Canada Alberta Northwest Territories

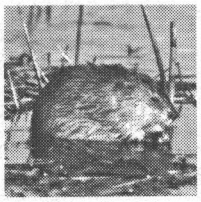
Northern River Basins Study












Prepared for the
Northern River Basins Study
under Project 2521-B1

by
M. Dunnigan
R.L. & L. Environmental Services Ltd.

NORTHERN RIVER BASINS STUDY PROJECT REPORT NO. 19

AQUATIC MACROINVERTEBRATE IDENTIFICATIONS

ON EKMAN DREDGE SAMPLES UPPER ATHABASCA RIVER, APRIL AND MAY, 1992

Published by the
Northern River Basins Study
Edmonton, Alberta
September, 1993

CANADIAN CATALOGUING IN PUBLICATION DATA

Dunnigan, Mark Edward, 1962-

Aquatic macroinvertebrate identifications on Ekman dredge samples, Upper Athabasca River, April and May, 1992

(Northern River Basins Study project report,
ISSN 1192-3571 ; no. 19)
Includes bibliographic references.
ISBN 0-662-20984-2
DSS cat. no. R71-49/3-19E

1. Aquatic invertebrates -- Effect of water pollution on -- Testing -- Alberta -- Athabasca River,
2. Organic water pollutants -- Alberta -- Athabasca River.
I. Northern River Basins Study (Canada) II. Title.
III. Series.

QH91.57A1D86 1993 592'.0526323'097123 C93-099675-5

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.

NORTHERN RIVER BASINS STUDY
PROJECT REPORT RELEASE FORM

This publication may be cited as:

Dunnigan, M., R.L. & L. Environmental Services Ltd., *Northern River Basins Study Project Report No. 19, Aquatic Macroinvertebrate Identifications on Ekman Dredge Samples, Upper Athabasca River, April and May, 1992*, Edmonton, Alberta, Canada, September, 1993.

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.

F.J. Wrona — 26 August 1993
(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;
this publication has been reviewed for scientific content and that the scientific practices represented in the report are acceptable given the specific purposes of the project and subject to the field conditions encountered.
SUPPLEMENTAL COMMENTARY HAS BEEN ADDED TO THIS PUBLICATION: [ ] Yes [✓] No

P.A. Larkin — Sept 8/93
(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

Whereas the Study Board is satisfied that this publication has been reviewed for scientific content and for immediate health implications,
IT IS HERE APPROVED BY THE BOARD OF DIRECTORS THAT;
this publication be released to the public, and that this publication be designated for: **[✓] STANDARD AVAILABILITY [ ] EXPANDED AVAILABILITY**

Bev Burns — 93/09/20
(Bev Burns, Co-chair) (Date)

NRBS.005

AQUATIC MACROINVERTEBRATE IDENTIFICATIONS ON EKMAN DREDGE SAMPLES, UPPER ATHABASCA RIVER, APRIL AND MAY, 1992

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.

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.*

This report provides a detailed description of the benthic invertebrate community of the Athabasca River from upstream of Hinton to Whitecourt. The kinds (taxa) and abundance of all invertebrate species were determined from replicate samples. In conjunction with this task, the food of mountain whitefish and northern pike were determined for this same reach. The stomach contents were weighed, and each food item was identified and measured.

The data presented in this report will provide key information for modelling the fate of pulp mill contaminants and determining levels of contaminants in mountain whitefish and pike. Furthermore, this information will be used to assess the impact of municipal and industrial effluents on species composition and health (eg., abundance, deformities, genetic makeup, etc.) of aquatic macroinvertebrate communities.

EXECUTIVE SUMMARY

The objective of this project was to process thirty (30) quantitative aquatic invertebrate samples collected under project 2371. The samples were Ekman dredges collected from depositional areas of the Upper Athabasca River (Hinton - Whitecourt area) in April 1992. Methods used in the enumeration and identification of aquatic invertebrates followed procedures outlined in Alberta Environment (1990). A preliminary evaluation of the incidence of deformities or abnormal growths in non-chironomid specimens was conducted; in addition, incidence of parasitism by nematodes in chironomid larvae was evaluated. This report is an addendum to projects 2382 and 2521 *Aquatic Macroinvertebrate identifications on samples from the upper Athabasca River*. Sampling locations and sampling procedures are documented in project 2371 *Field data on benthos and bottom sediment collections*.

The total number of aquatic invertebrates in an Ekman sample from the project area ranged from 14 to 301. In general, sites 2 and 5 (Weldwood Bridge and Windfall Bridge, respectively) had the greatest densities of invertebrates. No deformities or abnormal growths were observed. Chironomid larvae at Site 2 (Weldwood Bridge) had the greatest incidence of parasitism.

ACKNOWLEGEMENTS

We would like to thank Dr. Anne-Marie Anderson (Alberta Environment, Environmental Assessment Division) for providing information and assistance during this project.

Sample processing was conducted by Mike Braeuer, Jim Campbell, Mark Dunnigan, Scott Morrison, Rob Simpson, and Rob Stack. Ms. Frances Baker assisted with report production.

TABLE OF CONTENTS

LIST OF TABLES

SECTION 1
INTRODUCTION

Changes in aquatic invertebrate community composition can be used as an indicator of stress resulting from anthropogenic discharges. In fast flowing waters, riffle communities are most commonly studied; however, trace contaminants associated with particulate matter may accumulate in areas of slow flow velocity. Consequently, invertebrates which live in these depositional zones may be exposed to higher concentrations of contaminants and, therefore, exhibit more distinct responses.

The purpose of this project was to complete the processing of aquatic invertebrate samples taken from the upper reaches of the Athabasca River in April 1992. Previously, Neill cylinder samples collected from riffle areas were processed (R.L. & L. Environmental Services 1993). Thirty (30) Ekman dredges taken from depositional areas at the same sites were processed at a later date and the results are presented. This report is an addendum to projects 2382 and 2521 *Aquatic Macroinvertebrate identifications on samples from the upper Athabasca River*. Sampling locations and sampling procedures are documented in project 2371 *Field data on benthos and bottom sediment collections*.

SECTION 2
METHODS

Specific methodologies employed in the processing of the Ekman samples are outlined in R.L. & L. Environmental Services (1993).

Tasks performed in this study were as follows:

1. Invertebrates were sorted, enumerated, and identified following procedures outlined in Alberta Environment (1990). Identifications were to genus or species level, whenever possible. Chironomidae were identified to sub-family level, and they were not mounted.

2. A preliminary evaluation was conducted of the incidence of deformities or abnormal growths in non-chironomid specimens.

3. A preliminary evaluation was conducted of the incidence of parasitism by nematodes (primarily Elminthidae) in the chironomid larvae population.

4. Total wet weights were determined for invertebrates in each replicate sample, and

5. QA/QC procedures were implemented at each step of the sample processing.

SECTION 3
RESULTS

3.1 MACROINVERTEBRATE IDENTIFICATIONS

Table 3.1 summarizes identifications and enumerations as well as total wet weights of all invertebrates in each of the five replicate Ekman samples from the six sites on the Athabasca River.

3.1.1 Quality Control

Less than 2.3% (range 0-2.3%) of all invertebrates were overlooked when they were sorted from debris. Table 3.2 summarizes sorting efficiency and accuracy of sample processing.

3.1.2 Morphological Deformities and Abnormalities

No specimens were found with deformities. The only morphological abnormalities observed were missing and regenerating limbs.

Table 3.1 Summary of quantitative invertebrate identifications from the Athabasca River.

Five replicate Ekman samples were collected from six sites. Wet weight of all invertebrates within each sample is also presented.

SITE 1: UPSTREAM OF HINTON, NEAR ENTRANCE

DATE: 07 APRIL 1992
SAMPLER: EKMAN DREDGE (225 cm^2)
FINEST MESH SIZE: 0.212 mm
COLLECTION BY: M. DUNNIGAN AND C. PATTENDEN
SORTING BY: M. BRAEUER, J. CAMPBELL, M. DUNNIGAN, S. MORRISON, R. SIMPSON, AND R. STACK
COUNTS AND IDENTIFICATIONS BY: M. DUNNIGAN

	REPLICATE				
	1	2	3	4	5
ANNELIDA					
OLIGOCHAETA					
HAPLOTAXIDA					
Tubificidae	0	1	0	3	3
ARTHROPODA					
ARACHNOIDA					
ACARI	1	1	0	0	0
CRUSTACEA					
COPEPODA					
Cyclopoida	0	0	0	1	1
INSECTA					
COLLEMBOLA					
Isotomatidae					
Agrenia	1	0	0	0	0
DIPTERA					
Chironomidae	0	0	0	3	2
Chironomidae Pupae	0	1	0	0	0
Chironomini	5	5	5	25	3
Diamesinae	8	13	7	26	31
Tanypodinae	0	0	0	1	0
Tanytarsini	0	3	0	5	2
Orthocladiinae	8	17	8	8	14
Empididae					
Chelifera	1	1	0	0	0
Simuliidae	0	0	0	1	0
EPHEMEROPTERA	0	1	0	0	0
Ephemerellidae	0	0	0	2	0
NEMATODA	1	5	4	9	7
OSTRACODA	1	0	0	0	1
SOIL MITES	0	0	0	1	0
TOTAL NUMBER OF AQUATIC INVERTEBRATES	26	48	24	84	64
WET WEIGHT (mg)	5.7	9.4	20.5	11.6	11.4

SITE 2: WELDWOOD BRIDGE

DATE: 09 APRIL 1992
SAMPLER: EKMAN DREDGE (225 cm^2)
FINEST MESH SIZE: 0.212 mm
COLLECTION BY: M. DUNNIGAN AND C. PATTENDEN
SORTING BY: M. BRAEUER, M. DUNNIGAN, AND S. MORRISON
COUNTS AND IDENTIFICATIONS BY: M. DUNNIGAN

	REPLICATE				
	1	2	3	4	5
ANNELIDA					
OLIGOCHAETA					
HAPLOTAXIDA					
Enchytraeidae	3	2	2	1	6
Naididae	0	0	0	1	0
Tubificidae	1	2	5	1	2
ARTHROPODA					
ARACHNOIDA					
ACARI	0	1	0	1	2
CRUSTACEA					
COPEPODA					
Cyclopoida	2	8	0	0	3
Harpacticoida	0	1	0	0	0
INSECTA					
COLLEMBOLA					
Isotomatidae					
Agrenia	0	0	0	0	1
DIPTERA					
Ceratopogonidae	0	1	0	0	0
Chironomidae	6	8	0	0	0
Chironomidae Pupae	10	9	8	2	19
Chironomini	25	23	7	28	55
Diamesinae	28	39	12	8	24
Diamesinae (Parasitized)	0	1	0	0	1
Orthocladiinae	30	57	19	37	118
Orthocladiinae (Parasitized)	5	4	2	12	9
Tanypodinae	0	1	0	0	0
Tanytarsini	0	1	17	1	3
Empididae					
Chelifera	0	0	0	0	5
EPHEMEROPTERA	0	4	0	0	0
Baetidae	2	2	1	2	3
Baetis	1	6	0	2	3
Ephemerellidae	0	1	0	0	5
Heptageniidae	0	1	0	0	0
TRICHOPTERA					
Brachycentridae					
Brachycentrus	0	0	0	1	0
NEMATODA	13	27	10	4	42
OSTRACODA	0	0	0	1	0

TERRESTRIAL					
DIPTERA	0	0	0	0	2
HOMOPTERA	0	0	1	0	0
MITE	0	0	1	0	2
TOTAL NUMBER OF AQUATIC INVERTEBRATES	126	199	83	102	301
WET WEIGHT (mg)	32.4	34.9	39.2	37.4	60.5

SITE 3: OBED MOUNTAIN COAL BRIDGE

DATE: 10 APRIL 1992
SAMPLER: EKMAN DREDGE (225 cm^2)
FINEST MESH SIZE: 0.212 mm
COLLECTION BY: M. BRAEUER AND M. DUNNIGAN
SORTING BY: M. BRAEUER AND S. MORRISON
COUNTS AND IDENTIFICATIONS BY: M. DUNNIGAN

	REPLICATE				
	1	2	3	4	5
ANNELIDA					
OLIGOCHAETA					
HAPLOTAXIDA					
Enchytraeidae	7	6	2	13	7
Naididae	0	1	1	0	1
Tubificidae	0	0	0	0	1
ARTHROPODA					
CRUSTACEA					
CLADOCERA					
Chydoridae	0	0	0	0	1
Daphnidae					
Daphnia	2	0	0	0	0
COPEPODA					
Cyclopoida	1	0	0	0	0
Harpacticoida	0	1	0	0	0
INSECTA					
DIPTERA					
Chironomidae	1	0	3	2	0
Chironomini	1	5	8	6	9
Diamesinae	3	2	0	6	5
Orthocladiinae	10	19	24	6	9
Tanytarsini	7	23	23	6	48
Empididae					
Chelifera	1	0	0	0	2
EPHEMEROPTERA					
Baetidae	0	1	0	1	0
Baetis	1	0	0	0	0
Ephemerellidae	0	1	0	0	3
PLECOPTERA					
Chloroperlidae	0	1	0	0	0

NEMATODA	14	132	86	24	125
TERRESTRIAL MITE	0	2	0	0	0
TOTAL NUMBER OF AQUATIC INVERTEBRATES	58	192	147	64	211
WET WEIGHT (mg)	1.4	13.2	2.7	1.9	1.3

SITE 4: NEAR EMERSON LAKES

DATE: 11 APRIL 1992
SAMPLER: EKMAN DREDGE (225 cm^2)
FINEST MESH SIZE: 0.212 mm
COLLECTION BY: K. DEJAEGER AND S. MILLAR
SORTING BY: M. BRAEUER AND S. MORRISON
COUNTS AND IDENTIFICATIONS BY: M. DUNNIGAN

	REPLICATE				
	1	2	3	4	5
ANNELIDA					
OLIGOCHAETA					
HAPLOTAXIDA					
Enchytraeidae	0	1	0	0	0
Naididae	0	0	0	0	1
Tubificidae	1	3	0	4	7
ARTHROPODA					
INSECTA					
DIPTERA					
Chironomidae	0	1	1	0	1
Chironomini	2	6	7	10	9
Diamesinae	1	3	11	3	10
Orthocladiinae	4	2	10	7	10
Tanypodinae	0	0	1	0	0
Tanytarsini	1	1	1	2	5
Tipulidae					
Hexatoma	1	0	1	0	0
EPHEMEROPTERA					
Ephemerellidae	0	0	0	1	0
NEMATODA	4	4	2	22	5
TOTAL NUMBER OF AQUATIC INVERTEBRATES	14	21	34	49	48
WET WEIGHT (mg)	8.8	2.5	6.6	3.6	4.3

SITE 5: KNIGHT BRIDGE

DATE: 13 APRIL 1992
SAMPLER: EKMAN DREDGE (225 cm^2)
FINEST MESH SIZE: 0.212 mm
COLLECTION BY: M. BRAEUER AND K. DEJAEGER
SORTING BY: M. BRAEUER, M. DUNNINGAN, AND S. MORRISON
COUNTS AND IDENTIFICATIONS BY: M. DUNNIGAN

	REPLICATE				
	1	2	3	4	5
ANNELIDA					
OLIGOCHAETA					
HAPLOTAXIDA					
Enchytraeidae	0	3	2	2	2
Naididae	0	1	0	0	0
Tubificidae	0	0	0	0	2
ARTHROPODA					
CRUSTACEA					
COPEPODA					
Cyclopoida	0	1	1	0	0
Harpacticoida	0	0	1	0	0
INSECTA					
DIPTERA					
Ceratopogonidae	0	0	0	0	1
Chironomidae	1	4	0	1	2
Chironomidae Pupae	0	0	0	1	1
Chironomini	3	7	3	7	19
Diamesinae	1	0	14	5	5
Orthocladiinae	5	23	47	35	67
Tanytarsini	0	1	1	2	0
Empididae					
Chelifera	0	0	0	0	2
Clinocera	0	0	1	0	0
Tipulidae					
Hexatoma	0	0	0	0	1
EPHEMEROPTERA	0	0	0	0	1
Ephemerellidae	0	3	0	0	0
NEMATODA	4	9	16	3	3
TERRESTRIAL					
PLECOPTERA					
Nemouridae Adult	1	0	1	1	0
SOIL MITES	0	0	0	0	1
TOTAL NUMBER OF AQUATIC INVERTEBRATES	14	52	86	56	105
WET WEIGHT (mg)	5.3	4.4	11.3	11.4	32.4

SITE 6: WINDFALL BRIDGE

DATE: 14 APRIL 1992
SAMPLER: EKMAN DREDGE (225 cm^2)
FINEST MESH SIZE: 0.212 mm
COLLECTION BY: M. BRAEUER, AND K. DEJAEGER
SORTING BY: M. BRAEUER, M. DUNNIGAN, AND S. MORRISON
COUNTS AND IDENTIFICATIONS BY: M. DUNNIGAN

	REPLICATE				
	1	2	3	4	5
ANNELIDA					
OLIGOCHAETA					
HAPLOTAXIDA					
Enchytraeidae	16	17	66	24	17
Naididae	1	1	2	1	0
Tubificidae	10	7	20	15	10
ARTHROPODA					
ARACHNOIDA					
ACARI	0	1	0	0	0
CRUSTACEA					
COPEPODA					
Cyclopoida	1	0	12	2	0
INSECTA					
DIPTERA					
Chironomidae	6	4	6	3	4
Chironomini	59	22	24	49	69
Diamesinae	6	7	4	10	11
Diamesinae (Parasitized)	0	0	0	0	1
Orthocladiinae	16	11	64	13	22
Tanytarsini	0	3	0	1	1
Empididae					
Hemerodromia	0	0	1	0	3
EPHEMEROPTERA					
Ephemerellidae	0	0	3	0	2
Heptageniidae	0	0	1	0	0
Rhithrogena	0	0	0	0	1
HEMIPTERA					
Corixidae					
Callicorixa	0	0	1	1	0
GASTROPODA					
PULMONATA					
Lymnaeidae	0	0	0	0	1
NEMATODA	26	10	88	7	14
TERRESTRIAL					
PLECOPTERA					
Nemouridae Adult	7	4	2	0	0
TOTAL NUMBER OF AQUATIC INVERTEBRATES	141	84	293	127	156
WET WEIGHT (mg)	59.4	37.9	38.1	17.8	14.0

Table 3.2 Summary of quality assurance and control analysis on sorting efficiency and accuracy of Ekman samples from the Athabasca River.

SITE 1: UPSTREAM OF HINTON, NEAR ENTRANCE (Replicate No. 4)

ARTHROPODA	
INSECTA	
DIPTERA	
Chironomidae	
Diamesinae	1
EPHEMEROPTERA	
Ephemerellidae	1
QC Total	2
Total Enumerated	84
% Error*	2.3

SITE 4: NEAR EMERSON LAKES (Replicate No. 1)

QC Total	0
Total Enumerated	14
% Error*	0.0

SITE 4: NEAR EMERSON LAKES (Replicate No. 4)

QC Total	0
Total Enumerated	49
% Error*	0.0

*Error = QC Total/(Total Enumerated + QC Total) x 100

3.1.3 Chironomid Parasitism

During identification and enumeration procedures, it was noted that some of the chironomid larvae were parasitized by nematodes. The number of parasitized specimens, relative to the total number of chironomids present in a sample, is recorded in Table 3.1. The majority of parasitized specimens were located at Site 2, Weldwood Bridge.

SECTION 4
SUMMARY AND CONCLUSION

This report presents the results of analyses performed on quantitative benthic macroinvertebrate samples from the upper Athabasca River. Data were collected as part of a pilot study investigating trace contaminant migration, bioaccumulation, and biomagnification through trophic levels in the upper Athabasca River. To further assess time budgets and expenditures on future studies of this kind, estimated time used to perform various tasks is summarized in Table 4.1.

Table 4.1 Estimated time expended to complete various tasks presented in this report. MD=man-day (8 hours).

TASK	TIME EXPENDED
Sorting 30 Ekman Samples	95 MD
Identification/Enumeration and deformity processing of 30 Ekman samples	6 MD
Wet Weight Measurements	1 MD
Report Writing and Preparation	2 MD

Greater than 90% of all effort expended in this project was allocated to sorting. The samples were extremely difficult to process, even after elutriation, because of large amounts of organic and inorganic materials.

In future projects of this kind, it is important that the difficulty, and costs, of benthic invertebrate sample processing be realized prior to project initiation.

SECTION 5
LITERATURE CITED

Alberta Environment. 1990. Selected methods for the monitoring of benthic invertebrates in Alberta rivers. Environmental Quality Monitoring Branch. Environmental Assessment Division. 41 p.

R.L. & L. Environmental Services Ltd. 1993. Aquatic macroinvertebrate identifications on samples from the upper Athabasca River. Prep. for Northern River Basins Study. R.L. & L. Report No. 339F: 49 p + 2 app.

APPENDIX A
TERMS OF REFERENCE

NORTHERN RIVER BASINS STUDY

AQUATIC INVERTEBRATE SAMPLE PROCESSING

Terms of Reference

GENERAL OBJECTIVE

The objective of this project is to process thirty (30) quantitative aquatic invertebrate samples which have been collected under Project #2371 with Ekman Dredges from depositional areas of the Upper Athabasca River (Hinton - Whitecourt area) in April 1992. Specific Information requirements are detailed below.

REQUIREMENTS

1. The methods used in the enumeration and identification of aquatic invertebrates should follow procedures outlined in Alberta Environment (1990). Identifications must be to genus or species level whenever possible; Chironomidae may be identified to sub-family level.

2. Conduct a preliminary evaluation of the incidence of deformities or abnormal growths in non-chironomid specimens. Store abnormal specimens separately for further examination.

3. Conduct a preliminary evaluation of the incidence of parasitism by nematodes in the chironomid larvae population.

4. Determine total wet weights of invertebrates in each replicate sample.

5. Retain all specimens for archiving and return samples to the project manager.

DELIVERABLES

A draft report is required by February 3, 1993. Data should be provided as hard copy and in electronic form in a format to be specified by the project manager.

Five copies of the final report as well as one electronic copy will be required.