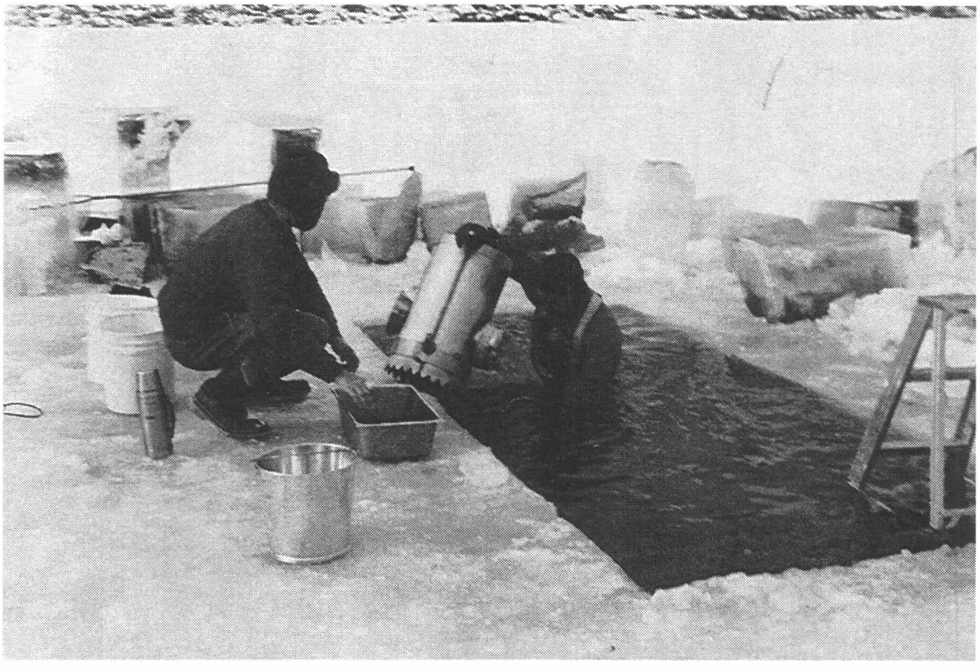

Plate 34. Setting the Neill cylinder without deep water sock. Site 3 - Obed Mountain Coal Bridge.

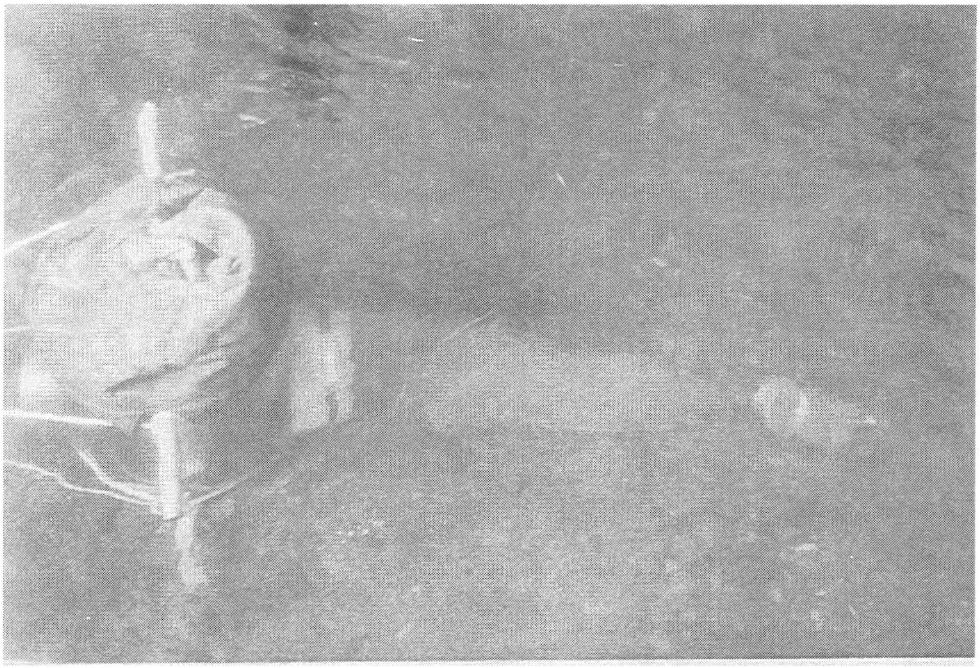

Plate 35. Neill sampler set. Note deep water sock covering cylinder top.

Plate 36. Scrubbing large rocks collected from Neill cylinder to remove invertebrates.

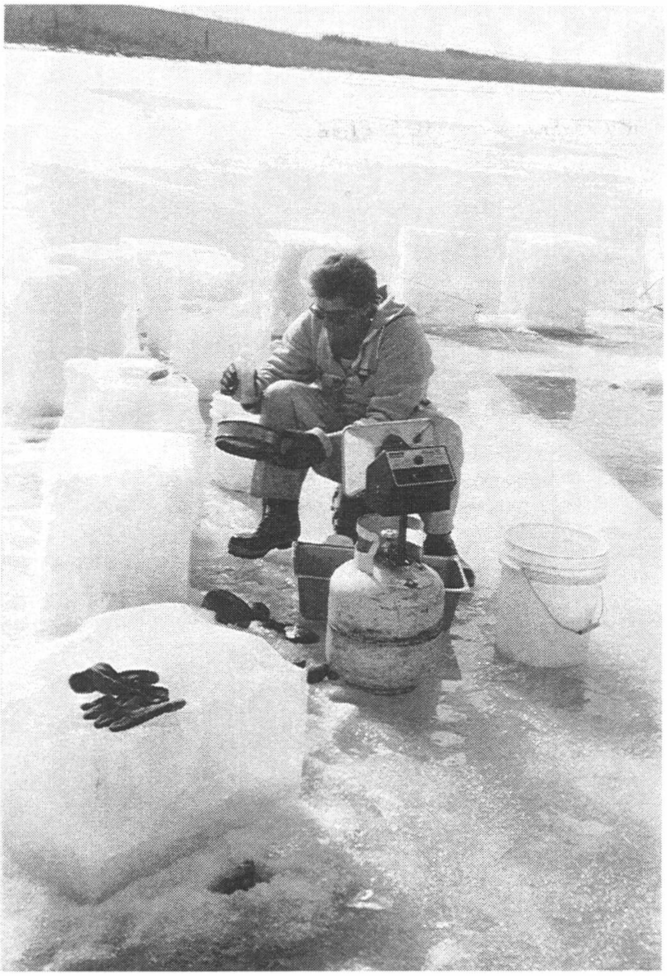

Plate 37. Elutriating and sieving Neill samples in field to remove inorganic and organic debris.

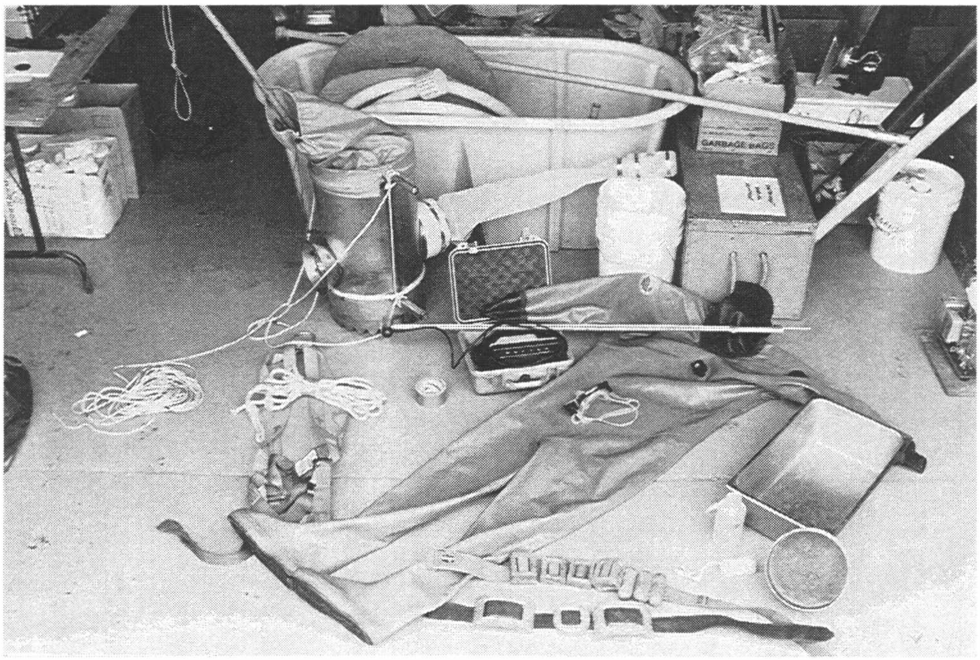

Plate 38. Neill sampling gear.

Plate 39. Lifting substrate with a steel shovel for biofilm sampling.

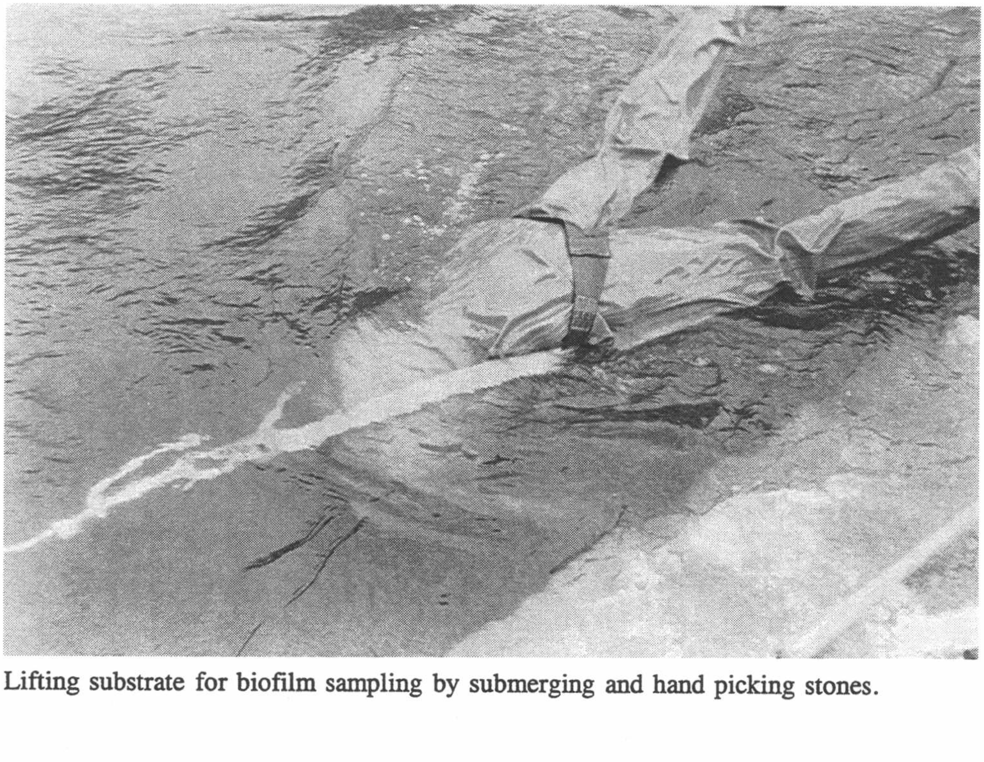

Plate 40. Lifting substrate for biofilm sampling by submerging and hand picking stones.

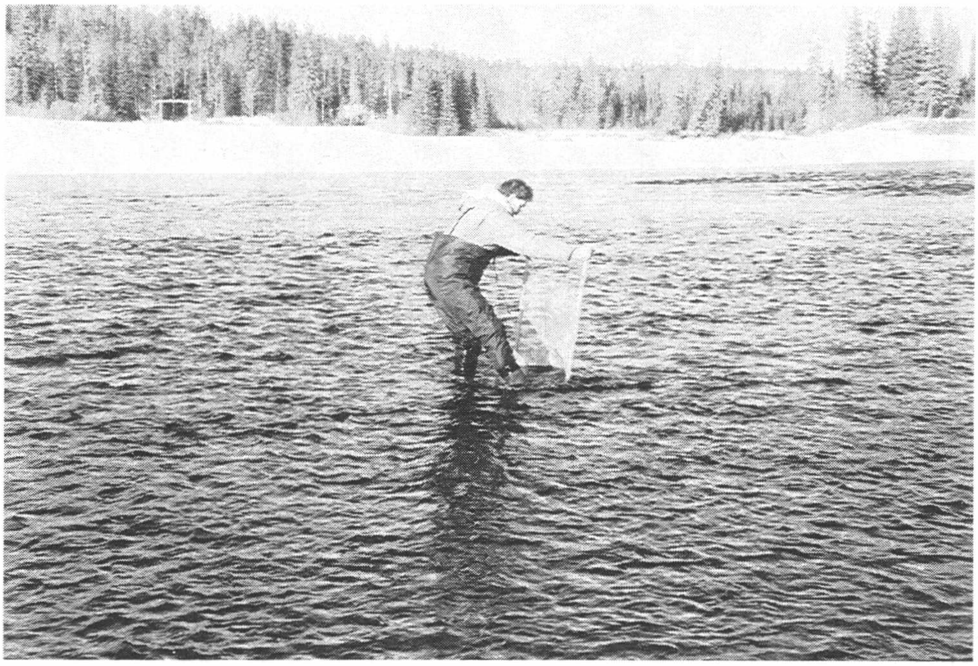

Plate 41. Open water kick netting of invertebrates for contaminant analysis at Site 2 - Weldwood Haul Bridge.

Plate 42. Through ice kick netting of invertebrates for contaminant analysis at Site 5 - Blue Ridge.

Plate 43. Removing invertebrates from kick screens at Site 2 - Weldwood Haul Bridge.

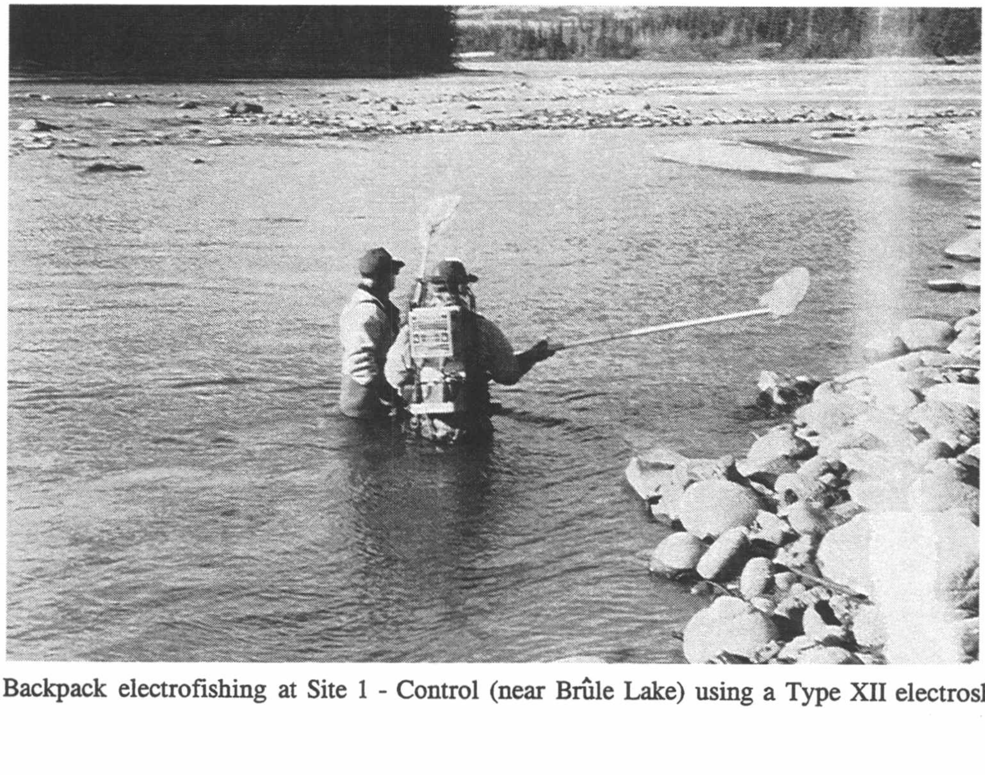

Plate 44. Backpack electrofishing at Site 1 - Control (near Brûle Lake) using a Type XII electroshocker.

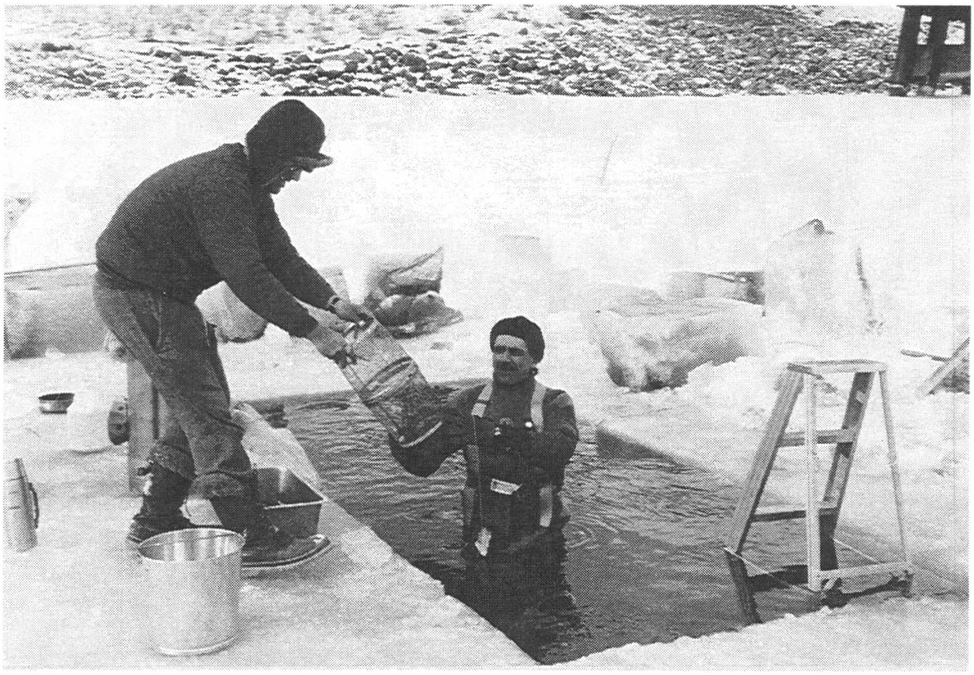

Plate 45. Setting a Gee-minnow trap at Site 3 - Obed Mountain Bridge.

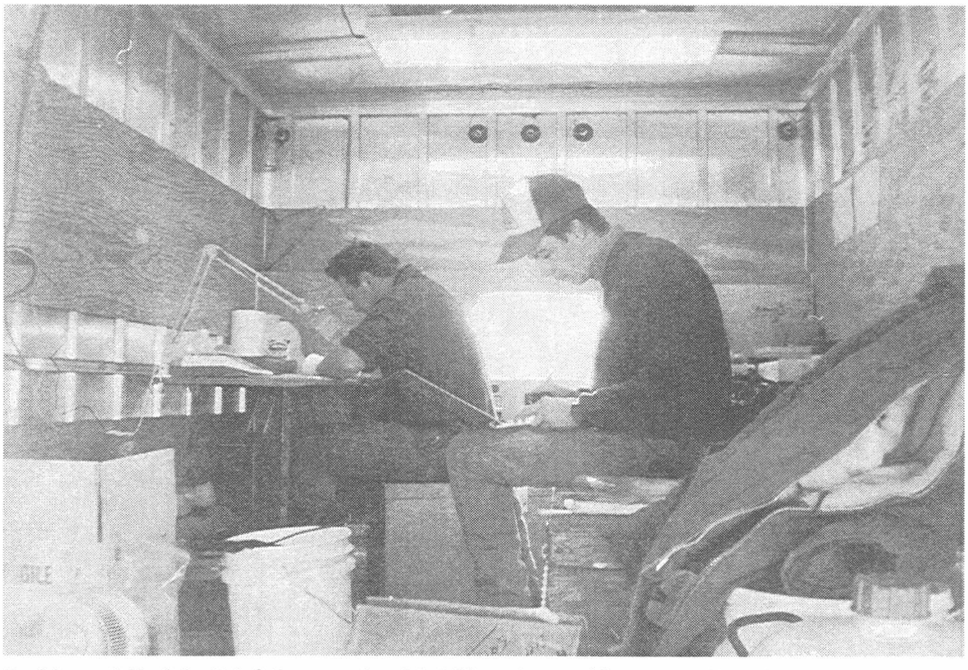

Plate 46. Inside mobile lab (14 ft box van). Multifunction oxidase sampling in progress.

APPENDIX C

Mean Daily Discharge of the Athabasca River at Hinton, Athabasca, and Fort McMurray.

Estimates of discharge upstream of Fort McMurray were derived from subtracting discharge rates of the Clearwater River from the Athabasca River rates obtained from a gauging station downstream of the confluence of these two rivers.

WATER SURVEY OF CANADA
MAR 10 1993 PAGE 11
CALGARY, ALTA 08:20

ATHABASCA RIVER AT HINTON

STATION NO. 07AD002

(PRELIMINARY) DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1992

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	41.5 B	47.2 B	40.0 B	40.0	165	396	477	327	150	149	102	53.2 B	1
2	43.1 B	49.2 B	40.5 B	40.3	174	486	419	358	164	155	95.1	48.0 B	2
3	43.1 B	52.3 B	41.5 B	44.6	153	590	383	372	181	163	89.6	38.2 B	3
4	42.3 B	51.6 B	43.2	51.1	140	513	360	361	163	181 A	84.0	34.0 B	4
5	37.9 B	43.3 B	41.7	54.3	140	428	350	356	176	219 A	78.9	32.0 B	5
6	40.6 B	41.0 B	41.1	53.0	175	382	353	378	196	197 A	76.2 B	32.3 B	6
7	36.1 B	34.4 B	42.2	50.1	260	372	373	364	191	174 A	79.3	34.0 B	7
8	29.2 B	31.9 B	41.2	47.2	319	397	404	359	152	154	78.3 B	38.1 B	8
9	39.8 B	29.8 B	39.6	47.0	348	441	470	321	152	145 A	76.9 B	49.7 B	9
10	42.0 B	28.0 B	39.2	44.4	312	507	496	275	143	135	66.7 B	44.9 B	10
11	44.0 B	27.0 B	40.2	43.3	267	551	451	246	142	122	56.5 B	41.7 B	11
12	44.0 B	29.0 B	39.3	43.7	229 A	533	406	241	171	127	54.8 B	41.7 B	12
13	43.3 B	36.4 B	41.4	44.1	198 A	599	377	254	193	126	60.7 B	37.0 B	13
14	41.1 B	41.3 B	43.6	44.4	177	652	377	274	186	117	77.0 B	31.0 B	14
15	40.5 B	40.8 B	44.2	44.5	170	614	386	315	170	97.8	72.7 B	44.7 B	15
16	39.8 B	38.9 B	44.2	45.2	163	574	348	333	159	80.0	60.5 B	52.0 B	16
17	42.2 B	37.8 B	45.7	47.4	153	592	322	321	140	75.2	56.6 B	45.2 B	17
18	41.0 B	36.0 B	44.7	50.3	151	597	325	304	139	80.2	53.6 B	39.3 B	18
19	40.5 B	30.1 B	44.4	53.8	171	558	345	311	131	84.9	55.8 B	30.9 B	19
20	40.7 B	21.9 B	43.8	54.0	189	523	343	316	128	85.6	58.2 B	30.7 B	20
21	41.0 B	23.5 B	41.4	54.2	188	536	334	278	152	78.0	54.6 B	34.6 B	21
22	39.9 B	25.1 B	40.6	57.4	175	560	342	245	181	91.3	47.2 B	31.8 B	22
23	38.5 B	27.6 B	39.2	60.0	161	580	376	206	176	91.7	44.2 B	33.1 B	23
24	37.0 B	34.0 B	39.5	61.4	156 A	608	378	177	186	94.1	35.1 B	34.9 B	24
25	36.5 B	40.3 B	40.3	60.1	171 E	609	360	162	219	216	32.3 B	30.2 B	25
26	37.0 B	54.9 B	38.5	59.5	212 A	568	353	153	224	235	29.7 B	28.6 B	26
27	37.5 B	53.1 B	39.2	63.8	368	554	354	158	202	186	36.1 B	30.3 B	27
28	39.2 B	42.1 B	41.2	75.6	443	573	340	195	181	148	48.7 B	24.0 B	28
29	42.8 B	41.5 B	38.4	97.7	408	571	321	200	165	123	56.2 B	23.0 B	29
30	47.2 B		37.4	124	390	541	306	169	151	121	54.2 B	24.0 B	30
31	48.0 B		38.8		386		306	153		113		28.1 B	31
TOTAL	1257.3	1090.0	1276.2	1656.4	7112	16005	11535	8482	5064	4164.8	1871.7	1121.2	TOTAL
MEAN	40.6	37.6	41.2	55.2	229	534	372	274	169	134	62.4	36.2	MEAN
MAX	48.0	54.9	45.7	124	443	652	496	378	224	235	102	53.2	MAX
MIN	29.2	21.9	37.4	40.0	140	372	306	153	128	75.2	29.7	23.0	MIN

SUMMARY FOR THE YEAR 1992
MEAN DISCHARGE, 166 M3/S
TOTAL DISCHARGE, 5240000 DAM3

MAXIMUM DAILY DISCHARGE, 652 M3/S ON JUN 14
MINIMUM DAILY DISCHARGE, 21.9 M3/S ON FEB 20

MAXIMUM INSTANTANEOUS DISCHARGE, 663 M3/S AT 12: 6 MST ON JUN 14

A-MANUAL GAUGE
B-ICE CONDITIONS
E-ESTIMATED

366 DAY(S) WITH DATA
118 DAY(S) WITH ICE
9 DAY(S) MANUAL DATA
1 DAY(S) ESTIMATED
0 DAY(S) WITH NO DATA

"Advance information subject to correction.
For private information only, pend
in Annual Department Report."

WATER SURVEY OF CANADA
SEP 29 1993 PAGE 8
CALGARY, ALTA 13:33

ATHABASCA RIVER AT HINTON

STATION NO. 07AD002

(PRELIMINARY) DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1993

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	29.0 B	38.0 B	31.2 B	31.0 B	38.4	366	296	327	280				1
2	28.7 B	36.0 B	31.3 B	35.3	38.7	400	289	292	303				2
3	31.1 B	34.5 B	31.0 B	36.1	38.4	451	293	283	309				3
4	31.9 B	32.4 B	31.4 B	36.9	38.0	431	299	281	305				4
5	35.1 B	32.0 B	32.0 B	36.4	38.1	389	328	288	300				5
6	35.1 B	31.5 B	35.0 B	36.4	45.3	355	361	298	279				6
7	37.1 B	31.2 B	35.5 B	34.8	58.3	338	392	325	258				7
8	34.1 B	31.0 B	35.0 B	35.1	72.0	347	405	362	238				8
9	38.6 B	30.2 B	33.3 B	37.2	71.8	390	430	340	241				9
10	40.1 B	29.9 B	30.0 B	38.3	65.4	363	429	335	242				10
11	39.0 B	28.7 B	28.5 B	39.4	63.3	317	382	374	234				11
12	36.1 B	26.6 B	27.0 B	38.5	108	287	348	385	244				12
13	35.3 B	25.8 B	26.0 B	37.9	261	264	320	346	229				13
14	35.0 B	25.7 B	25.5 B	33.9	456	253	305	329	199				14
15	35.0 B	24.1 B	25.0 B	33.3	580	257	300	322	187				15
16	35.1 B	23.6 B	24.4 B	33.5	574	283	310	298	176				16
17	35.5 B	22.9 B	24.9 B	36.6	580 E	318	310	296	164				17
18	36.0 B	24.7 B	25.5 B	41.5	540 E	334	311	296	153				18
19	36.6 B	27.3 B	27.0 B	44.0 E	520 E	375	313	297	152				19
20	37.2 B	27.3 B	29.3 B	47.0 E	500 E	443	314	297					20
21	37.9 B	25.5 B	31.6 B	50.0 E	479	412	325	302					21
22	38.1 B	27.6 B	37.0 B	52.0 E	456	373	351	320					22
23	38.0 B	29.2 B	38.6 B	54.0 E	412	372	365	326					23
24	38.0 B	27.1 B	38.6 B	54.0 E	365	342	352	338					24
25	38.2 B	27.9 B	38.0 B	52.0 E	336	301	339	352					25
26	38.5 B	28.3 B	33.4 B	48.0 E	353	296	336	299					
27	39.1 B	27.3 B	32.6 B	44.0 E	379	318	325	277					27
28	39.6 B	30.3 B	31.7 B	40.6	383	366	324	288					28
29	39.8 B		32.4 B	38.1	380	367	331	310					29
30	39.6 B		32.8 B	37.9	381	323	368	301					30
31	39.0 B		33.6 B		370		377	282					31
TOTAL	1127.4	806.6	969.1	1213.7	8980.7	10431	10528	9766					TOTAL
MEAN	36.4	28.8	31.3	40.5	290	348	340	315					MEAN
DAM3	97400	69700	83700	105000	776000	901000	910000	844000					DAM3
MAX	40.1	38.0	38.6	54.0	580	451	430	385					MAX
MIN	28.7	22.9	24.4	31.0	38.0	253	289	277					MIN

"Advance information subject to correction. For private information only, pending publication in Annual Department Report."

SUMMARY FOR THE YEAR 1993 (INCOMPLETE YEAR, SUMMARY DATA MAY NOT BE VALID)
MEAN DISCHARGE, M3/S
TOTAL DISCHARGE, DAM3

MAXIMUM DAILY DISCHARGE, M3/S ON
MINIMUM DAILY DISCHARGE, M3/S ON

MAXIMUM INSTANTANEOUS DISCHARGE, ? 605 M3/S AT 20:29 MST ON MAY 15

B-ICE CONDITIONS
E-ESTIMATED

262 DAY(S) WITH DATA
91 DAY(S) WITH ICE
0 DAY(S) MANUAL DATA
13 DAY(S) ESTIMATED
103 DAY(S) WITH NO DATA

WATER SURVEY OF CANADA
FEB 19 1993 PAGE 8
CALGARY, ALTA 15:41

ATHABASCA RIVER AT ATHABASCA

STATION NO. 07BE001

(PRELIMINARY) DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1992

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	118 B	96.8 B	99.0 B	260 B	415	750	723	421	264	311	251	105 B	1
2	117 B	97.8 B	116 B	321 B	439	753	727	399	268	291	232	106 B	2
3	116 B	103 B	136 B	305 B	462	765	698	385	251	272	222	108 B	3
4	115 B	108 B	146 B	266 B	479	774	644	391	236	256	215	118 B	4
5	113 B	109 B	151 B	242 B	492	929	575	418	233	250	204	131 B	5
6	108 B	113 B	153 B	256 B	459	1020	524	444	253	253	193	140 B	6
7	107 B	114 B	159 B	295 B	423	931	490	446	282	258	191	138 B	7
8	107 B	113 B	168 B	306 B	395	817	483	439	302	274	184	131 B	8
9	105 B	113 B	176 B	294 B	384	738	482	454	332	293	174 B	128 B	9
10	100 B	113 B	175 B	290 B	432	706	507	456	348	280	167 B	117 B	10
11	98.5 B	110 B	173 B	253 B	534	714	555	440	338	256	169 B	109 B	11
12	96.0 B	102 B	167 B	266 B	605	753	631	418	326	238	164 B	109 B	12
13	94.5 B	94.0 B	166 B	244 B	623	808	667	371	320	227	183 B	107 B	13
14	97.3 B	87.6 B	167 B	228 A	584	841	631	334	303	217	163 B	99.0 B	14
15	95.7 B	85.1 B	168 B	230 E	550	824	578	309	303	209	155 B	91.9 B	15
16	95.0 B	82.7 B	173 B	230 E	524	878	534	307	319	206	139 B	92.0 B	16
17	102 B	76.5 B	182 B	234 A	507	914	519	317	324	202 B	120 B	102 B	17
18	107 B	67.6 B	196 B	243	490	872	525	346	307	191 B	118 B	110 B	18
19	106 B	62.0 B	216 B	279	472	827	500	384	295	180 B	133 B	112 B	19
20	101 B	73.4 B	244 B	339	452	838	464	396	281	169 B	142 B	113 B	20
21	98.9 B	87.4 B	268 B	363	430	838	448	389	265	166	128 B	115 B	21
22	99.4 B	93.9 B	270 B	373	429	800	456	382	263	165	112 B	109 B	22
23	101 B	94.0 B	270 B	374	456	749	457	394	249	173	109 B	99.7 B	23
24	103 B	89.8 B	278 B	371	469	746	448	376	245	181	71.7 B	97.9 B	24
25	105 B	87.5 B	281 B	377	460	758	442	339	266	180	75.8 B	92.3 B	25
26	108 B	85.0 B	277 B	397	441	768	470	310	299	184	90.9 B	86.3 B	26
27	108 B	83.1 B	294 B	413	422	779	495	280	295	193	130 B	85.1 B	27
28	104 B	85.5 B	311 B	414	422	778	485	259	304	193	133 B	82.2 B	28
29	99.8 B	91.0 B	304 B	406	439	737	464	248	336	302	128 B	82.4 B	29
30	98.7 B		330 B	404	615	709	463	238	331	321	105 B	81.6 B	30
31	98.0 B		277 B		777		452	232		277		81.2 B	31
TOTAL	3222.8	2718.7	6491.0	9273	15081	24114	16537	11322	8738	7168	4602.4	3279.6	TOTAL
MEAN	104	93.7	209	309	486	804	533	365	291	231	153	106	MEAN
MAX	118	114	330	414	777	1020	727	456	348	321	251	140	MAX
MIN	94.5	62.0	99.0	228	384	706	442	232	233	165	71.7	81.2	MIN

SUMMARY FOR THE YEAR 1992
MEAN DISCHARGE, 308 M3/S
TOTAL DISCHARGE, 9720000 DAM3

MAXIMUM DAILY DISCHARGE, 1020 M3/S ON JUN 6
MINIMUM DAILY DISCHARGE, 62.0 M3/S ON FEB 19

MAXIMUM INSTANTANEOUS DISCHARGE, 1030 M3/S AT 8:46 MST ON JUN 6

A-MANUAL GAUGE
B-ICE CONDITIONS
E-ESTIMATED

366 DAY(S) WITH DATA
161 DAY(S) WITH ICE
2 DAY(S) MANUAL DATA
2 DAY(S) ESTIMATED
0 DAY(S) WITH NO DATA

"Advance information subj[illegible]n.
For priv[illegible]on
in Annual Department Report."

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WATER SURVEY OF CANADA                                        ATHABASCA RIVER AT ATHABASCA                                       STATION NO. 07BE001
JUN  9 1993   PAGE    6
CALGARY, ALTA       15:10                                                                                                          STREAM VAX MAR/92
                                           (PRELIMINARY) DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1993

DAY      JAN        FEB        MAR        APR        MAY       JUN       JUL       AUG       SEP       OCT       NOV       DEC      DAY
 1      81.0 B     70.0 B     57.1 B     94.7 B     233                                                                              1
 2      79.8 B     70.5 B     59.9 B     93.0 B     232                                                                              2
 3      77.6 B     70.4 B     60.9 B     95.5 B     228                                                                              3
 4      72.5 B     69.6 B     62.1 B    101    B    224                                                                              4
 5      65.7 B     69.3 B     63.4 B    106    B    222                                                                              5

 6      62.1 B     71.5 B     63.8 B    113    B    224                                                                              6
 7      60.6 B     77.1 B     65.2 B    120    B    225                                                                              7
 8      61.4 B     78.3 B     68.8 B    126    B    241                                                                              8
 9      63.4 B     71.8 B     72.2 B    133    B    327                                                                              9
10      65.5 B     71.8 B     74.3 B    141    B    436                                                                             10

11      67.4 B     72.3 B     74.8 B    143    B    426                                                                             11
12      69.0 B     69.3 B     75.0 B    152    B    383                                                                             12
13      69.9 B     71.6 B     77.8 B    169    B    350                                                                             13
14      70.3 B     72.1 B     80.8 B    183    B    319                                                                             14
15      70.0 B     70.6 B     79.6 B    205    B    294                                                                             15

16      69.8 B     69.5 B     75.4 B    247    B    345                                                                             16
17      70.8 B     69.1 B     74.4 B    212    B    666                                                                             17
18      71.1 B     68.5 B     72.8 B    271    B    849                                                                             18
19      70.3 B     67.4 B     74.3 B    282    B    818                                                                             19
20      69.7 B     66.2 B     71.7 B    289    B    749                                                                             20

21      69.5 B     64.6 B     71.0 B    270    B    710                                                                             21
22      69.2 B     63.2 B     68.3 B    258         682                                                                             22
23      68.8 B     61.7 B     68.0 B    250         667                                                                             23
24      68.8 B     60.6 B     69.8 B    225         675                                                                             24
25      69.0 B     59.9 B     72.9 B    220         651                                                                             25

26      69.5 B     60.9 B     74.2 B    223         605                                                                             26
27      69.5 B     59.2 B     74.5 B    232         554                                                                             27
28      69.7 B     58.0 B     76.2 B    234         513                                                                             28
29      69.5 B                81.3 B    233         521                                                                             29
30      69.3 B                89.4 B    232         556                                                                             30
31      69.6 B                95.3 B                574                                                                             31

TOTAL  2150.3     1905.0     2245.2     5653.2     14499                                                                         TOTAL
MEAN     69.4       68.0       72.4      188         468                                                                         MEAN
MAX      81.0       78.3       95.3      289         849                                                                         MAX
MIN      60.6       58.0       57.1       93.0       222                                                                         MIN

SUMMARY FOR THE YEAR 1993          (INCOMPLETE YEAR, SUMMARY DATA MAY NOT BE VALID)
          MEAN DISCHARGE,          M3/S                                                                               B-ICE CONDITIONS
          TOTAL DISCHARGE,          DAM3

          MAXIMUM DAILY DISCHARGE,          M3/S ON                                                              151 DAY(S) WITH DATA
          MINIMUM DAILY DISCHARGE,          M3/S ON                                                              111 DAY(S) WITH ICE
                                                                                                                   0 DAY(S) MANUAL DATA
          MAXIMUM INSTANTANEOUS DISCHARGE, ?    861 M3/S AT 16:32 MST ON MAY 18                                    0 DAY(S) ESTIMATED
                                                                                                                 214 DAY(S) WITH NO DATA
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"Advance information subject to [illegible]
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In Annual Department Report."

WATER SURVEY OF CANADA
FEB 3 1993 PAGE 1
CALGARY, ALTA. 08:20

ATHABASCA RIVER BELOW FORT McMURRAY

STATION NO. 07DA001

READQQ VAX APR/92

(PRELIMINARY) DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1992

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	157 B	158 B	165 B	399 B	873	852	948	626	468	529	457	190 B	1
2	160 B	156 B	165 B	419 B	876	1050	920	624	462	552	565	187 B	2
3	159 B	153 B	165 B	425 B	876	1090	926	604	453	541	452	180 B	3
4	159 B	152 B	164 B	420 B	885	1140	922	587	477	514	366	180 B	4
5	157 B	152 B	169 B	410 B	904	1180	894	560	488	489	350	172 B	5
6	155 B	151 B	176 B	405 B	913	1190	856	544	469	463	338	170 B	6
7	156 B	150 B	193 B	400 B	922	1320	797	552	450	439	329	168 B	7
8	155 B	150 B	214 B	390 B	911	1430	745	574	448	424	324	166 B	8
9	155 B	149 B	230 B	371 B	888	1340	706	607 A	452	418	313	163 B	9
10	155 B	148 B	238 B	370 B	857	1230	681	585	494	415	292 B	161 B	10
11	153 B	147 B	244 B	364 B	831	1130	673	585	518	423	285 B	159 B	11
12	152 B	146 B	252 B	360 B	830	1070	674	604	549	440	262 B	157 B	12
13	152 B	145 B	264 B	362 B	912	1050	706	600	566	427	232 B	155 B	13
14	150 B	143 B	276 B	370 B	997	1070	757	591	567	400	227 B	155 B	14
15	149 B	142 B	279 B	380 B	1050	1110	819	564	560	376	222 B	153 B	15
16	148 B	141 B	276 B	390 B	1020	1130	803	523	557	360	221 B	149 B	16
17	146 B	140 B	273 B	400 B	986	1120	758	494	545	320 B	220 B	148 B	17
18	144 B	139 B	272 B	410 B	956	1150	719	479	542	310 B	219 B	147 B	18
19	147 B	139 B	272 B	415 B	935	1180	692	486	555	301 B	218 B	144 B	19
20	147 B	138 B	272 B	420 B	913	1160	685	500	559	300 B	217 B	142 B	20
21	147 B	137 B	279 B	560 B	896	1130	674	530	541	298 B	213 B	140 B	21
22	142 B	137 B	292 B	726	879	1130	640	570	520	299 B	207 B	138 B	22
23	141 B	136 B	310 B	762	857	1120	613	579	506	303 B	201 B	137 B	23
24	140 B	136 B	333 B	788	834	1070	607	569	489	306 B	199 B	136 B	24
25	141 B	135 B	357 B	799	840	1010	613	571	501	302 B	196 B	134 B	25
26	143 B	146 B	365 B	798	858	992	611	585	495	295 B	197 B	132 B	26
27	146 B	155 B	366 B	796	859	1000	623	568	486	300 B	199 B	130 B	27
28	150 B	159 B	371 B	815	839	993	627	544	493	300 B	200 B	129 B	28
29	154 B	163 B	380 B	837	811	1000	654	519	526	297 B	200 B	128 B	29
30	155 B		386 B	865	792	986	666	487	525	317 B	196 B	127 B	30
31	157 B		390 B		787		643	471		313		126 B	31
TOTAL	4672	4243	8383	15626	27587	33423	22652	17282	15271	11771	8117	4703	TOTAL
MEAN	151	146	271	521	890	1110	731	557	509	380	271	152	MEAN
DAM3	404000	367000	725000	1350000	2380000	2890000	1960000	1490000	1320000	1020000	701000	406000	DAM3
MAX	160	163	390	865	1050	1430	948	626	567	552	565	190	MAX
MIN	140	135	164	360	787	852	607	471	448	295	196	126	MIN

SUMMARY FOR THE YEAR 1992
MEAN DISCHARGE, 475 M3/S
TOTAL DISCHARGE, 15000000 DAM3
MAXIMUM DAILY DISCHARGE, 1430 M3/S ON JUN 8
MINIMUM DAILY DISCHARGE, 126 M3/S ON DEC 31

"Advance information subject to correction. For private information only, pending publication in Annual Department Report."

A-MANUAL GAUGE
B-ICE CONDITIONS

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WATER SURVEY OF CANADA                ATHABASCA RIVER BELOW FORT McMURRAY                               STATION NO. 07DA001
 JUL  7 1993  PAGE    6
CALGARY, ALTA      11:48
                                      (PRELIMINARY) DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1993
DAY     JAN       FEB       MAR       APR       MAY       JUN       JUL       AUG       SEP      'OCT       NOV       DEC     DAY

  1     126 B     121 B     116 B     171 B                                                                                    1
  2     125 B     118 B     116 B                                                                                              2
  3     124 B     116 B     117 B                                                                                              3
  4     124 B     115 B     117 B                                                                                              4
  5     125 B     118 B     119 B                                                                                              5

  6     129 B     122 B     121 B                                                                                              6
  7     131 B     122 B     125 B                                                                                              7
  8     131 B     122 B     125 B                                                                                              8
  9     118 B     122 B     128 B                                                                                              9
 10     124 B     121 B     129 B                                                                                             10

 11     124 B     120 B     130 B                                                                                             11
 12     121 B     120 B     131 B                                                                                             12
 13     119 B     120 B     131 B                                                                                             13
 14     119 B     120 B     130 B                                                                                             14
 15     119 B     120 B     130 B                                                                                             15

 16     120 B     121 B     129 B                                                                                             16
 17     122 B     120 B     130 B                                                                                             17
 18     123 B     119 B     131 B                                                                                             18
 19     124 B     119 B     133 B                                                                                             19
 20     124 B     119 B     136 B                                                                                             20

 21     123 B     119 B     138 B                                                                                             21
 22     123 B     119 B     142 B                                                                                             22
 23     123 B     119 B     146 B                                                                                             23
 24     123 B     118 B     149 B                                                                                             24
 25     123 B     118 B     152 B                                                                                             25

 26     122 B     117 B     153 B                                                                                             26
 27     122 B     117 B     155 B                                                                                             27
 28     122 B     116 B     156 B                                                                                             28
 29     122 B               157 B                                                                                             29
 30     123 B               161 B                                                                                             30
 31     123 B               168 B                                                                                             31

TOTAL    3821      3338      4201                                                                                          TOTAl
MEAN      123       119       136                                                                                          MEAN
DAM3   330000    288000    363000                                                                                          DAM3
MAX       131       122       168                                                                                          MAX
MIN       118       115       116                                                                                          MIN

SUMMARY FOR THE YEAR 1993           (INCOMPLETE YEAR, SUMMARY DATA MAY NOT BE VALID)
          MEAN DISCHARGE,         M3/S                                                                         B-ICE CONDITIONS
          TOTAL DISCHARGE,         DAM3

          MAXIMUM DAILY DISCHARGE,         M3/S ON                                                          91 DAY(S) WITH DATA
          MINIMUM DAILY DISCHARGE,         M3/S ON                                                          91 DAY(S) WITH ICE
                                                                                                             0 DAY(S) MANUAL DATA
          MAXIMUM INSTANTANEOUS DISCHARGE, ?  [redacted]                                                     0 DAY(S) ESTIMATED
                                                                                                           274 DAY(S) WITH NO DATA
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WATER SURVEY OF CANADA
FEB 11 1993 PAGE 10
CALGARY, ALTA 10:55

CLEARWATER RIVER AT DRAPER

STATION NO. 07CD001

(PRELIMINARY) DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1992

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	49.0 B	49.0 B	47.5 B	62.0 B	169	124	123	65.4	56.5	108	80.7	52.0 B	1
2	49.5 B	48.5 B	46.8 B	64.0 B	175	125	117	66.2	57.5	108	80.8	51.5 B	2
3	49.8 B	48.2 B	46.0 B	66.0 B	178	149	108	64.1	58.6	106	80.3	51.0 B	3
4	49.6 B	48.1 B	45.5 B	68.2 B	180	164	98.5	67.4	59.5	104	80.0	50.7 B	4
5	49.2 B	48.1 B	44.8 B	72.0 B	182	167	93.3	65.3	59.2	102	79.2	50.0 B	5
6	49.0 B	48.0 B	44.5 B	76.0 B	185	169	90.7	60.9	58.3	99.6	78.7	49.8 B	6
7	49.0 B	47.9 B	44.7 B	80.3 B	183	169	86.6	60.7	57.5	98.1	76.1	49.0 B	7
8	49.0 B	47.8 B	44.2 B	83.7 B	180	167	83.1	61.6	57.8	96.8	78.0	48.5 B	8
9	49.0 B	47.6 B	44.5 B	85.8 B	178	165	80.7	61.5	58.9	95.8	75.8	48.2 B	9
10	49.0 B	47.6 B	44.9 B	88.0 B	175	161	76.9	61.6	58.9	94.5	72.5	48.0 B	10
11	49.1 B	47.5 B	45.6 B	92.0 B	169	154	75.4	58.7	59.6	93.9	71.0 B	46.0 B	11
12	49.2 B	47.5 B	45.7 B	95.0 B	167	149 A	74.6	57.7	60.3	92.7	68.5 B	46.2 B	12
13	49.2 B	47.8 B	45.9 B	98.0 B	165	145	74.5	57.4	62.8	91.7	66.2 B	46.4 B	13
14	48.9 B	47.8 B	46.0 B	100 B	162	141	73.3	56.9	68.8	90.6	65.0 B	46.4 B	14
15	48.8 B	48.0 B	46.0 B	103 B	161	135	71.2	56.2	73.5	88.8	63.5 B	46.0 B	15
16	48.6 B	48.0 B	46.0 B	107 B	156	129	70.8	54.4	77.5	85.9	61.9 B	45.7 B	16
17	48.7 B	48.0 B	46.2 B	110 B	155	124	70.0	53.2	80.2	82.7	60.5 B	45.0 B	17
18	49.0 B	48.0 B	46.2 B	114 B	155	122	72.1	52.3	80.7	80.0 B	59.4 B	44.0 B	18
19	49.1 B	48.0 B	46.8 B	118 B	152	120	75.2	53.5	81.4	80.0 B	58.7 B	43.0 B	19
20	49.0 B	48.0 B	47.0 B	122 B	150	122	74.8	55.4	81.9	80.5 B	58.2 B	43.0 B	20
21	48.8 B	48.0 B	47.2 B	124 B	149	137	74.1	55.8	82.3	81.8 B	57.9 B	42.0 B	21
22	48.6 B	48.1 B	47.2 B	128 B	148	137	73.1	56.9	82.8	81.9 B	57.1 B	42.3 B	22
23	48.4 B	48.2 B	47.2 B	131 B	146	133	72.5	56.9	84.1	81.9 B	57.0 B	42.0 B	23
24	48.3 B	48.5 B	47.5 B	135 B	146	130	70.7	56.8	84.5	80.5 B	56.0 B	41.9 B	24
25	48.4 B	48.8 B	48.0 B	140 B	145	126	70.0	55.8	90.8	80.2 B	55.2 B	41.9 B	25
26	48.5 B	49.0 B	48.7 B	142 B	144	120	69.3	55.1	100	80.9 B	54.6 B	41.9 B	26
27	48.6 B	48.8 B	49.5 B	152	141	120	71.5	54.8	103	81.5 B	54.2 B	42.2 B	27
28	48.6 B	48.4 B	51.0 B	158	138	125	72.3	54.3	105	82.0 B	54.0 B	42.0 B	28
29	48.4 B	48.0 B	56.0 B	163	132	121	69.8	54.2	106	82.8 B	53.8 B	41.9 B	29
30	48.6 B		58.2 B	165	131	117	68.9	53.6	108	82.0 B	53.0 B	41.8 B	30
31	49.0 B		60.8 B		129		67.1	54.4		82.2		41.7 B	31
TOTAL	1515.9	1395.2	1476.1	3243.0	4926	4167	2469.0	1799.0	2255.9	2777.3	1967.8	1412.0	TOTAL
MEAN	48.9	48.1	47.6	108	159	139	79.6	58.0	75.2	89.6	65.6	45.5	MEAN
MAX	49.8	49.0	60.8	165	185	169	123	67.4	108	108	80.8	52.0	MAX
MIN	48.3	47.5	44.2	62.0	129	117	67.1	52.3	56.5	80.0	53.0	41.7	MIN

SUMMARY FOR THE YEAR 1992
MEAN DISCHARGE, 80.3 M3/S
TOTAL DISCHARGE, 2540000 DAM3

MAXIMUM DAILY DISCHARGE, 185 M3/S ON MAY 6
MINIMUM DAILY DISCHARGE, 41.7 M3/S ON DEC 31

MAXIMUM INSTANTANEOUS DISCHARGE, 188 M3/S AT 12:12 MST ON MAY 6

"Advance information subject to correction. For private information only, pending publication in Annual Department Report."

A-MANUAL GAUGE
B-ICE CONDITIONS

366 DAY(S) WITH DATA
181 DAY(S) WITH ICE
1 DAY(S) MANUAL DATA
0 DAY(S) ESTIMATED
0 DAY(S) WITH NO DATA

WATER SURVEY OF CANADA
OCT 26 1993 PAGE 9
CALGARY, ALTA 14:49

CLEARWATER RIVER AT DRAPER

STATION NO. 07CD001

(PRELIMINARY) DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1993

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	41.8 B	38.0 B	39.0 B	55.9 B	118	92.5	71.2	132					1
2	41.0 B	38.0 B	38.9 B	57.4 B	118	89.6	76.2	145					2
3	40.9 B	37.9 B	38.7 B	58.2 B	118	87.5	80.4	151					3
4	40.6 B	37.9 B	38.6 B	59.0 B	117	84.8	81.5	155					4
5	40.5 B	38.0 B	38.5 B	60.0 B	116	82.5	81.7	157					5
6	40.6 B	38.0 B	38.6 B	62.6 B	115	80.8	80.1	157					6
7	40.0 B	38.2 B	39.0 B	62.9 B	116	79.5	78.8	158					7
8	39.9 B	38.4 B	39.9 B	63.7 B	122	77.4	77.5	159					8
9	39.4 B	38.5 B	40.2 B	65.2 B	133	76.6	77.7	162					9
10	38.7 B	38.7 B	41.7 B	66.5 B	143	76.7	77.6	165					10
11	38.4 B	38.2 B	41.9 B	68.2 B	142	79.3	78.0	169					11
12	38.1 B	38.2 B	42.2 B	70.0 B	144	80.7	79.0	167					12
13	38.0 B	38.5 B	43.3 B	74.0 B	148	80.4	80.1	167					13
14	38.0 B	38.2 B	43.9 B	83.0 B	148	79.9	79.6	166					14
15	38.1 B	37.8 B	44.3 B	89.9 B	145	78.5	79.6	162					15
16	38.2 B	37.8 B	44.9 B	95.0 B	140	77.2	78.4						16
17	38.6 B	37.6 B	45.3 B	103 B	136	75.9	77.3						17
18	38.7 B	37.5 B	45.9 B	114 B	131	74.3	75.2						18
19	38.4 B	37.8 B	46.1 B	123 B	127	72.3	73.3						19
20	38.1 B	37.6 B	46.9 B	124 B	123	71.0	72.4						20
21	38.1 B	37.9 B	47.8 B	123 B	120	69.4	73.3						21
22	38.0 B	38.0 B	48.1 B	122 B	116	70.0	78.7						22
23	38.0 B	38.1 B	49.2 B	120 B	112	71.6	84.5						23
24	38.0 B	38.4 B	49.9 B	118 B	110	71.4	87.3						24
25	37.9 B	38.7 B	50.3 B	116 B	108	71.4	84.6						25
26	38.0 B	39.0 B	51.2 B	114 B	105	71.4	85.0						26
27	38.1 B	39.2 B	52.0 B	121	104	71.3	90.4						27
28	38.2 B	39.2 B	52.6 B	119	102	70.6	100						28
29	38.5 B		53.5 B	118	99.6	68.9	108						29
30	38.2 B		54.0 B	118	97.2	68.8	111						30
31	38.0 B		54.9 B		94.8		123						31
TOTAL	1205.0	1069.3	1401.3	2744.5	3768.6	2302.2	2581.4						TOTAL
MEAN	38.9	38.2	45.2	91.5	122	76.7	83.3						MEAN
DAM3	104000	92400	121000	237000	326000	199000	223000						DAM3
MAX	41.8	39.2	54.9	124	148	92.5	123						MAX
MIN	37.9	37.5	38.5	55.9	94.8	68.8	71.2						MIN

"Advance information subject to correction. For private information only, pending publication in Annual Department Report."

SUMMARY FOR THE YEAR 1993 (INCOMPLETE YEAR, SUMMARY DATA MAY NOT BE VALID)
MEAN DISCHARGE, M3/S
TOTAL DISCHARGE, DAM3

MAXIMUM DAILY DISCHARGE, M3/S ON
MINIMUM DAILY DISCHARGE, M3/S ON

MAXIMUM INSTANTANEOUS DISCHARGE, ? 323 M3/S AT 12:06 MST ON APR 19

B-ICE CONDITIONS

227 DAY(S) WITH DATA
116 DAY(S) WITH ICE
0 DAY(S) MANUAL DATA
0 DAY(S) ESTIMATED
138 DAY(S) WITH NO DATA

APPENDIX D

Fish Collection Data Sheets

SEX AND MATURITY DESCRIPTIONS

99 = Sex indeterminable due to small gonad size

14 = Female. Definite gonad development; the fish has spawned before and will spawn during the coming spawning season.

07 = Male. Sexual organs filling ventral cavity; testes white, drops of milt fall with pressure.

04 = Male. Definite gonad development; the fish has spawned before and will spawn during the coming spawning season.

01 = Male. Small gonad size; fish has never spawned and will not spawn during the coming season.

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 15 Date (D/M/Y): 04/~~04~~ 03/93

Location: Site 1 - Near Entrance (open water site just below Brule' Lake) Station: —

* * *

Species MW Fork Length (mm) 66 Weight (g) 1.9

Sex 99 Age Structure —

Capture Method:

___ Set Line ___ Gee Trap ___ Dip Net ✓ Electrofish ___ Other

if other, specify: ___ Bait: ___

Gross Pathology Sheet: ___ Yes ✓ No

Liver Weight:

	Wt (g)	Sample #
Total	less than 0.1g	
MFO	< 0.1g	Vial 15
Residual Tissue	—	Bag —

Preservation of fish remains for residual tissue analysis ✓ Yes - Bag # 15

___ No

Comments:

Sampler(s) H. Larsen / R. DURACK

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 16 Date (D/M/Y): 04/~~04~~ 03/93

Location: Site 1 - near Entrance (below Brulé L.) Station: —

* * *

Species ocky ountain RMWF Fork Length (mm) 77 Weight (g) 3.3

Sex 99 Age Structure —

Capture Method:

____ Set Line ____ Gee Trap ____ Dip Net ✓ Electrofish ____ Other

if other, specify: ____ Bait: ____

Gross Pathology Sheet: ____ Yes ✓ No

Liver Weight:

	Wt (g)	Sample #
Total	<0.1g	▨
MFO	<0.1g	Vial 16
Residual Tissue	—	Bag —

Preservation of fish remains for residual tissue analysis ✓ Yes - Bag # 16

____ No

Comments:

gall bladder broke during dissection

Sampler(s) H. Larsen / R. DURACK

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 17 Date (D/M/Y): 04/~~04~~ 03/93

Location: Site 1 - near Entrance (open water below Brule L.) Station: —

* * *

Species R.M.W.F (ocky ountain hite) Fork Length (mm) 70 Weight (g) 2.3

Sex 99 Age Structure

Capture Method:

Set Line Gee Trap Dip Net [✓ Electrofish] Other

if other, specify: Bait:

Gross Pathology Sheet: Yes [✓ No]

Liver Weight:

	Wt (g)	Sample #
Total	<0.1g	▨
MFO	<0.1g	Vial 17
Residual Tissue	—	Bag —

Preservation of fish remains for residual tissue analysis [✓ Yes - Bag # 17] No

Comments:

Sampler(s) H. Larsen / R. DURACK

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 18 Date (D/M/Y): 04/03/93

Location: Site 1 - near Entrance Station: —

* * *

Species [illegible].M.W.[illegible] Fork Length (mm) 65 Weight (g) 2.0

Sex 99 Age Structure ______

Capture Method:

____ Set Line ____ Gee Trap ____ Dip Net ✓ Electrofish ____ Other

if other, specify: ______ Bait: ______

Gross Pathology Sheet: ____ Yes ✓ No

Liver Weight:

	Wt (g)	Sample #
Total	<0.1	▨
MFO	<0.1	Vial 18
Residual Tissue	—	Bag —

Preservation of fish remains for residual tissue analysis ✓ Yes - Bag # 18

____ No

Comments:

Sampler(s) LARSEN / DURACK

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 19 Date (D/M/Y): 04/~~[illegible]~~ 03/93

Location: Site 1-near Entrance (open water below Brulé L.) Station: —

* * *

Species [illegible]MW[illegible] Fork Length (mm) 69 Weight (g) 2.2

Sex 99 Age Structure —

Capture Method:

___ Set Line ___ Gee Trap ___ Dip Net ✓ Electrofish ___ Other

if other, specify: ________ Bait: ________

Gross Pathology Sheet: ___ Yes ✓ No

Liver Weight:

	Wt (g)	Sample #
Total	<0.1	▨
MFO	<0.1	Vial 19
Residual Tissue	—	Bag —

Preservation of fish remains for residual tissue analysis ✓ Yes - Bag # 19

___ No

Comments:

Sampler(s) LABSEN/ DURACK

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 20 Date (D/M/Y): 04/03/93

Location: Site 1 - near Entrance (open water below Brulé L.) Station: —

* * *

Species MW Fork Length (mm) 112 Weight (g) 10.4

Sex 99 Age Structure —

Capture Method:

____ Set Line ____ Gee Trap ____ Dip Net ✓ Electrofish ____ Other

if other, specify: ____ Bait: ____

Gross Pathology Sheet: ____ Yes ✓ No

Liver Weight:

	Wt (g)	Sample #
Total	<0.1	▨
MFO	<0.1	Vial 20
Residual Tissue	—	Bag —

Preservation of fish remains for residual tissue analysis ✓ Yes - Bag # 20

____ No

Comments:

Sampler(s) LARSEN / DURACK

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 21 Date (D/M/Y): 04/$\overset{03}{09}$/93

Location: Site 1-near Entrance (open water site below Brulé L.) Station: —

* * *

Species M.W. Fork Length (mm) 107 Weight (g) 10.9

Sex ♀♀ Age Structure —

Capture Method:

___ Set Line ___ Gee Trap ___ Dip Net ✓ Electrofish ___ Other

if other, specify: ______ Bait: ______

Gross Pathology Sheet: ___ Yes ✓ No

Liver Weight:

	Wt (g)	Sample #
Total	<0.1	▨
MFO	<0.1	Vial 21
Residual Tissue	—	Bag —

Preservation of fish remains for residual tissue analysis ✓ Yes - Bag # 21

___ No

Comments:

- broken gall bladder during tissue removal.

Sampler(s) LARSEN/ DURACK

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 22 Date (D/M/Y): 04/03/93

Location: Site 1 - near Entrance (open water site below Brulé L.) Station: —

* * *

Species MW Fork Length (mm) 292 Weight (g) 272.3

Sex 14 Age Structure —

Capture Method:

___ Set Line ___ Gee Trap ___ Dip Net [✓ Electrofish] ___ Other

if other, specify: ___ Bait: ___

Gross Pathology Sheet: ___ Yes [✓ No]

Liver Weight:

	Wt (g)	Sample #
Total	2.3	
MFO	2.3	Vial 22
Residual Tissue		Bag

Preservation of fish remains for residual tissue analysis [✓ Yes - Bag # 22]

___ No

Comments:

- residual eggs within cavity
- gall bladder broke during dissection

Sampler(s) LARSEN / DURACK

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET PROJECT #368

Sample No. 23 Date (D/M/Y): 05/03/93

Location: Site 1 (near Brule lake) Station: ______

* * *

Species MW Fork Length (mm) 112 Weight (g) 12.2

Sex 99 Age Structure ______

Capture Method:

____ Set Line ____ Gee Trap ____ Dip Net [✓ Electrofish] ____ Other

if other, specify: ______ Bait: ______

Gross Pathology Sheet: ____ Yes [✓ No]

Liver Weight:

	Wt (g)	Sample #
Total	0.2	
MFO	0.2	Vial 23
Residual Tissue		Bag 23

Preservation of fish remains for residual tissue analysis [✓ Yes] - Bag # 23

____ No

Comments:

Sampler(s) Larsen/Stack

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 24 Date (D/M/Y): 05/03/93

Location: Site 1 (near Brule lake) Station: ______

* * *

Species MW Fork Length (mm) 77 Weight (g) 2.7

Sex 99 Age Structure ______

Capture Method:

____ Set Line ____ Gee Trap ____ Dip Net ✓ Electrofish ____ Other

if other, specify: ______ Bait: ______

Gross Pathology Sheet: ____ Yes ✓ No

Liver Weight:

	Wt (g)	Sample #
Total	>0.1	▨
MFO	>0.1	Vial 24
Residual Tissue		Bag

Preservation of fish remains for residual tissue analysis ✓ Yes - Bag # 24

____ No

Comments:

Sampler(s) Larsen/Stack

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 25 Date (D/M/Y): 05/03/93

Location: Site 1 (near Brule lake) Station:

* * *

Species MW Fork Length (mm) 61 Weight (g) 1.6

Sex 99 Age Structure

Capture Method:

Set Line Gee Trap Dip Net [✓ Electrofish] Other

if other, specify: Bait:

Gross Pathology Sheet: Yes [✓ No]

Liver Weight:

	Wt (g)	Sample #
Total	> 0.1	▨
MFO	> 0.1	Vial 25
Residual Tissue		Bag

Preservation of fish remains for residual tissue analysis [✓ Yes - Bag # 25]

No

Comments:

Sampler(s) Larsen/Stack

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 26

Date (D/M/Y): 05/03/93

Location: Site 1 (near Brule lake)

Station:

* * *

Species MW

Fork Length (mm) 72

Weight (g) 2.9

Sex 99

Age Structure

Capture Method:

____ Set Line ____ Gee Trap ____ Dip Net [✓ Electrofish] ____ Other

if other, specify:

Bait:

Gross Pathology Sheet: ____ Yes [✓ No]

Liver Weight:

	Wt (g)	Sample #
Total	> 0.1	
MFO	> 0.1	Vial 26
Residual Tissue		Bag

Preservation of fish remains for residual tissue analysis [✓ Yes - Bag # 26]

____ No

Comments:

Sampler(s) Larson/stack

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 27 Date (D/M/Y): 05/03/93

Location: Site 1 (near Brule lake) Station: ____

* * *

Species MW Fork Length (mm) 74 Weight (g) 2.9

Sex 99 Age Structure ____

Capture Method:

____ Set Line ____ Gee Trap ____ Dip Net ✓ Electrofish ____ Other

if other, specify: ____ Bait: ____

Gross Pathology Sheet: ____ Yes ✓ No

Liver Weight:

	Wt (g)	Sample #
Total	>0.1	
MFO	>0.1	Vial 27
Residual Tissue		Bag

Preservation of fish remains for residual tissue analysis ✓ Yes - Bag # 27

____ No

Comments:

Sampler(s) Larsen/stack

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 28 Date (D/M/Y): 05/03/93

Location: Site 1 (near Brule lake) Station: ____

* * *

Species MW Fork Length (mm) 80 Weight (g) 4.5

Sex 9 9 Age Structure ____

Capture Method:

____ Set Line ____ Gee Trap ____ Dip Net [✓ Electrofish] ____ Other

if other, specify: ____ Bait: ____

Gross Pathology Sheet: ____ Yes [✓ No]

Liver Weight:

	Wt (g)	Sample #
Total	>0.1	▨
MFO	>0.1	Vial 28
Residual Tissue		Bag

Preservation of fish remains for residual tissue analysis [✓ Yes] - Bag # 28

____ No

Comments:

Sampler(s) Larsen /Stack

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 29 Date (D/M/Y): 05/03/93

Location: Site 1 (near Brule lake) Station:

* * *

Species MW Fork Length (mm) 75 Weight (g) 3.1

Sex 99 Age Structure

Capture Method:

___ Set Line ___ Gee Trap ___ Dip Net [✓ Electrofish] ___ Other

if other, specify: Bait:

Gross Pathology Sheet: ___ Yes [✓ No]

Liver Weight:

	Wt (g)	Sample #
Total	>0.1	▨
MFO	>0.1	Vial 29
Residual Tissue		Bag

Preservation of fish remains for residual tissue analysis [✓ Yes] - Bag # 29

___ No

Comments:

Sampler(s) Larsen/Stack

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 30 Date (D/M/Y): 05/03/93

Location: Site 1 (near Brule lake) Station: ______

* * *

Species MW Fork Length (mm) 65 Weight (g) 1.5

Sex 99 Age Structure ______

Capture Method:

______ Set Line ______ Gee Trap ______ Dip Net ✓ Electrofish ______ Other

if other, specify: ______ Bait: ______

Gross Pathology Sheet: ______ Yes ✓ No

Liver Weight:

	Wt (g)	Sample #
Total	>0.1	▨
MFO	>0.1	Vial 30
Residual Tissue		Bag

Preservation of fish remains for residual tissue analysis ✓ Yes - Bag # 30

______ No

Comments:

Sampler(s) Larsen / Stack

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 31 Date (D/M/Y): 05/03/93

Location: Site 1 (near Brule lake) Station: _____

* * *

Species MW Fork Length (mm) 75 Weight (g) 2.8

Sex 99 Age Structure _____

Capture Method:

_____ Set Line _____ Gee Trap _____ Dip Net ✓ Electrofish _____ Other

if other, specify: _____ Bait: _____

Gross Pathology Sheet: _____ Yes ✓ No

Liver Weight:

	Wt (g)	Sample #
Total	>0.1	
MFO	>0.1	Vial 31
Residual Tissue		Bag

Preservation of fish remains for residual tissue analysis ✓ Yes - Bag # 31

_____ No

Comments:

Sampler(s) Larsen / Stack

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 32 Date (D/M/Y): 05/03/93

Location: Site 1 (near Brule lake) Station: ______

* * *

Species MW Fork Length (mm) 73 Weight (g) 2.9

Sex 99 Age Structure ______

Capture Method:

___ Set Line ___ Gee Trap ___ Dip Net ✓ Electrofish ___ Other

if other, specify: ______ Bait: ______

Gross Pathology Sheet: ___ Yes ✓ No

Liver Weight:

	Wt (g)	Sample #
Total	>0.1	▨
MFO	>0.1	Vial 32
Residual Tissue		Bag

Preservation of fish remains for residual tissue analysis ✓ Yes - Bag # 32

___ No

Comments:

Sampler(s) Larsen/Stack

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 33 Date (D/M/Y): 05/03/93

Location: Site 1 (near Brule lake) Station: ______

* * *

Species MW Fork Length (mm) 70 Weight (g) 2.3

Sex ♀♀ Age Structure ______

Capture Method:

___ Set Line ___ Gee Trap ___ Dip Net ✓ Electrofish ___ Other

if other, specify: ______ Bait: ______

Gross Pathology Sheet: ___ Yes ✓ No

Liver Weight:

	Wt (g)	Sample #
Total	>0.1	▨
MFO	>0.1	Vial 33
Residual Tissue		Bag

Preservation of fish remains for residual tissue analysis ✓ Yes - Bag # 33

___ No

Comments:

Sampler(s) Larsen / Stack

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 34 Date (D/M/Y): 05/03/93

Location: Site 1 (near Brule lake) Station: ______

* * *

Species MW Fork Length (mm) 60 Weight (g) 1.3

Sex 99 Age Structure ______

Capture Method:

___ Set Line ___ Gee Trap ___ Dip Net ✓ Electrofish ___ Other

if other, specify: ______ Bait: ______

Gross Pathology Sheet: ___ Yes ✓ No

Liver Weight:

	Wt (g)	Sample #
Total	>0.1	
MFO	>0.1	Vial 34
Residual Tissue		Bag

Preservation of fish remains for residual tissue analysis ✓ Yes - Bag # 34

___ No

Comments:

Sampler(s) Larsen/Stack

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 35 Date (D/M/Y): 05/03/93

Location: site1 (near Brule lake) Station: ____

* * *

Species MW Fork Length (mm) 73 Weight (g) 2.5

Sex 99 Age Structure ____

Capture Method:

____ Set Line ____ Gee Trap ____ Dip Net ✓ Electrofish ____ Other

if other, specify: ____ Bait: ____

Gross Pathology Sheet: ____ Yes ✓ No

Liver Weight:

	Wt (g)	Sample #
Total	>0.1	▨
MFO	>0.1	Vial 35
Residual Tissue		Bag

Preservation of fish remains for residual tissue analysis ✓ Yes - Bag # 35

____ No

Comments:

Sampler(s) Larsen/Stack

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 36 Date (D/M/Y): 05/03/93

Location: Site 1 (near Brule lake) Station: ____

* * *

Species MW Fork Length (mm) 64 Weight (g) 1.7

Sex 99 Age Structure ____

Capture Method:

____ Set Line ____ Gee Trap ____ Dip Net ✓ Electrofish ____ Other

if other, specify: ____ Bait: ____

Gross Pathology Sheet: ____ Yes ✓ No

Liver Weight:

	Wt (g)	Sample #
Total	>0.1	▨
MFO	>0.1	Vial 36
Residual Tissue		Bag

Preservation of fish remains for residual tissue analysis ✓ Yes - Bag # 36

____ No

Comments:

Sampler(s) Larsen / Stack

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET PROJECT #368

Sample No. 37

Date (D/M/Y): 05/03/93

Location: Site 1 (near Brule lake)

Station:

* * *

Species MW

Fork Length (mm) 62

Weight (g) 1.5

Sex 99

Age Structure

Capture Method:

___ Set Line ___ Gee Trap ___ Dip Net ✓ Electrofish ___ Other

if other, specify:

Bait:

Gross Pathology Sheet: ___ Yes ✓ No

Liver Weight:

	Wt (g)	Sample #
Total	>0.1	
MFO	>0.1	Vial 37
Residual Tissue		Bag

Preservation of fish remains for residual tissue analysis ✓ Yes - Bag # 37

___ No

Comments:

Sampler(s) Larsen / stack

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 38 Date (D/M/Y): 05/03/93

Location: Site 1 (near Brule lake) Station: ______

* * *

Species MW Fork Length (mm) 61 Weight (g) 1.5

Sex 99 Age Structure ______

Capture Method:

____ Set Line ____ Gee Trap ____ Dip Net ✓ Electrofish ____ Other

if other, specify: ______ Bait: ______

Gross Pathology Sheet: ____ Yes ✓ No

Liver Weight:

	Wt (g)	Sample #
Total	>0.1	▨
MFO	>0.1	Vial 38
Residual Tissue		Bag

Preservation of fish remains for residual tissue analysis ✓ Yes - Bag # 38

____ No

Comments:

Sampler(s) Larsen / Stack

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 39 Date (D/M/Y): 05/03/93

Location: Site 1 (near Brule lake) Station: ______

* * *

Species MW Fork Length (mm) 64 Weight (g) 1.8

Sex 99 Age Structure ______

Capture Method:

____ Set Line ____ Gee Trap ____ Dip Net ✓ Electrofish ____ Other

if other, specify: ______ Bait: ______

Gross Pathology Sheet: ____ Yes ✓ No

Liver Weight:

	Wt (g)	Sample #
Total	>0.1	▨
MFO	>0.1	Vial 39
Residual Tissue		Bag

Preservation of fish remains for residual tissue analysis ✓ Yes - Bag # 39

____ No

Comments:

Sampler(s) Larsen / Stack

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 40 Date (D/M/Y): 05/03/93

Location: Site 1 (near Brule lake) Station:

* * *

Species MW Fork Length (mm) 64 Weight (g) 1.7

Sex 99 Age Structure

Capture Method:

___ Set Line ___ Gee Trap ___ Dip Net ✓ Electrofish ___ Other

if other, specify: Bait:

Gross Pathology Sheet: ___ Yes ✓ No

Liver Weight:

	Wt (g)	Sample #
Total	>0.1	▨
MFO	>0.1	Vial 40
Residual Tissue		Bag

Preservation of fish remains for residual tissue analysis ✓ Yes - Bag # 40

___ No

Comments:

Sampler(s) Larsen/Stack

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 41 Date (D/M/Y): 05/03/93

Location: Site 1 (near Brule lake) Station: ____

* * *

Species MW Fork Length (mm) 59 Weight (g) 1.3

Sex 99 Age Structure ____

Capture Method:

____ Set Line ____ Gee Trap ____ Dip Net ✓ Electrofish ____ Other

if other, specify: ____ Bait: ____

Gross Pathology Sheet: ____ Yes ✓ No

Liver Weight:

	Wt (g)	Sample #
Total	>0.1	
MFO	>0.1	Vial 41
Residual Tissue		Bag

Preservation of fish remains for residual tissue analysis ✓ Yes - Bag # 41

____ No

Comments:

Sampler(s) Larsen / Stack

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET PROJECT #368

Sample No. 42 Date (D/M/Y): 05/03/93

Location: Site 1 (near Brule lake) Station: ______

* * *

Species MW Fork Length (mm) 60 Weight (g) 1.5

Sex 99 Age Structure ______

Capture Method:

____ Set Line ____ Gee Trap ____ Dip Net ✓ Electrofish ____ Other

if other, specify: ______ Bait: ______

Gross Pathology Sheet: ____ Yes ✓ No

Liver Weight:

	Wt (g)	Sample #
Total	>0.1	▨
MFO	>0.1	Vial 42
Residual Tissue		Bag

Preservation of fish remains for residual tissue analysis ✓ Yes - Bag # 42

____ No

Comments:

Sampler(s) Larson/stack

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 43 Date (D/M/Y): 05/03/93

Location: Site 1 (near Brule lake) Station:

* * *

Species MW Fork Length (mm) 58 Weight (g) 1.4

Sex 99 Age Structure

Capture Method:

____ Set Line ____ Gee Trap ____ Dip Net ✓ Electrofish ____ Other

if other, specify: Bait:

Gross Pathology Sheet: ____ Yes ✓ No

Liver Weight:

	Wt (g)	Sample #
Total	>0.1	
MFO	>0.1	Vial 43
Residual Tissue		Bag

Preservation of fish remains for residual tissue analysis ✓ Yes - Bag # 43

____ No

Comments:

Sampler(s) Larsen/Stack

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET PROJECT #368

Sample No. 44 Date (D/M/Y): 05/03/93

Location: Site 1 (near Brule lake) Station: ____

* * *

Species MW Fork Length (mm) 66 Weight (g) 1.9

Sex 99 Age Structure ____

Capture Method:

____ Set Line ____ Gee Trap ____ Dip Net [✓ Electrofish] ____ Other

if other, specify: ____ Bait: ____

Gross Pathology Sheet: ____ Yes [✓ No]

Liver Weight:

	Wt (g)	Sample #
Total	>0.1	▨
MFO	>0.1	Vial 44
Residual Tissue		Bag

Preservation of fish remains for residual tissue analysis [✓ Yes] - Bag # 44

____ No

Comments:

Sampler(s) Larsen / Stack

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. Blank 2 Date (D/M/Y): 05/03/93

Location: site 1 (near Brule lake) Station: ______

* * *

Species NA Fork Length (mm) NA Weight (g) ______

Sex NA Age Structure ______

Capture Method:

____ Set Line ____ Gee Trap ____ Dip Net ____ Electrofish ____ Other

if other, specify: NA Bait: ______

Gross Pathology Sheet: ____ Yes ____ No

Liver Weight:

	Wt (g)	Sample #
Total	NA	▨
MFO	NA	Vial
Residual Tissue		Bag

Preservation of fish remains for residual tissue analysis ✓ Yes - Bag # Blank 2

____ No

Comments:

Sampler(s) Larsen/Stack

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 1 Date (D/M/Y): 24 Fb 93

Location: Weldwood Bridge - Site 2 Station:

* * *

Species MW Fork Length (mm) 135 Weight (g) 20.9 g

Sex — Age Structure —

Capture Method:

___ Set Line ___ Gee Trap ___ Dip Net X Electrofish ___ Other

if other, specify: Bait:

Gross Pathology Sheet: ___ Yes X No

Liver Weight:

	Wt (g)	Sample #
Total	0.1	▨
MFO	0.1	Vial 1
Residual Tissue	.03	Bag —

Preservation of fish remains for residual tissue analysis ✓ Yes - Bag # 1

___ No

Comments:

- largest fish caught - liver still less 0.1g

Sampler(s) Sam /HL

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 2 Date (D/M/Y): 24/2/93

Location: Site 2- Weldwood Bridge Station: –

* * *

Species MW Fork Length (mm) 51 Weight (g) 1.0

Sex – Age Structure –

Capture Method:

____ Set Line ____ Gee Trap ____ Dip Net _X_ Electrofish ____ Other

if other, specify: ____ Bait: ____

Gross Pathology Sheet: ____ Yes _X_ No

Liver Weight:

	Wt (g)	Sample #
Total	<0.1	▨
MFO	<0.1	Vial 2
Residual Tissue	0	Bag –

Preservation of fish remains for residual tissue analysis _✓_ Yes - Bag # 2

____ No

Comments:

Sampler(s) HL / Sbm

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 3 Date (D/M/Y): 24/2/92

Location: Site 2 - Weldwood Bridge Station: —

* * *

Species MW Fork Length (mm) 78 Weight (g) 3.4

Sex — Age Structure —

Capture Method:

____ Set Line ____ Gee Trap ____ Dip Net x Electrofish ____ Other

if other, specify: ____ Bait: ____

Gross Pathology Sheet: ____ Yes X No

Liver Weight:

	Wt (g)	Sample #
Total	<0.1	
MFO	<0.1	Vial 3
Residual Tissue	0	Bag —

Preservation of fish remains for residual tissue analysis ✓ Yes - Bag # 3

____ No

Comments:

Sampler(s) Sam HL

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 4 Date (D/M/Y): 24/12/93

Location: Site 2 - Weldwood Haul Bridge Station: —

* * *

Species MW Fork Length (mm) 69 Weight (g) 2.5

Sex — Age Structure —

Capture Method:

___ Set Line ___ Gee Trap ___ Dip Net X Electrofish ___ Other

if other, specify: ___ Bait: ___

Gross Pathology Sheet: ___ Yes X No

Liver Weight:

	Wt (g)	Sample #
Total	<0.1	▨
MFO	<0.1	Vial 4
Residual Tissue	0	Bag -

Preservation of fish remains for residual tissue analysis X Yes - Bag # 4

___ No

Comments:

Sampler(s) / HL

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 5 Date (D/M/Y): 24/12/93

Location: Site 2 - Weldwood Haul Bridge Station: –

* * *

Species MW Fork Length (mm) 52 Weight (g) 1.0

Sex – Age Structure –

Capture Method:

___ Set Line ___ Gee Trap ___ Dip Net X Electrofish ___ Other

if other, specify: ______ Bait: ______

Gross Pathology Sheet: ___ Yes X No

Liver Weight:

	Wt (g)	Sample #
Total	<0.1	▨
MFO	<0.1	Vial 5
Residual Tissue	[illegible]	Bag –

Preservation of fish remains for residual tissue analysis X Yes - Bag # 5

___ No

Comments:

- NO GALL BLADDER FOUND

Sampler(s) SBM /HL

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET PROJECT #368

Sample No. 6 Date (D/M/Y): 24 / 2 / 93

Location: Site 2 - Weldwood Haul Bridge Station: –

* * *

Species MW Fork Length (mm) 74 Weight (g) 3.1

Sex – Age Structure –

Capture Method:

____ Set Line ____ Gee Trap ____ Dip Net x Electrofish ____ Other

if other, specify: ________ Bait: ________

Gross Pathology Sheet: ____ Yes X No

Liver Weight:

	Wt (g)	Sample #
Total	<0.1	▨
MFO	<0.1	Vial 6
Residual Tissue	0	Bag 5

Preservation of fish remains for residual tissue analysis X Yes - Bag # 6

____ No

Comments:

Sampler(s) SAM / HL

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET PROJECT #368

Sample No. 7 Date (D/M/Y): 24/2/93

Location: Site 2- Weldwood Haul Bridge Station: /

* * *

Species MW Fork Length (mm) 65 Weight (g) 2.1

Sex – Age Structure /

Capture Method:

___ Set Line ___ Gee Trap ___ Dip Net ☒ Electrofish ___ Other

if other, specify: ___ Bait: ___

Gross Pathology Sheet: ___ Yes ☒ No

Liver Weight:

	Wt (g)	Sample #
Total	<0.1	▨
MFO	<0.1	Vial 7
Residual Tissue	2.0	Bag 7

Preservation of fish remains for residual tissue analysis ☒ Yes - Bag # 7

___ No

Comments:

Sampler(s) Sam / HL

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 8 Date (D/M/Y): 24/2/93

Location: Site 2 - Weldwood HAUL Bridge Station: /

* * *

Species MW Fork Length (mm) 61 Weight (g) 2.1

Sex / Age Structure /

Capture Method:

___ Set Line ___ Gee Trap ___ Dip Net x Electrofish ___ Other

if other, specify: ___ Bait: ___

Gross Pathology Sheet: ___ Yes x No

Liver Weight:

	Wt (g)	Sample #
Total	<0.1	
MFO	<0.1	Vial 8
Residual Tissue	0	Bag -

Preservation of fish remains for residual tissue analysis x Yes - Bag # 8

___ No

Comments:

Sampler(s) Sam /HL

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 9 Date (D/M/Y): 24/12/93

Location: Site 2 - Wildwood Bridge Station: —

* * *

Species MW Fork Length (mm) 63 Weight (g) 1.9

Sex — Age Structure —

Capture Method:

____ Set Line ____ Gee Trap ____ Dip Net __X__ Electrofish ____ Other

if other, specify: ____ Bait: ____

Gross Pathology Sheet: ____ Yes __X__ No

Liver Weight:

	Wt (g)	Sample #
Total	<0.1	
MFO	<0.1	Vial 9
Residual Tissue	—	Bag —

Preservation of fish remains for residual tissue analysis __x__ Yes - Bag # 9

____ No

Comments:

Sampler(s) SAM / HL

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 10 Date (D/M/Y): 24/2/93

Location: Site 2- Weldwood Haul Bridge Station: —

* * *

Species SCUL Fork Length (mm) 102 Weight (g) 12.7

Sex (07) Gravid Male Age Structure —

Capture Method:

___ Set Line ___ Gee Trap ___ Dip Net _X_ Electrofish ___ Other

if other, specify: ___ Bait: ___

Gross Pathology Sheet: ___ Yes _X_ No

Liver Weight:

	Wt (g)	Sample #
Total		▨
NO LIVER ~~MFO~~		~~Vial~~
Residual Tissue		Bag

NO LIVE
FOUND &
PRESE

Preservation of fish remains for residual tissue analysis _X_ Yes - Bag # 10

___ No

Comments:

NO LIVER

Sampler(s) SBM / MIL

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. BLANK TISSUE Date (D/M/Y): 24 Feb 93

Location: Site 2 - Weldwood Haul Bridge Station: /

* * *

Species / Fork Length (mm) / Weight (g) 21.8

Sex ______ Age Structure ______

Capture Method:

____ Set Line ____ Gee Trap ____ Dip Net ____ Electrofish ____ Other

if other, specify: ______ Bait: ______

Gross Pathology Sheet: ____ Yes ____ No

Liver Weight:

	Wt (g)	Sample #
Total	21.8	▨
MFO	21. 8	Vial BLANK TISSUE
Residual Tissue		Bag

Preservation of fish remains for residual tissue analysis ____ Yes - Bag # ____

____ No

Comments:

BLANK TISSUE

Sampler(s) SBM / HL

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 11 Date (D/M/Y): 27 /12 /93

Location: Site 3: OBED Bridge Station: /

* * *

Species MW Fork Length (mm) 414 Weight (g) 841

Sex F - 04 - hasn't spawned Age Structure /

Capture Method:

___ Set Line ___ Gee Trap ___ Dip Net X Electrofish ___ Other

if other, specify: ___ Bait: ___

Gross Pathology Sheet: ___ Yes X No

Liver Weight:

	Wt (g)	Sample #
Total	14.8	▨
MFO	5.8	Vial 11
Residual Tissue	9.0	Bag 11

small contam bag

Preservation of fish remains for residual tissue analysis X Yes - Bag # 11

___ No

Comments:

Sampler(s) HL /

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 12 Date (D/M/Y): 27/2/93

Location: Site 3 - OBED BRIDGE Station: /

* * *

Species MW Fork Length (mm) 199 Weight (g) 92.9

Sex 99- Age Structure –

Capture Method:

____ Set Line ____ Gee Trap ____ Dip Net __X__ Electrofish ____ Other

if other, specify: ____ Bait: ____

Gross Pathology Sheet: ____ Yes __X__ No

Liver Weight:

	Wt (g)	Sample #
Total	1.0	▨
MFO	1.0	Vial 12
Residual Tissue	–	Bag –

Preservation of fish remains for residual tissue analysis __X__ Yes - Bag # 12

____ No

Comments:

Sampler(s) HL /

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 13 Date (D/M/Y): 27/2/93

Location: SITE 3- OBED BRIDGE Station: ✓

* * *

Species MW Fork Length (mm) 237 Weight (g) 165.2

Sex 99 Age Structure ✓

Capture Method:

____ Set Line ____ Gee Trap ____ Dip Net X Electrofish ____ Other

if other, specify: ____ Bait: ____

Gross Pathology Sheet: ____ Yes X No

Liver Weight:

	Wt (g)	Sample #
Total	2.1	▨
MFO	2.1	Vial 13
Residual Tissue	–	Bag –

Preservation of fish remains for residual tissue analysis X Yes - Bag # 13

____ No

Comments:

Sampler(s) Sam / HL

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 14 Date (D/M/Y): 27/2/93

Location: Site 3 - OBED BRIDGE Station: —

* * *

Species MW Fork Length (mm) 183 Weight (g) 75.2

Sex 99 Age Structure

Capture Method:

___ Set Line ___ Gee Trap ___ Dip Net X Electrofish ___ Other

if other, specify: Bait:

Gross Pathology Sheet: ___ Yes X No

Liver Weight:

	Wt (g)	Sample #
Total	0.8	
MFO	0.8	Vial 14
Residual Tissue	—	Bag —

Preservation of fish remains for residual tissue analysis X Yes - Bag # 14

___ No

Comments:

Sampler(s)

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 45 Date (D/M/Y): 08/03/93

Location: Site 4 - Emerson Lakes Bridge Station: —

* * *

Species MW Fork Length (mm) 190 Weight (g) 76.4

Sex 01 Age Structure —

Capture Method:

____ Set Line ____ Gee Trap ____ Dip Net ✓ Electrofish ____ Other

if other, specify: ____ Bait: ____

Gross Pathology Sheet: ____ Yes ✓ No

Liver Weight:

	Wt (g)	Sample #
Total	0.7	
MFO	0.7	Vial 45
Residual Tissue		Bag [redacted]

Preservation of fish remains for residual tissue analysis ✓ Yes - Bag # 45

____ No

Comments:

Sampler(s) DURACK / LARSEN

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. 46 Date (D/M/Y): 08/03/93

Location: Site 4 - Emerson Lakes Bridge Station: ____________

* * *

Species MW Fork Length (mm) 312 Weight (g) 395.7

Sex ____________ Age Structure ____________

Capture Method:

_____ Set Line _____ Gee Trap _____ Dip Net ✓ Electrofish _____ Other

if other, specify: ____________ Bait: ____________

Gross Pathology Sheet: _____ Yes ✓ No

Liver Weight:

	Wt (g)	Sample #
Total	5.0	
MFO	5.0	Vial 46
Residual Tissue		Bag

Preservation of fish remains for residual tissue analysis ✓ Yes - Bag # 46

_____ No

Comments:

Sampler(s) LARSEN / DURACK

R.L. & L. ENVIRONMENTAL SERVICES LTD.

FISH COLLECTION SHEET **PROJECT #368**

Sample No. BLANK 3 Date (D/M/Y): 08/03/93

Location: Site 4 - Emerson Lakes Br. Station: —

* * *

Species — Fork Length (mm) — Weight (g) ~16.7

Sex — Age Structure —

Capture Method:

____ Set Line ____ Gee Trap ____ Dip Net ____ Electrofish ____ Other

if other, specify: blank tissue sample Bait: ____

Gross Pathology Sheet: ____ Yes ✓ No

Liver Weight:

	Wt (g)	Sample #
Total		▨
MFO		Vial
Residual Tissue		Bag

Preservation of fish remains for residual tissue analysis ✓ Yes - Bag # BLANK 3

____ No

Comments:

Sampler(s) LARSEN / DURACK