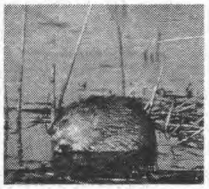
Canada Alberta Northwest Territories

Northern River Basins Study





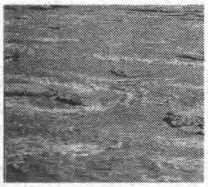



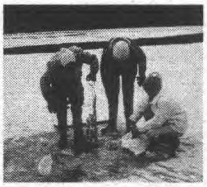


NORTHERN RIVER BASINS STUDY PROJECT REPORT NO. 27

AN ANNOTATED BIBLIOGRAPHY OF NUTRIENT LOADING

ON THE PEACE, ATHABASCA AND SLAVE RIVERS






Prepared for the
Northern River Basins Study
under Project 2601-B1

by

Sentar Consultants Ltd.

NORTHERN RIVER BASINS STUDY PROJECT REPORT NO. 27

AN ANNOTATED BIBLIOGRAPHY OF NUTRIENT LOADING ON THE PEACE, ATHABASCA AND SLAVE RIVERS

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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.

This report contains referenced data obtained from sources external to the Northern River Basins Study. Individuals interested in using external data must obtain permission to do so from the donor agency.

NORTHERN RIVER BASINS STUDY
PROJECT REPORT RELEASE FORM

This publication may be cited as:

Sentar Consultants Ltd. 1994. *"Northern River Basins Study Project Report No. 27, An Annotated Bibliography of Nutrient Loading on the Peace, Athabasca and Slave Rivers".* Northern River Basins Study, Edmonton, Alberta.

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 — 28 Jan 94
(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 — 17 Feb/94
(Dr. P. A. Larkin, Ph.D., Chair) (Date)

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, Co-chair) April 7/94 (Date)

Lucille Partington — April 7/94
(Lucille Partington, Co-chair) (Date)

AN ANNOTATED BIBLIOGRAPHY OF NUTRIENT LOADING ON THE PEACE, ATHABASCA AND SLAVE RIVERS

STUDY PERSPECTIVE

> ***Related Study Questions***
>
> 2) *What is the current state of water quality in the Peace, Athabasca and Slave river basins, including the Peace-Athabasca Delta?*
>
> 5) *Are the substances added to the rivers by natural and man-made discharges likely to cause deterioration of the water quality?*

A particular area of concern related to municipal and industrial effluent discharges in the northern river basins is the effect of nutrients (nitrogen and phosphorus) on the aquatic environment. Nutrients enter a river from municipal and industrial effluents, agricultural and timber-harvesting runoff, natural runoff, groundwater sources and tributary inflow. Added nutrients can cause changes in the abundance and production of benthic biota and on the production, reproduction and survivorship of fish. Nutrients may also decrease dissolved oxygen concentrations as a result of enhanced plant growth, which is, in turn, decomposed by bacteria that consume oxygen. The changes to the biological communities resulting from the addition of nutrients and their subsequent effect on the chemical and physical components of the ecosystem is referred to scientifically as eutrophication. Understanding the impacts of nutrients on the aquatic environment is therefore critical for regulating industrial and municipal effluent discharges to the Peace, Athabasca and Slave rivers in order to prevent eutrophication, protect aquatic habitats and preserve ecosystem health.

This report is an annotated bibliography of existing information and data related to impact of nutrient loading on river water and sediment nutrient concentrations, and on benthic invertebrate and periphyton communities. Such information is critical for assessing the effects on nutrient loading from industrial, municipal, agricultural and other sources on river biota. It will also be important for the development of reliable nutrient fate/response models. These models in the northern river basins will be used to predict the relationship between nutrients and algal and invertebrate production, and nutrient transport and fate in the aquatic environment, so that the consequences of changes in nutrient loading to the rivers can be assessed.

EXECUTIVE SUMMARY

This bibliography contains references to government and industry reports, journal articles, databases and other sources of information on instream nutrient (nitrogen and phosphorus) concentrations and loading, nutrient sources, and the effects of nutrient loading on the benthic communities and sediment oxygen demand within the three northern rivers of the study: the Athabasca, Peace and Slave rivers. A few references from outside the study area have been included because of the relevance of their findings. Each reference consists of the author, date, title, journal/book, publisher, annotation and key words. This bibliography contains 134 references in total.

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 OBJECTIVES AND SCOPE

SENTAR Consultants Ltd. (SENTAR) was authorized by the Northern River Basins Study (NRBS) to compile and review water quality and related data pertaining to nutrients. The project consists of three parts: data collection, a synthesis report, and an annotated bibliography.

The objective of the annotated bibliography is to identify and annotate the available databases, government and industry reports, journal papers, and other sources of information on instream nutrient concentrations and loading, nutrient sources, sediment oxygen demand, and the effects of nutrient loading on the benthic communities within the three northern rivers of the study. The benthic communities included in the study are the benthic biofilm (including algae, fungi and bacteria) and benthic macroinvertebrates. The nutrients considered in this report are nitrogen and phosphorus.

The study area includes the Peace River, the Athabasca River and the Slave River within Alberta and the Northwest Territories (Fig.1.1). The study includes major tributaries to the three rivers; for example, the evaluation of the Peace River will include the Wapiti River-Smoky River system. The Lesser Slave River is a major tributary to the Athabasca River.

The annotated bibliography pertaining to nutrients is similar to annotated bibliographies being prepared for the NRBS on other topics including ecotoxicity of pulp mill effluents and contaminants in the aquatic ecosystems. For this reason, the bibliography was completed on dBASE IV. By using this database, topics can be searched electronically by key words. To assist users, SENTAR Consultants Ltd. has supplied the nutrient bibliography in both printed version and computer disc. The other bibliographies are being prepared in the same format on dBASE IV to allow users to search a comprehensive composite bibliography on many aspects of the water quality of the three northern river basins.

SENTAR

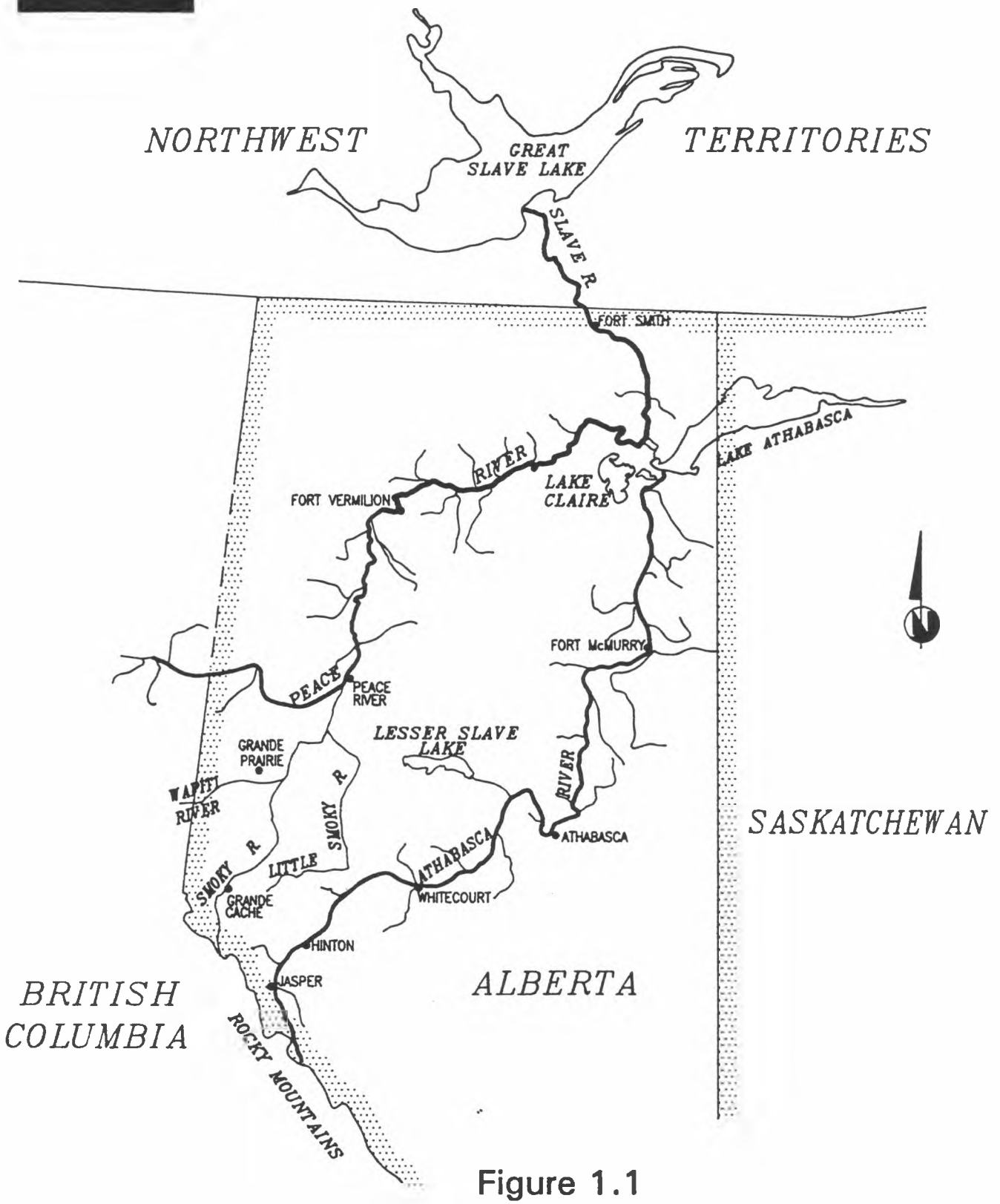

Figure 1.1

NORTHERN RIVER BASINS
STUDY AREA

All references that have been obtained during the search have been annotated. In some cases, these reports list secondary sources which have also been included in the bibliography. The annotation will reference the first author who cited the document.

1.2 ACKNOWLEDGEMENTS

This report was produced in consultation with the Nutrients Group of the NRBS. SENTAR would like to thank Dr. Patricia Chambers, head of the Nutrients Group, who made the documents in her library available to us. The assistance of Greg Wagner of the NRBS and the cooperation of Alberta Environment, Environment Canada and the pulp mills (coordinated by Brian Steinback) are all greatly appreciated.

2.0 USER'S INFORMATION

2.1 ORGANIZATION

The annotated bibliography is arranged alphabetically by author, then by date of publication. As much information as possible was included in each bibliography to provide users with several options when searching for a report or group of related reports.

The annotated bibliography is organized as follows:

AUTHOR	The name of author(s) or organizations who prepared the report.
DATE	The year in which the report was published.
DUP_DATE	A lower-case letter indicating more than one report being published by the same author in the same year.
TITLE	The report title.
OTHER1	The name of client(s) for whom the report was prepared.
PUBLISHER	The name of publisher or the name of the journal/publication, the volume number and the pages.
OTHER2	Additional information such as project number, detailed date, report length and appendices.
ANNOTATION	A note explaining the contents of the report. For a secondary reference, it cites the sources of the reference.
KEY	Twelve key word fields identifying the topics covered.

This annotated bibliography is comprised of only the nutrient and benthic reports for the NRBS area; it is, therefore, a subset of a larger bibliography. For this reason the duplicate dates (e.g. Smith 1991a, 1991c) listed for the same author and year may not be consecutive if a report with the same author and year (e.g. Smith 1991b) pertains to another topic such as contaminants.

One objective of the annotation was to quantify the amount and type of "hard" data available so that the reader could assess whether the document was an overview, a synthesis of existing data, or a source of new data. The annotation specifies the number of locations sampled, the sampling frequency, the forms of the nutrient measured, the benthic sampling method used, etc. This information should also allow the reader to assess whether studies can be compared. For example, the results of benthic invertebrate studies sampled by an artificial sampler would not be comparable to results for studies using the Neill sampler. The annotation answers the question "Will this report be useful to me?".

2.2 KEY WORD FIELDS

2.2.1 Summary of Key Word Field Names

Twelve "key word" fields have been created. Each field contains one or more words.

The key word fields were set up for three purposes:

1) to aid and simplify database searching,
2) to provide cues for accurate data entry, and
3) to ensure quality control of data entry.

Five general categories of information were identified. Key word fields were defined for each of these five information categories (Table 2.2.1). Then the relevant key words were assigned to each of these fields.

Table 2.2.1
Information Categories and Key Word Field Names

INFORMATION TYPE	FIELD NAME
1. Location	
(a) Waterbody/Basin	KEY_WATER
(b) Geographic Descriptors	KEY_GEOG
2. Nutrients/Parameters	
(a) Nitrogen	KEY_NTROGN
(b) Phosphorus	KEY_PHSFRS
(c) Other Parameters	KEY_PARAM
3. Biota	
(a) Animals	KEY_ANIMAL
(b) Plants	KEY_PLANT
(c) Microbes	KEY_MCROBE
4. Sampling Media	KEY_MEDIA
5. Miscellaneous	KEY_MISC1 KEY_MISC2 KEY_MISC3

2.3 EXPLANATION OF KEY WORD FIELDS

2.3.1 Waterbody/Basin

Key Word Field: KEY_WATER

Key Words:

ATHABASCA	MACKAY	RED DEER
BEAVER	MACKENZIE	RICHARDSON
BOW	MCLEOD	SLAVE
CLEARWATER	MILK	SMOKY
GREGG	MUSKEG	SOUTH SASKATCHEWAN
HARTLEY	NORTH SASKATCHEWAN	STEEPBANK
HIGHWOOD	OLDMAN	STURGEON
HINTON	PEACE	THOMPSON
LESSER SLAVE	PEACE-ATHABASCA	TRI-CREEKS
LOVETT	PEMBINA	WAPITI

Words entered into this field define the water body(s) referred to in a document. Zero to many waterbodies may be listed. All of the main rivers in the NRBS area and their tributaries are eligible for this field. In cases where waterbodies outside of the NRBS area are discussed, they are also listed. The key words do not indicate waterbody type. That is, they do not designate if the waterbody is a river, lake, reservoir, etc. These designations are found in the miscellaneous key word field(s).

Some of the key words in this field appear to be redundant. For example, both "Athabasca" and "Peace-Athabasca" are used. This is done to accommodate searching strategies. For example, "Athabasca" is listed to capture documents on the Athabasca River, or on the Athabasca Basin. "Peace-Athabasca" is listed to capture documents pertaining to the Peace-Athabasca Delta.

2.3.2 GEOGRAPHIC DESCRIPTORS

Key Word Field: KEY_GEOG

Key Words:

ALASKA	CANADA	ONTARIO
ALBERTA	FORT CHIPEWYAN	OREGON
ALBERTA-PACIFIC	FORT MCMURRAY	PEACE RIVER
ATHABASCA	GRANDE PRAIRIE	SLAVE LAKE
BENNETT DAM	HINTON	WHITECOURT
BRITISH COLUMBIA	NORTHWEST TERRITORIES	

In some cases it is useful to describe the location of the study in geographic terms other than the name of a waterbody/basin. This field defines political boundaries and/or specific locations.

2.3.3 NITROGEN

Key Word Field: KEY_NTROGN

Key Word: NITROGEN

This field indicates that the document provides information on nitrogen in one or more of its different forms. Nitrogen is the only word found in this field. Explanation of the nitrogen forms or methods can be found in the "Annotation" field. In the event that nutrients are not specifically named in a document and are just referred to generally, the key word 'nutrient' is placed in the miscellaneous field.

2.3.4 PHOSPHORUS

Key Word Field: KEY_PHSFRS

Key Word: PHOSPHORUS

This field indicates that the document provides information on phosphorus in one or more of its different forms. Phosphorus is the only word found in this field. Explanation of the phosphorus forms or methods can be found in the "Annotation" field. In the event that nutrients are not specifically named in a document and are just referred to generally, the key word 'nutrient' is placed in the miscellaneous field.

2.3.5 OTHER PARAMETERS

Key Word Field: KEY_PARAM

Key Words:

METAL	ORGANICS	OXYGEN DEMAND
NON-METAL INORGANICS	OXYGEN	PHYSICAL PARAMETERS
		TOXIC

This field describes (in general terms) measurable parameters other than nitrogen and phosphorus. Efforts have been made to keep the key word lists for all fields as brief as possible. The terms listed below were chosen to categorize different types of parameters.

KEY WORD	WATER QUALITY PARAMETERS
Physical Parameters:	- temperature - alkalinity - hardness - pH - conductivity - odour - colour - total suspended solids (filterable residue) - total dissolved solids (non-filterable residue)
Oxygen:	- dissolved oxygen
Oxygen Demand:	- biochemical oxygen demand (BOD) - chemical oxygen demand (COD) - sediment oxygen demand (SOD)
Metals:	
Non-Metal Inorganics:	- major ions - halides - arsenic, etc.
Organics:	
Toxic:	

2.3.6 ANIMALS

Key Word Field: KEY_ANIMAL

Key Words: FAUNA VERTEBRATE
INVERTEBRATE

This field indicates whether a document contains information about specific animals. Because these terms are so broad, further clarification of the animal may be found in the miscellaneous key word field. For example, if a document refers to a study on the effects of pulp mill effluent on fish, the key word for this field will be vertebrates. And, in the KEY_MISC field, "fish" will be listed. (Note: the ANNOTATION field may also contain the term "fish").

The term "fauna" is a generic term for those documents that are not specific about the animal(s) that are being discussed.

2.3.7 PLANTS

Key Word Field: KEY_PLANT

Key Words:

ALGAE	MACROPHYTE
CHLOROPHYLL	TREES
FLORA	

This field indicates whether a document contains information about plants. The same principles apply for this field, as for the KEY_ANIMAL field.

2.3.8 MICROBES

Key Word Field: KEY_MCROBE

Key Words:

BACTERIA	MICROBE
FUNGI	VIRUSES

This field indicates whether a document contains information about microscopic biota: bacteria (total coliform, fecal coliform, fecal streptococci), fungi or viruses.

2.3.9 SAMPLING MEDIA

Key Word Field: KEY_MEDIA

Key Words:

AIR	SEDIMENT
BIOTA	WATER
EFFLUENT	

The medium that is under study is defined.

2.3.10 MISCELLANEOUS

Key Word Fields: KEY_MISC1, KEY_MISC2, KEY_MISC3

Key Words:

ALBERTA-PACIFIC
ANNUAL REPORT
ANC
BASELINE
BASIN
BENTHOS
BIBLIOGRAPHY
BIOACCUMULATION
CLIMATE
CONTAMINANT
CORRESPONDENCE
DAISHOWA
DATABASE
DELTA
DRAFT
ECOLOGY
ECOSYSTEM
EFFLUENT
EIA
FATE
FISH
FOOD CHAIN
FOREST HARVESTING
GENERAL REFERENCES
GEOLOGY
GLOBAL WARMING
HINTON
HUMAN
HUMAN HEALTH
HYDROLOGY
IMPACT
INDEX
INDUSTRY
INVENTORY
INVESTIGATION
LAKE
LICENCE
MILLAR WESTERN
MINING
MODEL
MONITORING
NAQUADAT
NUTRIENT
OIL
ORGANOCHLORINE
PATHWAY
PROCTER & GAMBLE
PULP MILL
REPRODUCTION
RESOURCES
RIVER
SALMONID
SAMPLING
SEWAGE TREATMENT
SLAVE LAKE
SPILL
STUDIES
SUNCOR
SURVEY
SYNCRUDE
WATER QUALITY
WATER RESOURCES
WATER USE
WELDWOOD

As the field name suggests, these key words are miscellaneous terms that help to describe a document and/or to refine the definition of a key word from another field. For example, "baseline" listed in KEY_MISC1 would help to locate all documents that involved collection of baseline data. Or, to give another example, if a document describes a study about the levels of organochlorines in a river, and the key word "organics" is listed in KEY_PARAM1, than to narrow the description of the document further, "organochlorine" would be listed in KEY_MISC1.

These fields are provided to accommodate many key words. The more data in the database, the longer it takes to search. The intent when creating these miscellaneous fields was to provide

information useful for searching, but the fields would probably be used for small data sets created from previous searches.

2.4 dBASE FILE INFORMATION

The annotated bibliography was designed using dBASE IV. The database file name is BIBLNUTR.dbf and is accompanied with a file named BIBLNUTR.dbt. The .dbt extension refers to data contained in the memo field. The .dbt file must accompany the .dbf file.

Indexes created during the use of the database will have a .mdx extension. When backing up files or transferring to other disks, it is important that all .dbf, .dbt and .mdx files are copied. When performing a search, make sure the words selected are in uppercase. It is advisable to use a wild card extension when searching key words that may or may not be pluralized (Example: INVERTEBRATE*, METAL*). Often, a field may have several key words. When searching for one key word in a list of several, place the key word in quotation marks preceded by a "$" sign (e.g. $"WORD"). This tells dBASE that the character string being searched is imbedded. Multiple key words and multiple fields can be searched at the same time. The above rules apply (e.g. uppercase, $ and quotation marks for imbedded strings, and separate lines for each key word). The following example illustrates this:

KEY_XX	KEY_YY	KEY_ZZ
$"WORD1"		
$"WORD2"		
	$"WORD3"	
	$"WORD4"	
		"WORD5"

The WORD5 example shown above illustrates a case where only one key word would be found in that field, as opposed to a list of key words.

Several key words can be searched in one field. Put each word on a separate row (one beneath the other) in the Query definition screen. By doing this, dBASE will search for records containing any or all of the key words.

3.0 ANNOTATED BIBLIOGRAPHY

The annotated bibliography which follows consists of 127 references from government and industry reports, scientific papers and other print sources (Appendix A), and seven references identifying electronic databases (Appendix B).

APPENDIX A

ANNOTATED BIBLIOGRAPHY FROM PRINTED (HARD COPY) SOURCES

AUTHOR	Alberta Environment.
DATE	**1993**
DUP_DATE	**a.**
TITLE	**Nutrient Data, Northern Rivers Study Area.**
OTHER1	
PUBLISHER	**Environmental Assessment Division, Environmental Protection Services, Alberta Environment.**
OTHER2	
ANNOTATION	*This is a collection of data provided by Alberta Environment on 1) nutrient data file descriptions, 2) Athabasca River sample sites, 3) a list of Peace/Athabasca/Slave government water quality background reports, 4) LTRN and MTRN sites in Northern Alberta, and 5) Alberta Environment water quality data, nitrogen and phosphorus. Forms of nutrients include particulate nitrogen, dissolved nitrogen, particulate Kjeldahl nitrogen, nitrate nitrogen, nitrite/nitrate nitrogen, total ammonia nitrogen, total phosphorus, dissolved inorganic phosphorus, and total inorganic phosphorus.*
KEY_WATER	ATHABASCA, PEACE, SLAVE
KEY_GEOG	ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	
KEY_ANIMAL	
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	WATER
KEY_MISC1	NUTRIENTS, BIBLIOGRAPHY, RIVER, WATER QUALITY, MODEL, MONITORING, DATABASE
KEY_MISC2	
KEY_MISC3	

AUTHOR	Alberta Environment.
DATE	**1990**
DUP_DATE	**d.**
TITLE	**Additional Information on Nitrogen and Phosphorus in the Athabasca River System and in Pulp Mill Effluents.**
OTHER1	**Presented to: The Alberta-Pacific Environmental Impact Assessment Review Board, January 15, 1990.**
PUBLISHER	**Environmental Assessment Division, Alberta Environment.**
OTHER2	**In: Aspects of Nitrogen and Phosphorus in the Athabasca River System, by L.R. Noton, Environmental Quality Monitoring Branch, Environmental Assessment Division, Environmental Protection Services, Alberta Environment, January 1990.**

ANNOTATION

This document provides information on nitrogen and phosphorus in the Athabasca River System in response to the question "Is the nitrogen to phosphorus ratio in the river such that this increase in phosphorus relative to nitrogen in loading is likely to cause a species shift in the direction of blue-green [algae]?" by Dr. Schindler at the Alberta-Pacific Environment Impact Assessment Review Board on December 7, 1989.

All sampling was done by Alberta Environment or Environment Canada at stations on the Athabasca River for the time period between 1977-1988. Analytical methods and sampling programs varied over the years. Data were also compiled for the final effluents of existing Alberta pulp mills: Weldwood at Hinton, Millar Western at Whitecourt, and Procter & Gamble at Grande Prairie on the Wapiti River (for comparison) . The information contained includes: nitrite-nitrate concentrations (mg/L), ammonia-nitrogen concentrations (mg/L), dissolved inorganic nitrogen (mg/L), total nitrogen (mg/L), estimated mass transport of nitrogen (kg/day), and nitrogen:phosphorous ratios. The focus is on the bio-available forms and ratios of these nutrients.

KEY_WATER	ATHABASCA, WAPITI
KEY_GEOG	ALBERTA, HINTON, WHITECOURT, GRANDE PRAIRIE
KEY_NTROGN	
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	
KEY_ANIMAL	
KEY_PLANT	ALGAE, MACROPHYTES
KEY_MCROBE	
KEY_MEDIA	EFFLUENT, WATER
KEY_MISC1	PULP MILL, EFFLUENT, ALBERTA-PACIFIC, RIVER, NUTRIENTS, PROCTER & GAMBLE, WELDWOOD, MILLAR WESTERN
KEY_MISC2	
KEY_MISC3	

AUTHOR	Alberta Environment.
DATE	**1990**
DUP_DATE	**e.**
TITLE	**Selected Methods for the Monitoring of Benthic Invertebrates in Alberta Rivers.**
OTHER1	
PUBLISHER	**Environmental Quality Monitoring Branch.**
OTHER2	
ANNOTATION	*This document describes methods for sampling design, field collection and statistical analysis that are recommended for monitoring benthic invertebrate communities.*
KEY_WATER	
KEY_GEOG	ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	WATER, BIOTA
KEY_MISC1	BENTHOS, MONITORING
KEY_MISC2	
KEY_MISC3	

AUTHOR	Alberta Environment.
DATE	**1989**
DUP_DATE	**a.**
TITLE	**Phosphorus in the Athabasca River System.**
OTHER1	**Presented to: The Alberta-Pacific Environment Impact Assessment Review Board, Public Hearing Proceedings held at Grassland, Alberta, December 7, 1989.**
PUBLISHER	**Environmental Protection Services, Alberta Environment.**
OTHER2	**In: Aspects of Nitrogen and Phosphorus in the Athabasca River System, by L.R. Noton, Environmental Quality Monitoring Branch, Environmental Assessment Division, Environmental Protection Services, Alberta Environment, January 1990.**

ANNOTATION *This document presents information on "phosphorus in the Athabasca River System with respect to its concentrations, the possible mechanisms by which it cycles and functions in the system, and to describe some of the pertinent features of the river system in regards to phosphorus and phosphorus dynamics there" (cited from document). This presentation is based on Alberta Environment data from three locations on the Athabasca River system for the time period between 1974 and 1988.*

Effluent sources examined include pulp mills and sewage treatment plants. The information contained includes: phosphorus loadings (kg/day), suspended solids concentrations (mg/L), and both dissolved and total phosphorus concentrations (mg/L). Also outlined are the possible effects on sediment oxygen demand, aquatic plants, and benthic algae. Analytical methods are not specifically defined.

KEY_WATER	ATHABASCA
KEY_GEOG	ALBERTA
KEY_NTROGN	
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	OXYGEN DEMAND, ORGANICS
KEY_ANIMAL	
KEY_PLANT	ALGAE, CHLOROPHYLL, MACROPHYTE
KEY_MCROBE	
KEY_MEDIA	SEDIMENT, WATER
KEY_MISC1	PULP MILL, SEWAGE, EFFLUENT, RIVER, ALBERTA-PACIFIC
KEY_MISC2	
KEY_MISC3	

AUTHOR	Alberta Environment.
DATE	**1985.**
DUP_DATE	
TITLE	**Slave River Basin Overview.**
OTHER1	
PUBLISHER	**Environmental Assessment Section, Planning Services Branch, Planning Division, Alberta Environment.**
OTHER2	
ANNOTATION	*"This report provides an inventory of existing information pertaining to geology, soils, vegetation, climate, fish, wildlife, and land use of the basin as well the water quality and hydrology of the Slave River; critical areas for fish and wildlife and unique features of the Salt River Sub-basin" (cited from McGregor and Cary, 1991).*
KEY_WATER	SLAVE
KEY_GEOG	ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	
KEY_ANIMAL	FAUNA
KEY_PLANT	FLORA
KEY_MCROBE	
KEY_MEDIA	
KEY_MISC1	RIVER, WATER QUALITY, HYDROLOGY
KEY_MISC2	
KEY_MISC3	

AUTHOR	Alberta Environmental Centre.
DATE	**1987.**
DUP_DATE	
TITLE	**Toxicity and Environmental Chemistry of Wastewater from a Kraft Pulp and Paper Mill: Fish Toxicity Studies.**
OTHER1	**Report AECV87-R4.**
PUBLISHER	**Alberta Environmental Centre.**
OTHER2	**67 pp.**
ANNOTATION	*"The purpose of this investigation was to determine if effluent discharged from the Procter & Gamble Cellulose Ltd. (Grande Prairie) kraft process pulp and paper mill was deleterious to fish in the Wapiti River. The presence and concentrations of organic and inorganic chemicals in effluent, river water and selected fish tissues were determined. In addition, selected tissues from fish resident in the river adjacent to the mill were examined for evidence of pathological changes....The results reported herein represent a more in-depth assessment of water and effluent chemistry than is normally carried out for monitoring purposes" (cited from document abstract).*
KEY_WATER	WAPITI
KEY_GEOG	GRANDE PRAIRIE, ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	TOXIC, ORGANICS, METALS, PHYSICAL PARAMETERS, OXYGEN DEMAND, NON-METAL ORGANICS
KEY_ANIMAL	VERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	WATER, BIOTA, EFFLUENT
KEY_MISC1	PULP MILL, EFFLUENT, FISH, FATE, CONTAMINANT, NUTRIENT, SAMPLING, STUDIES
KEY_MISC2	
KEY_MISC3	

AUTHOR	Alberta-Pacific Environmental Impact Assessment Review Board.
DATE	**1990**
DUP_DATE	**b.**
TITLE	**The Proposed Alberta-Pacific Pulp Mill: Report of the EIA Review Board. March 1990.**
OTHER1	**Submitted to the Alberta Minister of the Environment.**
PUBLISHER	**Alberta Environment, Edmonton, Alberta.**
OTHER2	**93 pp.**

ANNOTATION *This report outlines the environmental issues, concerns and recommendations of the Review Board, for the construction and operation of the bleached kraft pulp mill, proposed by Alberta-Pacific Forest Industries Inc. for the County of Athabasca #12. The Review Board recommends that it not be approved (at this time) and that further scientific studies on the river systems be conducted.*

Eutrophication by kraft mill effluents is discussed briefly. Alberta-Pacific would be required to utilized current technology to remove phosphorus from the effluent by tertiary treatment.

KEY_WATER	ATHABASCA
KEY_GEOG	ALBERTA
KEY_NTROGN	
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	METALS, OXYGEN, OXYGEN DEMAND, PHYSICAL PARAMETERS, TOXIC, ORGANICS, TOXIC,
KEY_ANIMAL	VERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	WATER
KEY_MISC1	FISH, RIVER, BIOACCUMULATION, PULP MILL, EIA, ALBERTA-PACIFIC, EFFLUENT, NUTRIENT, ORGANOCHLORINE
KEY_MISC2	WATER QUALITY
KEY_MISC3	

AUTHOR	Allan, R.J. and T.A. Jackson.
DATE	**1978.**
DUP_DATE	
TITLE	**Heavy Metals in Bottom Sediments of the Mainstem Athabasca River System in the AOSERP Study Area.**
OTHER1	**Prepared for the Alberta Oil Sands Environmental Research Program.**
PUBLISHER	**Fisheries and Environment Canada, Freshwater Institute.**
OTHER2	**AOSERP Report 34. 72 pp.**
ANNOTATION	*"Dredged sediments and sediment cores were collected from sites along the Athabasca River system from between Fort McMurray and the confluence of Riviere des Rochers with the Slave River. A selected sample suite representing all of the drainage units and textural variations was analysed by several total and partial element extraction techniques" (as cited in document).*
KEY_WATER	ATHABASCA, SLAVE
KEY_GEOG	ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	
KEY_PARAM	METALS, TOXIC, ORGANICS, NON-METAL INORGANICS
KEY_ANIMAL	
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	SEDIMENT, WATER
KEY_MISC1	RIVER, OIL, SAMPLING, STUDIES, GEOLOGY, HYDROLOGY, CONTAMINANT
KEY_MISC2	
KEY_MISC3	

AUTHOR	Anderson, A.M.
DATE	**1991.**
DUP_DATE	
TITLE	**An Overview of Long-Term Zoobenthic Monitoring in Alberta Rivers (1983-1987).**
OTHER1	
PUBLISHER	**Environmental Quality Monitoring Branch, Environmental Assessment Division, Alberta Environment.**
OTHER2	**October, 1991. 115 pp.**
ANNOTATION	*Benthic invertebrates were sampled in the spring and fall from 1983 to 1987 at 20 long-term sites on the major rivers of Alberta, including the Athabasca River. Two sites were located on the Athabasca River near Hinton, one site at Fort McMurray and one at Embarras. Five replicate samples were collected from riffle areas with a Neill cylinder.*
KEY_WATER	ATHABASCA
KEY_GEOG	ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	WATER, BIOTA
KEY_MISC1	RIVER, WATER QUALITY, BENTHOS, MONITORING
KEY_MISC2	
KEY_MISC3	

AUTHOR	Anderson, A.M.
DATE	**1989.**
DUP_DATE	
TITLE	**An Assessment of the Effects of the Combined Pulp Mill and Municipal Effluents at Hinton on the Water Quality and Zoobenthos of the Athabasca River.**
OTHER1	
PUBLISHER	**Environmental Quality Monitoring Branch, Environmental Assessment Division, Alberta Environment.**
OTHER2	**December 1989. 205 pp.**

ANNOTATION

"This document combines the results of two survey programs carried out between 1984 and 1986 on the upper Athabsca River. It evaluates the effects of the combined pulp mill and municipal effluent discharges at Hinton on the zoobenthic community during spring 1984 and fall 1985, and on physical/chemical water quality during low flow conditions in fall 1985 and winter 1986" (cited from document).

Nutrient forms measured (mg/l) include total phosphorus, total dissolved phosphorus, soluble reactive phosphorus, total Kjeldahl nitrogen, ammonium nitrogen, nitrate/nitrite nitrogen, nitrite nitrogen and particulate nitrogen.

Other water quality parameters measured include physical characteristics, non-metal inorganics, oxygen, oxygen demands, organics, bacteria and chlorophyll. Mass loadings are reported for various constituents in effluent (kg/d and R.U./d). NAQUADAT analytical method codes are provided.

KEY_WATER	ATHABASCA
KEY_GEOG	ALBERTA, HINTON
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	NON-METAL INORGANICS, ORGANICS, OXYGEN, OXYGEN DEMAND, PHYSICAL PARAMETERS, TOXIC
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	CHLOROPHYLL
KEY_MCROBE	BACTERIA
KEY_MEDIA	WATER, EFFLUENT, BIOTA
KEY_MISC1	WELDWOOD, PULP MILL, EFFLUENT, NAQUADAT, NUTRIENT, RIVER, SEWAGE, WATER QUALITY, BENTHOS
KEY_MISC2	
KEY_MISC3	

AUTHOR	Anonymous.
DATE	**1992**
DUP_DATE	**a.**
TITLE	**Northern River Basins Study Status Report on Companion Studies.**
OTHER1	**October 20, 1992. 15 pp.**
PUBLISHER	
OTHER2	
ANNOTATION	*This report reviews some known sources of studies as well as parallel studies that are relevant to the Northern River Basins Study and that are available to coordinators of and specialist contributors to the Northern River Basins Study.*
KEY_WATER	PEACE, ATHABASCA, SLAVE, WAPITI, SMOKY, LESSER SLAVE, MACKENZIE
KEY_GEOG	BENNETT DAM, BRITISH COLUMBIA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	TOXIC, OXYGEN, ORGANICS
KEY_ANIMAL	VERTEBRATE, INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	SEDIMENT, WATER
KEY_MISC1	BIBLIOGRAPHY, PULP MILL, BASIN, GLOBAL WARMING, MONITORING, CONTAMINANT, ORGANOCHLORINE
KEY_MISC2	FOOD CHAIN, REPRODUCTION, FISH
KEY_MISC3	

AUTHOR	Anonymous.
DATE	**1992**
DUP_DATE	**b.**
TITLE	**List of Aquatic Environment Studies by Alberta Pulp and Paper Mills.**
OTHER1	
PUBLISHER	
OTHER2	
ANNOTATION	*A list of environmental studies categorized by pulp mill: 1) Peace River Pulp, 2) Slave Lake Pulp, 3) Millar Western Pulp, 4) Alberta Newsprint Company, and 5) Procter & Gamble Cellulose.*
KEY_WATER	ATHABASCA, WAPITI, PEACE, SMOKY, MCLEOD, SLAVE
KEY_GEOG	ALBERTA, WHITECOURT, GRANDE PRAIRIE, HINTON, PEACE RIVER, SLAVE LAKE
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	TOXIC, ORGANICS, PLHYSICAL PARAMETERS, METAL, NON-METAL INORGANICS, OXYGEN DEMAND, OXYGEN
KEY_ANIMAL	VERTEBRATE, INVERTEBRATE
KEY_PLANT	ALGAE,
KEY_MCROBE	
KEY_MEDIA	WATER, BIOTA, SEDIMENT
KEY_MISC1	BIBLIOGRAPHY, DAISHOWA, EFFLUENT, FISH, BIOACCUMULATION, MONITORING, BENTHOS, SLAVE LAKE, ANC,
KEY_MISC2	ORGANOCHLORINE, PULP MILL, RIVER, SAMPLING, WATER QUALITY, PROCTER & GAMBLE, MILLAR WESTERN,
KEY_MISC3	

AUTHOR	Aquatic Environments Ltd.
DATE	**1981**
DUP_DATE	**b.**
TITLE	**Chemical and Biological Monitoring of Muskeg Drainage at the Alsands Site: Vol. III Program Evaluation and Suggestions for Continued Monitoring.**
OTHER1	
PUBLISHER	**Alsands Energy Ltd.**
OTHER2	

ANNOTATION *"This report describes suggestions for continued aquatic biomonitoring that apply specifically to the Muskeg drainage, but can serve as a guide for monitoring other rivers of a similar nature in the AOSERP area. There are few, if any, universally accepted monitoring methods for aquatic biota, and those suggested in the report are those that were found useful in Alsands 1980 studies.*

This report also discusses impacts, mitigation measures, monitoring parameters and methods, water quality, biological parameters, benthic invertebrates, periphytic algae, data storage and retrieval and preliminary studies" (cited from McGregor and Cary, 1991).

KEY_WATER	ATHABASCA, MUSKEG
KEY_GEOG	ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	
KEY_MEDIA	WATER
KEY_MISC1	RIVER, BASIN, MONITORING, OIL, WATER QUALITY, BENTHOS
KEY_MISC2	
KEY_MISC3	

AUTHOR	Aquatic Environments Ltd./Hardy Assoc. Ltd.
DATE	**1981.**
DUP_DATE	
TITLE	**Chemical & Biological Monitoring of Muskeg Drainage at the Alsands Site - Vol. II - Fish Studies.**
OTHER1	
PUBLISHER	**Alberta Environment and Alsands Energy Ltd.**
OTHER2	

ANNOTATION *The main objective of this report is "to study the effect of drainage in the Muskeg River Basin on biological communities. Drainage from the mine site ditch reduced the biomass of periphelegic algae but increased the circumstance of certain invertebrates and predators a short distance below the outfall. Only algae biomass on glass showed evidence of environmental impact for downstream" (cited from McGregor and Cary, 1991).*

KEY_WATER	ATHABASCA
KEY_GEOG	ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	
KEY_ANIMAL	INVERTEBRATE, VERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	
KEY_MEDIA	BIOTA
KEY_MISC1	RIVER, FISH
KEY_MISC2	
KEY_MISC3	

AUTHOR	Barton, D.R. and M.A. Lock.
DATE	**1979.**
DUP_DATE	
TITLE	**Numerical Abundance and Biomass of Bacteria, Algae, and Macrobenthos of a Large Northern River, the Athabasca.**
OTHER1	
PUBLISHER	**Internationale Revue der gesamten Hydrobiologie und Hydrographie 64(3):345-359.**
OTHER2	
ANNOTATION	*"The benthic flora and fauna of a large, turbid, northern river was sampled in autumn. Macroinvertebrate communities on bedrock resembled those of smaller streams but specialized Chironomidae larvae dominated sandy substrates. Bacterial densities on rocks were within the ranges reported from smaller streams. Benthic primary production is probably limited by high turbidity so that most of the energy available to benthic communities is probably allochthonous in origin" (cited from document abstract).*
KEY_WATER	ATHABASCA
KEY_GEOG	ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	ALGAE, CHLOROPHYLL
KEY_MCROBE	BACTERIA
KEY_MEDIA	WATER, BIOTA, SEDIMENT
KEY_MISC1	RIVER, BENTHOS, INVENTORY, GEOLOGY, SAMPLING, STUDIES
KEY_MISC2	
KEY_MISC3	

AUTHOR	Barton, D.R. and R.R. Wallace.
DATE	**1980.**
DUP_DATE	
TITLE	**Ecological Studies of the Aquatic Invertebrates of the Alberta Oil Sands Environmental Research Program Study Area of Northeastern Alberta.**
OTHER1	
PUBLISHER	**Alberta Environment and Environment Canada, Edmonton, Alberta.**
OTHER2	**AOSERP Report 88, Project AF 2.0.1.**
ANNOTATION	*Invertebrate fauna of the Athabasca River and its tributaries, the Muskeg and Steepbank rivers, are described from baseline information gathered in 1976 and 1977. Twelve sites on the Muskeg and Steepbank rivers were sampled four to five times between July 1976 and July 1977. Samples were collected by kick sampling using a coarse meshed dip net. Sampling of the Athabasca River in 1977 illustrated that development of benthic communities is strongly influenced by substrate. A study of the effects of exposure to oil sands on the composition of benthic invertebrates was also conducted.*
KEY_WATER	ATHABASCA, MUSKEG, STEEPBANK
KEY_GEOG	ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	WATER, BIOTA
KEY_MISC1	BASELINE, RIVER, BENTHOS, OIL, SURVEY, SAMPLING
KEY_MISC2	
KEY_MISC3	

AUTHOR	Barton, D.R. and R.R. Wallace.
DATE	**1979**
DUP_DATE	**a.**
TITLE	**The Effects of an Experimental Spillage of Oil Sands Tailings Sludge on Benthic Invertebrates.**
OTHER1	
PUBLISHER	**Environ. Pollut. 18:305-312.**
OTHER2	
ANNOTATION	*A minor (0.11 m3) instantaneous spillage of oil sands tailings sludge was introduced to a 30 m reach of the Muskeg River about 1 km above its confluence with the Athabasca River on 2 October 1976. Benthic samples were collected with a scoop. Loss on ignition, grain size, total organic carbon, and oil and grease analyses were done on the sludge.*
KEY_WATER	
KEY_GEOG	
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	TOXIC
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	BIOTA, WATER
KEY_MISC1	OIL, SPILL, BENTHOS, STUDIES, IMPACT
KEY_MISC2	
KEY_MISC3	

AUTHOR	Barton, D.R. and R.R. Wallace.
DATE	**1979**
DUP_DATE	**b.**
TITLE	**Effects of Eroding Oil Sand and Periodic Flooding on Benthic Macroinvertebrate Communities in a Brown-Water Stream in Northeastern Alberta, Canada.**
OTHER1	**In Canadian Journal of Zoology 57(3): 533-541.**
PUBLISHER	**National Research Council of Canada.**
OTHER2	
ANNOTATION	*A portion of the Steepbank River, a tributary of the Athabasca River which cuts through the Athabasca oil sands deposit, was studied seasonally in 1976 and 1977. Benthic invertebrates were sampled above and within the oil sands deposit. Substrate and flooding were examined.*
KEY_WATER	STEEPBANK, ATHABASCA
KEY_GEOG	FORT MCMURRAY, ATHABASCA, ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	TOXIC
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	WATER, SEDIMENT
KEY_MISC1	OIL, RIVER, BENTHOS, STUDIES, HYDROLOGY
KEY_MISC2	
KEY_MISC3	

AUTHOR	Beak Associates.
DATE	**1991**
DUP_DATE	**a.**
TITLE	**Benthic Invertebrate Monitoring Study on the Athabasca and McLeod Rivers Near Whitecourt, Alberta, 1990.**
OTHER1	**Prepared for Millar Western Pulp Ltd.**
PUBLISHER	**Beak Associates Consulting Ltd., Calgary, Alberta.**
OTHER2	**April 1991. Project No. 09-020-01-01. 63 pp. + Appendices.**
ANNOTATION	*Benthic invertebrate sampling (using a modified Neill-Hess cylinder) was conducted during May 14-17, and October 11-15, 1990 at 8 sites (5 replicates per site) on the McLeod and Athabasca Rivers in the vicinity of the ANC and Millar Western effluent and Town of Whitecourt sewage discharges.*
KEY_WATER	ATHABASCA, MCLEOD
KEY_GEOG	WHITECOURT, ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	PHYSICAL PARAMETERS, OXYGEN DEMAND, OXYGEN, ORGANICS, METAL, NON-METAL INORGANICS
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	
KEY_MEDIA	BIOTA, WATER
KEY_MISC1	RIVER, PULP MILL, BENTHOS, MONITORING, MILLAR WESTERN, SURVEY, EFFLUENT, SAMPLING, WATER QUALITY
KEY_MISC2	
KEY_MISC3	

AUTHOR	Beak Associates.
DATE	**1991**
DUP_DATE	**b.**
TITLE	**Benthic Invertebrate Monitoring Study on the Athabasca River, Whitecourt, Alberta, 1990.**
OTHER1	**Prepared for Alberta Newsprint Company Ltd., Whitecourt, Alberta.**
PUBLISHER	**Beak Associates Consulting Ltd., Calgary, Alberta.**
OTHER2	**April 1991. Project No. 09-021-01-01. 62 pp. + Appendices.**

ANNOTATION *Benthic invertebrate and water quality sampling was conducted on May 14-17 and October 11-15, 1990 to provide pre-operational and operational (start-up) data for the Athabasca River above and below the ANC CTMP mill which began operations in August 1990. Five replicate samples were collected at seven sites using a modified Neill-Hess cylinder sampler. Water quality analyses for nutrients included total phosphorus and total Kjeldahl nitrogen.*

KEY_WATER	ATHABASCA, MCLEOD
KEY_GEOG	ALBERTA, WHITECOURT
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	PHYSICAL PARAMETERS, OXYGEN DEMAND, OXYGEN, ORGANICS, METALS, NON-METAL ORGANICS
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	
KEY_MEDIA	WATER, BIOTA
KEY_MISC1	SURVEY, BENTHOS, RIVER, ANC, WATER QUALITY, SAMPLING, MONITORING, EFFLUENT, PULP MILL
KEY_MISC2	
KEY_MISC3	

AUTHOR	Beak Associates.
DATE	1991
DUP_DATE	c.
TITLE	Winter Water Quality Survey on the Athabasca River, February 1991.
OTHER1	Prepared for Millar Western Pulp Ltd. and Alberta Newsprint Company, Whitecourt, Alberta.
PUBLISHER	Beak Associates Consulting Ltd., Calgary, Alberta.
OTHER2	June 1991. Project No. 09-055-01-01. 20 pp.

ANNOTATION

In February 1991 a 2-day survey was conducted at 13 locations on the Athabasca River and its tributaries (near Whitecourt), to determine the water quality both upstream and downstream of effluent discharge points coming from Millar Western Pulp Ltd. and Alberta Newsprint Company.

Parameters were measured using "standard methods" of analyses. Parameters include dissolved oxygen, BOD, major ions, metals, nutrients, suspended solids, physical parameters, color, phenols, chelators, coliforms and resin acids.

Nutrients analyzed (mg/l) include total phosphorus, dissolved phosphorus, nitrate/nitrite nitrogen, total Kjeldahl nitrogen, and ammonia nitrogen.

KEY_WATER	ATHABASCA
KEY_GEOG	ALBERTA, WHITECOURT
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	METAL, NON-METAL ORGANICS, OXYGEN, OXYGEN DEMAND, TOXIC, ORGANICS, PHYSICAL PARAMETERS
KEY_ANIMAL	
KEY_PLANT	
KEY_MCROBE	BACTERIA
KEY_MEDIA	WATER
KEY_MISC1	RIVER, MILLAR WESTERN, ANC, WATER QUALITY, NUTRIENT, PULP MILL, MONITORING
KEY_MISC2	
KEY_MISC3	

AUTHOR	Beak Associates.
DATE	**1990**
DUP_DATE	**a.**
TITLE	**Benthic Invertebrate Monitoring Study on the Athabasca and McLeod Rivers Near Whitecourt, Alberta, 1989.**
OTHER1	**Prepared for Millar Western Pulp Ltd., Whitecourt, Alberta.**
PUBLISHER	**Beak Associates Consulting Ltd., Calgary, Alberta.**
OTHER2	**September 1990. Project No. 09-007-01-01. 54 pp. + Appendices.**
ANNOTATION	*Benthic invertebrate and water quality sampling were conducted in June 22-25 and October 6-10, 1989 to provide pre-operational data for the Athabasca River above and below the Millar Western Pulp Ltd. CTMP mill. Five replicate samples were collected at seven sites using a modified Neill-Hess cylinder sampler. Water quality analyses for nutrients included total phosphorus and total Kjeldahl nitrogen.*
KEY_WATER	ATHABASCA, MCLEOD
KEY_GEOG	WHITECOURT, ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	PHYSICAL PARAMETERS, OXYGEN, OXYGEN DEMAND
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	ALGAE, MACROPHYTE
KEY_MCROBE	
KEY_MEDIA	BIOTA, WATER
KEY_MISC1	RIVER, PULP MILL, BENTHOS, MONITORING, MILLAR WESTERN, EFFLUENT, SAMPLING, SEWAGE TREATMENT, SURVEY
KEY_MISC2	
KEY_MISC3	

AUTHOR	Beak Associates.
DATE	**1990**
DUP_DATE	**b.**
TITLE	**Benthic Invertebrate Monitoring Study and Fish Habitat Assessment on the Athabasca River, Whitecourt, Alberta, 1989.**
OTHER1	**Prepared for Alberta Newsprint Company Ltd., Whitecourt, Alberta.**
PUBLISHER	**Beak Associates Consulting Ltd., Calgary, Alberta.**
OTHER2	**June 1990. Project No. 9-009-01-01. 54 pp. + Appendices.**
ANNOTATION	*Benthic invertebrate and water quality sampling were conducted in June 22-25 and October 6-9, 1989 to provide pre-operational data for the Athabasca River above and below the ANC CTMP mill. Five replicate samples were collected at seven sites using a modified Neill-Hess cylinder sampler. Water quality analyses for nutrients included total phosphorus and total Kjeldahl nitrogen.*
KEY_WATER	ATHABASCA
KEY_GEOG	WHITECOURT, ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	PHYSICAL PARAMETERS, OXYGEN, OXYGEN DEMAND
KEY_ANIMAL	VERTEBRATE, INVERTEBRATE
KEY_PLANT	ALGAE, MACROPHYTE
KEY_MCROBE	
KEY_MEDIA	BIOTA, WATER
KEY_MISC1	RIVER, PULP MILL, BENTHOS, MONITORING, ANC, EFFLUENT, SAMPLING, SEWAGE TREATMENT, SURVEY
KEY_MISC2	
KEY_MISC3	

AUTHOR	Beak Associates.
DATE	**1990**
DUP_DATE	**c.**
TITLE	**Winter Water Quality Survey on the Athabasca River, February 1990.**
OTHER1	**Prepared for Alberta Newsprint Company Ltd. and Millar Western Pulp Ltd., Whitecourt, Alberta.**
PUBLISHER	**Beak Associates Consulting Ltd., Calgary, Alberta.**
OTHER2	**April 1990. Project No. 9-013-01-01. 15 pp.**
ANNOTATION	*Water quality sampling was conducted at 11 locations from Windfall bridge to just upstream of Smith on the Athabasca River, plus tributary streams and effluents on February 21-23, 1990. Nutrient measurements included total phosphate, total Kjeldahl nitrogen, ammonia nitrogen and nitrite-nitrate nitrogen. Water quality parameters examined included physical characteristics, metals, non-metal organics, organics, dissolved oxygen, BOD, phenolics and resins.*
KEY_WATER	ATHABASCA, MCLEOD, PEMBINA
KEY_GEOG	ALBERTA, WHITECOURT
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	METAL, PHYSICAL PARAMETERS, OXYGEN, OXYGEN DEMAND, ORGANICS, NON-METAL INORGANICS
KEY_ANIMAL	
KEY_PLANT	
KEY_MCROBE	BACTERIA
KEY_MEDIA	WATER
KEY_MISC1	WATER QUALITY, SURVEY, RIVER, ANC, MILLAR WESTERN, PULP MILL, EFFLUENT, SAMPLING
KEY_MISC2	
KEY_MISC3	

AUTHOR	Beak Associates.
DATE	**1989**
DUP_DATE	**a.**
TITLE	**Baseline Benthic Invertebrate Monitoring Study on the Athabasca and McLeod Rivers Near Whitecourt, Alberta, 1988.**
OTHER1	**Prepared for Millar Western Pulp Ltd., Whitecourt, Alberta.**
PUBLISHER	**Beak Associates Consulting Ltd., Calgary, Alberta.**
OTHER2	**October 1989. Project No. 10-209-01-01. 47 pp. + Appendices.**
ANNOTATION	*Benthic invertebrate sampling (using a modified Neill-Hess cylinder) was conducted during June 1-4 and October 16-21, 1988 at 10 sites (five replicates per site) on the McLeod and Athabasca Rivers in the vicinity of the ANC and Millar Western effluent and Town of Whitecourt sewage discharges. The spring measured pre-operational conditions and the fall measured operational conditions although effluent discharge is not at capacity. Nutrient analyses included total phosphorus and total Kjeldahl nitrogen.*
KEY_WATER	ATHABASCA, MCLEOD
KEY_GEOG	WHITECOURT, ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	PHYSICAL PARAMETERS, OXYGEN
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	
KEY_MEDIA	BIOTA, WATER
KEY_MISC1	RIVER, PULP MILL, BENTHOS, MONITORING, MILLAR WESTERN, WATER QUALITY, SAMPLING
KEY_MISC2	
KEY_MISC3	

AUTHOR	Beak Associates.
DATE	**1989**
DUP_DATE	**b.**
TITLE	**1982 Athabasca River Water Quality Assessment, Suncor Inc. Oil Sands Group, June, 1988.**
OTHER1	**Draft.**
PUBLISHER	**Beak Associates Consulting Ltd., Edmonton, Alberta.**
OTHER2	**February 2, 1989. Project No. 10-234-01-01. 58 pp. + Appendices.**
ANNOTATION	*In response to upset conditions at the Suncor oil sands plant, research was initiated to determine the impact of the upset on the Athabasca River. The research included an assessment of fish distribution and tainting, and benthic invertebrate monitoring using artificial substrates. Benthic sampling was done at seven sites on the Athabasca River in August and September 1982. Artificial samplers consisting of baskets of cobble-sized rocks were suspended in the river for approximately a month.*
KEY_WATER	ATHABASCA, PEACE-ATHABASCA, BEAVER, MACKAY
KEY_GEOG	ATHABASCA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	PHYSICAL PARAMETERS, OXYGEN DEMAND, TOXIC
KEY_ANIMAL	VERTEBRATE, INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	WATER
KEY_MISC1	BENTHOS, SAMPLING, SUNCOR, EFFLUENT, OIL, ECOLOGY, SALMONID, FISH, WATER QUALITY
KEY_MISC2	
KEY_MISC3	

AUTHOR	Beak Associates.
DATE	**1988**
DUP_DATE	**a.**
TITLE	**Baseline Benthic Invertebrate Monitoring Study on the Athabasca and McLeod Rivers Near Whitecourt, Alberta, 1987.**
OTHER1	**Prepared for Millar Western Pulp Ltd., Edmonton, Alberta.**
PUBLISHER	**Beak Associates Consulting Ltd., Calgary, Alberta.**
OTHER2	**April 1988. Project No. 10-185-01-01. 44 pp. + Appendices.**
ANNOTATION	*Pre-operational baseline benthic invertebrate sampling (using a modified Neill-Hess cylinder) was conducted during June 2-7 and November 13-16, 1987 (after completion of diffuser installation) at 10 sites (five replicates per site) on the McLeod and Athabasca Rivers in the vicinity of the ANC and Millar Western effluent and Town of Whitecourt sewage discharges. Nutrient analyses included total phosphorus and total Kjeldahl nitrogen.*
KEY_WATER	ATHABASCA, MCLEOD
KEY_GEOG	WHITECOURT, ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	PHYSICAL PARAMETERS, OXYGEN
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	BIOTA, WATER
KEY_MISC1	RIVER, PULP MILL, BENTHOS, MONITORING, MILLAR WESTERN, WATER QUALITY, SAMPLING
KEY_MISC2	
KEY_MISC3	

AUTHOR	Beak Associates.
DATE	**1988**
DUP_DATE	**(Draft).**
TITLE	**1987 Athabasca River Water Quality Program, Phase One.**
OTHER1	**Prepared for Suncor Inc. Oil Sands Group.**
PUBLISHER	**Beak Associates Consulting Ltd., Edmonton, Alberta.**
OTHER2	**June 1988. Project No. 10-191-01-01. 42 pp. + Appendices.**

ANNOTATION *In 1987, a study was carried out to collect baseline data on EPA priority pollutants, chronic toxicity to fish, water odour and fish taste within the Athabasca River and to determine whether or not environmental impacts of the Suncor operation could be detected in the river. The study did not include nutrients or benthic invertebrates.*

KEY_WATER	ATHABASCA
KEY_GEOG	ATHABASCA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	
KEY_PARAM	METAL, NON-METAL INORGANICS, ORGANICS,
KEY_ANIMAL	VERTEBRATE, INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	WATER
KEY_MISC1	BASELINE, TOXIC, SUNCOR, OIL, IMPACT, FISH, STUDIES, SAMPLING, WATER QUALITY, EFFLUENT, MONITORING
KEY_MISC2	
KEY_MISC3	

AUTHOR	Beak Consultants Limited.
DATE	**1980.**
DUP_DATE	
TITLE	**Biological and Water Chemistry Survey of the Athabasca River, 1979.**
OTHER1	**Prepared for St. Regis (Alberta) Ltd.**
PUBLISHER	**Beak Consultants Limited, Calgary, Alberta.**
OTHER2	**January 1980.**
ANNOTATION	*Athabasca River water samples were collected on September 20-21 and October 22-23, 1979 from nine stations extending 4.8 km upstream of the St. Regis pulp mill effluent and 44 km downstream. The chemical analysis did not include nutrients. Benthic invertebrates were sampled using artificial substrate trays that were installed in groups of six on September 20-21 and retrieved a month later.*
KEY_WATER	ATHABASCA
KEY_GEOG	HINTON, ALBERTA, ATHABASCA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	PHYSICAL PARAMETERS, ORGANICS, OXYGEN DEMAND, OXYGEN
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	WATER, BIOTA
KEY_MISC1	EFFLUENT, BENTHOS, SAMPLING, RIVER, HINTON, WATER QUALITY
KEY_MISC2	
KEY_MISC3	

AUTHOR	Beak Consultants Limited.
DATE	**1978.**
DUP_DATE	
TITLE	**Biological and Water Quality Survey of the Athabasca River 1977.**
OTHER1	**Prepared for North Western Pulp and Power Ltd., Hinton, Alberta.**
PUBLISHER	**Beak Consultants Limited, Calgary, Alberta.**
OTHER2	**January 1978.**
ANNOTATION	*Athabasca River water samples were collected on April 25 to May 20, 1977 from nine stations extending 4.8 km upstream of the St. Regis pulp mill effluent and 44 km downstream. The chemical analyses did not include nutrients. Benthic invertebrates were sampled using artificial substrate trays. Siltation of the samplers occurred in this survey.*
KEY_WATER	ATHABASCA
KEY_GEOG	ATHABASCA, ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	PHYSICAL PARAMETERS, OXYGEN, TOXIC, ORGANICS, OXYGEN DEMAND
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	BIOTA, WATER
KEY_MISC1	WATER QUALITY, SURVEY, BENTHOS, EFFLUENT, PULP MILL, STUDIES
KEY_MISC2	
KEY_MISC3	

AUTHOR	Beak Consultants Limited.
DATE	**1977**
DUP_DATE	**b.**
TITLE	**Biological and Water Quality Survey of the Athabasca River 1976.**
OTHER1	**Prepared for North Western Pulp and Power Ltd., Hinton, Alberta.**
PUBLISHER	**Beak Consultants Limited, Calgary, Alberta**
OTHER2	**March 1977.**
ANNOTATION	*A biological and water quality survey of the Athabasca River was conducted on 96 km of river in the vicinity of Hinton during September and October 1976. The chemical analysis did not include nutrients. Benthic invertebrates were sampled using six artificial substrate trays at ten locations. Trays remained in the river for one month.*
KEY_WATER	ATHABASCA
KEY_GEOG	ATHABASCA, ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	PHYSICAL PARAMETERS, OXYGEN, TOXIC, ORGANICS, OXYGEN DEMAND
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	BIOTA, WATER
KEY_MISC1	WATER QUALITY, SURVEY, BENTHOS, EFFLUENT, PULP MILL, STUDIES
KEY_MISC2	
KEY_MISC3	

AUTHOR	Beak Consultants Limited.
DATE	**1975**
DUP_DATE	**b.**
TITLE	**A Biological and Chemical Survey of the Athabasca River, 1974.**
OTHER1	**Prepared for North Western Pulp and Power Ltd., Hinton, Alberta.**
PUBLISHER	**Beak Consultants Limited, Vancouver, B.C.**
OTHER2	**January 1975.**
ANNOTATION	*A biological and water quality survey of the Athabasca River was conducted in the vicinity of Hinton from July 22 to September 6, 1974. The chemical analysis did not include nutrients. Benthic invertebrates were sampled using artificial substrate trays. Trays remained in the river for six weeks.*
KEY_WATER	ATHABASCA
KEY_GEOG	ATHABASCA, ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	PHYSICAL PARAMETERS, ORGANICS, OXYGEN DEMAND
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	BIOTA, WATER
KEY_MISC1	SURVEY, WATER QUALITY, BENTHOS, EFFLUENT, PULP MILL, STUDIES
KEY_MISC2	
KEY_MISC3	

AUTHOR	Beak, T.W.
DATE	**1960**
DUP_DATE	**a.**
TITLE	**Survey of the Athabasca River - May 1960. Summary Report.**
OTHER1	
PUBLISHER	**Thomas W. Beak, Ontario.**
OTHER2	
ANNOTATION	*The water quality and benthic invertebrate survey of the Athabasca River near Hinton in May 1960 indicated that the mill had a definite but slight impact on invertebrates which were measured by a modified Surber sampler. The chemical analysis did not include nutrients or organics.*
KEY_WATER	ATHABASCA
KEY_GEOG	HINTON, ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	PHYSICAL PARAMETERS, OXYGEN, OXYGEN DEMAND
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	ALGAE, FUNGI
KEY_MCROBE	
KEY_MEDIA	WATER, BIOTA
KEY_MISC1	WATER QUALITY, EFFLUENT, HINTON, SAMPLING, MONITORING, PULP MILL
KEY_MISC2	
KEY_MISC3	

AUTHOR	Boerger, H.
DATE	**1983.**
DUP_DATE	
TITLE	**Distribution and Abundance of Macrobenthos in the Athabasca River near Fort McMurray.**
OTHER1	
PUBLISHER	**Research Management Division, Alberta Environment, Edmonton, Alberta.**
OTHER2	**Report OF-53.**
ANNOTATION	*Benthic macroinvertebrates were collected from gravel bars with a cylinder sampler at two-week intervals May 13 to August 18, 1982 at 16 sites along an 85 km stretch of the Athabasca River between Fort McMurray and the Ells River. The average densities of macroinvertebrates at locations downstream of the Suncor plant were 31% lower than upstream locations, but average densities were also influenced by the Fort McMurray sewage treatment plant and the Clearwater River.*
KEY_WATER	ATHABASCA, CLEARWATER
KEY_GEOG	FORT MCMURRAY, ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	WATER, BIOTA
KEY_MISC1	BENTHOS, RIVER, SUNCOR, OIL, SURVEY, SAMPLING, SEWAGE TREATMENT
KEY_MISC2	
KEY_MISC3	

AUTHOR	Bothwell, M.L.
DATE	**1992.**
DUP_DATE	
TITLE	**Eutrophication of Rivers by Nutrients in Treated Kraft Pulp Mill Effluent.**
OTHER1	**Environmental Sciences Division, National Hydrology Research Division, Environment Canada, Saskatoon, Saskatchewan.**
PUBLISHER	**Wat. Poll. Res. J. Can. 27(3):447-472.**
OTHER2	

ANNOTATION

"This paper reviews current knowledge about the quantitative relationship between primary nutrients (nitrogen and phosphorus) in pulp mill effluent and the growth rate and biomass accumulation of attached algae in rocky-bottom rivers" (cited from document).

Small-scale experiments were conducted on algal communities in the Thompson River, British Columbia and in the McKenzie River, Oregon (outside of study area).

Forms of nitrogen (ug/l) discussed include nitrate nitrogen, ammonium nitrogen, and dissolved inorganic nitrogen. Forms of phosphorus (ug/l) discussed include orthophosphorus and soluble phosphorus.

KEY_WATER	THOMPSON
KEY_GEOG	BRITISH COLUMBIA, OREGON
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	NON-METAL INORGANICS, TOXIC, PHYSICAL PARAMETERS
KEY_ANIMAL	
KEY_PLANT	ALGAE
KEY_MCROBE	
KEY_MEDIA	WATER
KEY_MISC1	PULP MILL, RIVER, EFFLUENT, EXPERIMENT, WATER QUALITY, NUTRIENT
KEY_MISC2	
KEY_MISC3	

AUTHOR	Bothwell, M.L. and J.G. Stockner.
DATE	**1980.**
DUP_DATE	
TITLE	**Influence of Secondarily Treated Kraft Mill Effluent on the Accumulation Rate of Attached Algae in Experimental Continuous-Flow Troughs.**
OTHER1	
PUBLISHER	**Can. J. Fish. Aquat. Sci. 37:248-254.**
OTHER2	
ANNOTATION	*In three seasonal experiments in 1977, increases in the rate of attached algal accumulation were normally found within each additional increment of secondarily treated kraft mill effluent. The study was done outside of the NRBS study area using experimental troughs.*
KEY_WATER	
KEY_GEOG	
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	
KEY_ANIMAL	
KEY_PLANT	ALGAE
KEY_MCROBE	
KEY_MEDIA	WATER, BIOTA
KEY_MISC1	EFFLUENT, REPRODUCTION, PULP MILL
KEY_MISC2	
KEY_MISC3	

AUTHOR	Bothwell, M.L., S. Jasper and R.J. Daley.
DATE	**1989.**
DUP_DATE	
TITLE	**Phosphorus Control of Algal Production and Biomass in the Thompson River, British Columbia.**
OTHER1	
PUBLISHER	**National Hydrology Research Institute, Environment Canada.**
OTHER2	**Inland Waters Directorate Scientific Series No. 165. 9 pp.**
ANNOTATION	*This paper describes the results of the experimental trough research program undertaken by Environment Canada and Weyerhaeuser Canada Ltd. in which the growth rates and biomass accumulation of periphytic diatoms in the Thompson River is measured and compared to phosphate levels in the troughs and in pulp mill effluent.*
KEY_WATER	THOMPSON
KEY_GEOG	B.C.
KEY_NTROGN	
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	
KEY_MEDIA	WATER
KEY_MISC1	RIVER, EXPERIMENT, NUTRIENT
KEY_MISC2	
KEY_MISC3	

AUTHOR	Bramm, S.
DATE	**1983.**
DUP_DATE	
TITLE	**A Bibliography of the Peace-Athabasca Delta.**
OTHER1	**For Alberta Environment Library.**
PUBLISHER	**Alberta Environment. Edmonton, Alberta.**
OTHER2	**March 1993.**

ANNOTATION

This is a bibliography of the holdings of the Alberta Environment Library which refer to the watercourses and adjacent land areas of the Peace-Athabasca Delta, the watershed of Lake Athabasca (Alberta portions), and Wood Buffalo National Park. Included are books, reports and periodical articles referring to the following areas of interest: surface water and ground water, water resources management, water quality and pollution, aquatic flora and fauna, land use planning, inventory and impacts, and geology. There are 150 distinct entries, each indexed by author(s), title and geographic location(s). Abstracts are not included therefore references which specifically pertain to nutrients cannot be identified.

KEY_WATER	PEACE-ATHABASCA
KEY_GEOG	ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	
KEY_ANIMAL	FAUNA
KEY_PLANT	FLORA
KEY_MCROBE	
KEY_MEDIA	SEDIMENT, WATER
KEY_MISC1	BIBLIOGRAPHY, GENERAL REFERENCES, RIVER, STUDIES, WATER RESOURCES, WATER QUALITY, GEOLOGY
KEY_MISC2	
KEY_MISC3	

AUTHOR	Casey, R.J.
DATE	**1990.**
DUP_DATE	
TITLE	**Sediment Oxygen Demand During the Winter in the Athabasca River and the Wapiti-Smoky River System, 1990.**
OTHER1	
PUBLISHER	**Standards & Approvals Division and Environmental Assessment Division, Alberta Environment.**
OTHER2	**49 pp + Appendices.**
ANNOTATION	*This document examines sediment oxygen demand (SOD) rates in winter and longitudinal trends of SOD in the Athabasca River and the Wapiti-Smoky River system. The study was carried out between January and March 1990 for five sites on the Athabasca River and five sites on the Wapiti-Smoky River system. Dissolved oxygen and % organic content of sediment were also measured. There is a brief discussion of the association between SOD, nutrients, organic materials and benthic organisms, however specific information on nutrients is not provided. The 'open' and 'closed' chamber methods used to measure the SOD are described in the document.*
KEY_WATER	ATHABASCA, WAPITI, SMOKY
KEY_GEOG	GRANDE PRAIRIE, WHITECOURT, ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	OXYGEN DEMAND, OXYGEN, ORGANICS
KEY_ANIMAL	
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	SEDIMENT
KEY_MISC1	RIVER, PROCTER & GAMBLE, MILLAR WESTERN, PULP MILL, SEWAGE
KEY_MISC2	
KEY_MISC3	

AUTHOR	Casey, R.J. and L.R. Noton.
DATE	**1989.**
DUP_DATE	
TITLE	**Method Development and Measurement of Sediment Oxygen Demand During the Winter on the Athabasca River.**
OTHER1	
PUBLISHER	**Environmental Quality Monitoring Branch, Environmental Assessment Division, Alberta Environment.**
OTHER2	**43 pp.**
ANNOTATION	*"The objective of this study was to develop a method to measure SOD and to use this procedure to obtain SOD measurments (g/m2/day) during the winter on the Athabasca River." (cited from document)* *Sample locations were Hinton, Knight Bridge, Windfall Bridge, Whitecourt and Fort Assiniboine, Alberta. No nutrient data are given.*
KEY_WATER	ATHABASCA
KEY_GEOG	ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	OXYGEN DEMAND, PHYSICAL PARAMETERS
KEY_ANIMAL	
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	SEDIMENT
KEY_MISC1	RIVER, SAMPLING, BENTHOS
KEY_MISC2	
KEY_MISC3	

AUTHOR	Chambers, P.A.
DATE	**1992.**
DUP_DATE	
TITLE	**Nutrients and Their Interaction with Contaminants: Impacts on the Peace-Athabasca River Systems.**
OTHER1	**Prepared for The Science Advisory Board, Northern River Basins Study.**
PUBLISHER	**P.A. Chambers, Environmental Sciences Division, National Hydrology Research Institute, Saskatoon, Saskatchewan.**
OTHER2	**September 1, 1992. 13 pp.**
ANNOTATION	*"In the Peace-Athabasca River system, point-sources of nutrient loading presently include 10 pulp mills and four municipal effluents with an additional pulp mill planned as part of future developments. In addition to point-sources of nutrient loading, agricultural activities as well as changes in land-use patterns (notably logging) will result in increased nutrient loads to the basin....The objective of this report...was to (i) highlight the current state of knowledge with respect to the impact of nutrients and nutrient-contaminant interactions on the Peace-Athabasca River system, (ii) to identify knowledge gaps, (iii) to determine additional information required to set nutrient loading guidelines for the preservation of water quality and aquatic habitats and biota, and (iv) outline a study proposal to fulfill (ii) and (iii) " (cited from document). Organics, physical parameters, sediment oxygen demand (SOD), total phosphorus and nitrogen (total Kjeldahl, ammonium and nitrate-nitrite) are mentioned.*
KEY_WATER	PEACE, ATHABASCA, LESSER SLAVE, PEACE-ATHABASCA
KEY_GEOG	ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	OXYGEN DEMAND, ORGANICS, PHYSICAL PARAMETERS, TOXIC
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	BACTERIA
KEY_MEDIA	WATER, BIOTA, EFFLUENT
KEY_MISC1	RIVER, ALBERTA-PACIFIC, ANC, MILLAR WESTERN, PROCTER & GAMBLE, SLAVE LAKE, DAISHOWA, WELDWOOD
KEY_MISC2	IMPACT, CONTAMINANT, EFFLUENT, FOREST HARVESTING, INDUSTRY, NUTRIENT, PULP MILL, WATER QUALITY
KEY_MISC3	

AUTHOR	Charlton, S.E.D. and M. Hickman.
DATE	**1984.**
DUP_DATE	
TITLE	**Seasonal Physical, Chemical and Algal Changes in Five Rivers Flowing Through the Oil Sands Region of Alberta, Canada.**
OTHER1	**In Int. Revue ges. Hydrobiol. 69(3): 297-332.**
PUBLISHER	
OTHER2	

ANNOTATION *Epilithic algal communities and water quality were studied seasonally in 1978 and 1979 at specific sites in five tributary rivers flowing through the northeastern Alberta oil sands region to the Athabasca River. The tributaries are the Muskeg, Steepbank, Hangingstone, Ells and MacKay rivers. Algae were collected quantitatively, identified to species and enumerated.*

KEY_WATER	MUSKEG, STEEPBANK, MACKAY, ATHABASCA
KEY_GEOG	FORT MCMURRAY, ATHABASCA, ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	NON-METAL INORGANICS, PHYSICAL PARAMETERS
KEY_ANIMAL	
KEY_PLANT	ALGAE
KEY_MCROBE	
KEY_MEDIA	WATER
KEY_MISC1	OIL, RIVER, WATER QUALITY, NUTRIENT
KEY_MISC2	
KEY_MISC3	

AUTHOR	Charlton, S.E.D., M. Hickman and C.G. Jenkerson.
DATE	**1981.**
DUP_DATE	
TITLE	**Longitudinal Physico-chemical and Algal Surveys of Rivers Flowing Through the Oil Sands Region of Northeastern Alberta, Canada.**
OTHER1	**In Nova Hedwigia 35: 465-522. Edited by J. Cramer.**
PUBLISHER	
OTHER2	

ANNOTATION *Longitudinal synoptic surveys of five rivers flowing through the oil sands region of Alberta included measurement of various physico-chemical parameters, algal species composition and standing crops. Synoptic surveys were conducted in June on the Ells River, July on the Muskeg River, and September for the Hangingstone, MacKay and Steepbank rivers. Algae were collected quantitatively, identified to species and enumerated.*

KEY_WATER	MUSKEG, STEEPBANK, MACKAY, ATHABASCA
KEY_GEOG	FORT MCMURRAY, ATHABASCA, ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	NON-METAL INORGANICS, PHYSICAL PARAMETERS
KEY_ANIMAL	
KEY_PLANT	ALGAE, CHLOROPHYLL
KEY_MCROBE	
KEY_MEDIA	WATER
KEY_MISC1	OIL, RIVER, SURVEYS, NUTRIENT, BENTHOS
KEY_MISC2	
KEY_MISC3	

AUTHOR	Corkum, L.
DATE	**1985.**
DUP_DATE	
TITLE	**Water Quality of the Athabasca Oil Sands Area: A Regional Study.**
OTHER1	
PUBLISHER	**Water Quality Control Branch, Alberta Environment.**
OTHER2	**AOSERP Report L-85. 273 pp.**

ANNOTATION

"The objective of this report is to summarize water quality constituents in the AOSERP study area and to examine relationships between these constituents and changes in land formation, hydrology, and development.

Summaries of routine parameters, nutrients, and metals are presented for sampling sites along the Athabasca River to detect longitudinal and seasonal changes in water quality and to determine the effects of point source effluents on the river. A principal component analysis (PCA) was used for the simultaneous examination of selected water quality paramaters on the Athabasca River. Sites exhibiting similar water quality characteristics were delineated on schematic maps of the river.

Baseline data and relationships among parameters also are presented for east, west and south drainages entering the Athabasca River between Fort McMurray and Embarras Airport, as well as the Athabasca Delta drainage. An overall analysis of the four regions was conducted using PCA to delineate those sites with similar water quality characteristics. Site groupings often reflected the geological type of the region" (as cited in document).

KEY_WATER	ATHABASCA, CLEARWATER, MUSKEG
KEY_GEOG	FORT MCMURRAY, EMBARRAS, ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	PHYSICAL PARAMETERS, ORGANICS, NON-METAL INORGANICS, METALS, OIL
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	BACTERIA
KEY_MEDIA	WATER
KEY_MISC1	BASELINE, EFFLUENT, RIVER, NUTRIENT, WATER QUALITY, HYDROLOGY, GEOLOGY, SAMPLING, STUDIES, OIL
KEY_MISC2	
KEY_MISC3	

AUTHOR	Crowther, R.A.
DATE	**1979.**
DUP_DATE	
TITLE	**Ecological Investigations of Hartley Creek, Alberta.**
OTHER1	**A thesis submitted to the Faculty of Graduate Studies in partial fulfilment of the requirements for the degree of Doctor of Philosophy.**
PUBLISHER	**Department of Biology, University of Calgary.**
OTHER2	**November 7, 1979.**
ANNOTATION	*This thesis examined the ecology of adult and immature benthic invertebrates inhabiting Hartley Creek, a tributary to the Athabasca River, monthly during the open water season from May 1976 to November 1977. Algae, bacteria and physical parameters were also measured. Data were analyzed by reciprocal averaging ordination and discriminant analysis.*
KEY_WATER	HARTLEY, MUSKEG, ATHABASCA
KEY_GEOG	FORT MCMURRAY, ATHABASCA, ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	PHYSICAL PARAMETERS
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	ALGAE, CHLOROPHYLL
KEY_MCROBE	
KEY_MEDIA	WATER
KEY_MISC1	OIL, RIVER, BENTHOS, STUDIES, REPRODUCTION, ECOLOGY
KEY_MISC2	
KEY_MISC3	

AUTHOR	Crowther, R.A. and B.J. Lade.
DATE	**1981.**
DUP_DATE	
TITLE	**An Assessment of Benthic Secondary Production in the Muskeg River of Northeastern Alberta.**
OTHER1	**Prepared for the Alberta Oil Sands Environmental Research Program.**
PUBLISHER	**IEC International Environmental Consultants Ltd.**
OTHER2	**AOSERP Report 116. 106 pp.**
ANNOTATION	*This study of benthic invertebrates in the Muskeg River, a tributary of the Athabasca River in the oil sands area, assessed changes in the level of secondary production and related these to changes in substrate. Ten replicate benthic samples were collected at three sites with a modified Neill cylinder.*
KEY_WATER	MUSKEG, ATHABASCA
KEY_GEOG	FORT MCMURRAY, ATHABASCA, ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	SEDIMENT
KEY_MISC1	BENTHOS, RIVER, SURVEY, STUDIES, ECOSYSTEM
KEY_MISC2	
KEY_MISC3	

AUTHOR	Culp, J.M., H.R. Hamilton, A. Sosiak and R.W. Davies.
DATE	1992.
DUP_DATE	
TITLE	**Longitudinal Zonation of the Biota and Water Quality of the Bow River System in Alberta, Canada.**
OTHER1	**In Water Quality of a North American River System, C.D. Becker and D.S. Neitzel, eds. Pp. 31-45.**
PUBLISHER	**Batelle Press.**
OTHER2	
ANNOTATION	*Upstream of major municipalities, concentrations of plant nutrients in the Bow River are so low that they appear to limit production of primary producers during summer. The major impact of phosphorus and nitrogen from the City of Calgary significantly increases plant nutrients in all seasons, stimulating the production of attached macrophytes and algae. This review document summarizes data from many sources. The Bow River is outside of the study area.*
KEY_WATER	BOW
KEY_GEOG	ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	
KEY_MEDIA	WATER, BIOTA
KEY_MISC1	RIVER, WATER QUALITY, BENTHOS, NUTRIENT
KEY_MISC2	
KEY_MISC3	

AUTHOR	Davis, T.M., B.D. Vance and J.H. Rodgers.
DATE	**1988.**
DUP_DATE	
TITLE	**Productivity Responses of Periphyton and Phytoplankton to Bleach-Kraft Mill Effluent.**
OTHER1	
PUBLISHER	**Aquat. Toxicol. 12:83-106.**
OTHER2	

ANNOTATION *"Responses of periphyton and phytoplankton productivity in the lower Sulphur River (Texas-Arkansas) to bleach-kraft mill effluent (BKME) were monitored using in situ C14 incubation. Periphyton productivity was not significantly decreased downstream of mill discharge nor were periphyton productivity efficiencies. The community structure of the periphyton community shifted toward heterotrophic population near the mill discharge but recovered to upstream characteristics at downstream stations. Phytoplankton primary productivity and productivity efficiency were significantly decreased downstream of the mill discharge. These decreases were associated with increased light attenuation downstream due to the mill effluent. Chlorophyll a concentrations of periphyton and phytoplankton were not significantly altered by the mill effluent; therefore, the effluent was not lethal to the algae. Significant inverse relationships found with increased light attenuation indicators (sigma and selected water chemistry) indicated that light availability was associated with changes in C14 rates" (cited from document abstract).*

KEY_WATER	
KEY_GEOG	
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	PHYSICAL PARAMETERS, OXYGEN, OXYGEN DEMAND, TOXIC
KEY_ANIMAL	
KEY_PLANT	ALGAE, CHLOROPHYLL
KEY_MCROBE	
KEY_MEDIA	WATER, EFFLUENT
KEY_MISC1	EFFLUENT, PULP MILL, REPRODUCTION, SURVEY, STUDIES
KEY_MISC2	
KEY_MISC3	

AUTHOR	Environment Canada.
DATE	**1992.**
DUP_DATE	
TITLE	**Technical Guidance Document For Aquatic Environmental Effects Monitoring.**
OTHER1	
PUBLISHER	**Department of Fisheries and Oceans, Environment Canada.**
OTHER2	**156 pp.**

ANNOTATION *This document provides "guidance on how to perform the tasks needed to fulfill the requirements for the environmental effects monitoring (EEM) program under the Fisheries Act" (cited from document). General topics discussed include: 1) description of a study area, 2) sampling design, 3) general quality assurance/quality control for conducting EEM, 4) statistical sampling design, 5) sample collection for physical, chemical, bacteriological and toxicological studies, 6) physical, chemical, bacteriological analyses, 7) toxicity tests and fish tainting and behaviour evaluation, 8) adult fish survey, and 9) benthic community assessment. There are no nutrient data in this document.*

KEY_WATER	
KEY_GEOG	
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	TOXIC, NON-METAL INORGANICS, ORGANICS, OXYGEN, OXYGEN DEMAND, PHYSICAL PARAMETERS
KEY_ANIMAL	VERTEBRATE, INVERTEBRATE
KEY_PLANT	ALGAE, CHLOROPHYLL
KEY_MCROBE	BACTERIA
KEY_MEDIA	WATER
KEY_MISC1	EFFLUENT, FISH, EIA, BENTHOS, SAMPLING, RIVER, WATER QUALITY
KEY_MISC2	
KEY_MISC3	

AUTHOR	Environment Canada.
DATE	**1991**
DUP_DATE	**a.**
TITLE	**Update on Water Quality Monitoring in Wood Buffalo National Park.**
OTHER1	**October, 1991.**
PUBLISHER	**Environment Canada.**
OTHER2	

ANNOTATION *This report presents data available from August 1989 to August 1991 to provide a record of ongoing Park water quality monitoring. Nutrient data include total particulate and dissolved phosphorus, particulate nitrogen, dissolved nitrogen, total nitrogen, nitrite-nitrate nitrogen and total ammonia. Analyses also include metals, major ions and general parameters for the Athabasca River at 27 baseline, the Peace River at Peace Point, and the Peace River at Garden River. Additional analytical results for fish and sediments are included as well. The report does not interpret the data.*

KEY_WATER	ATHABASCA, PEACE, SLAVE
KEY_GEOG	NORTHWEST TERRITORIES, ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	PHYSICAL PARAMETERS, METALS, ORGANICS, NON-METAL ORGANICS, OXYGEN
KEY_ANIMAL	VERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	WATER
KEY_MISC1	NAQUADAT, SAMPLING, BASELINE, FISH, STUDIES, MONITORING
KEY_MISC2	
KEY_MISC3	

AUTHOR	Environment Canada.
DATE	**1985**
DUP_DATE	**b.**
TITLE	**Mackenzie River Basin Study Program 1978-81, Supplement No. 9: Water Quality.**
OTHER1	**Prepared for Mackenzie River Basin Committee.**
PUBLISHER	**Water Quality Branch, Inland Waters Directorate, Environment Canada.**
OTHER2	**201 pp.**

ANNOTATION

"This report describes the general state, seasonal and spatial trends of many physical, chemical, nutrient, metal and organic contaminant parameters of the major subbasins of the Mackenzie River basin. This is the only comprehensive assessment of water quality data that have been collected in the basin since the early 1960s by federal and provincial governments.

The report recommends changes to the present monitoring design and strategy to reflect current requirements and water quality issues. Particular emphasis is given to sampling medium and frequency, uniformity of analytical techniques and basin coverage, with the intention of increasing the amount of information that can be obtained from the collected data" (as cited in document).

KEY_WATER	MACKENZIE
KEY_GEOG	NORTHWEST TERRITORIES, BRITISH COLUMBIA, ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	PHYSICAL PARAMETERS, NON-METAL INORGANICS, ORGANICS, OXYGEN DEMAND, METALS
KEY_ANIMAL	VERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	BIOTA, WATER
KEY_MISC1	BASIN, CONTAMINANT, FISH, HYDROLOGY, GEOLOGY, NAQUADAT, RIVER, SAMPLING, STUDIES, WATER QUALITY
KEY_MISC2	NUTRIENT
KEY_MISC3	

AUTHOR	Environmental Management Associates (EMA).
DATE	**1989**
DUP_DATE	
TITLE	**Wapiti-Smoky River Synoptic Water Quality Survey.**
OTHER1	**Prepared for Water Quality Control Branch, Alberta Environment, Edmonton, Alberta.**
PUBLISHER	**Environmental Management Associates, Calgary, Alberta.**
OTHER2	**March 1989.**

ANNOTATION *This report contains the results of a March 1-9, 1989 synoptic water quality survey at sixteen sites on the Wapiti-Smoky River system during the critical low-flow, ice-cover period. Samples were analyzed for general water quality and effluent parameters, metals, major ions, conventional organics and bacteria. The nutrients measured included nitrate-nitrite nitrogen, ammonia nitrogen, total Kjeldahl nitrogen and total phosphorus.*

KEY_WATER	WAPITI, SMOKY, PEACE
KEY_GEOG	ALBERTA, GRANDE PRAIRIE, PEACE RIVER
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	OXYGEN DEMAND, OXYGEN, PHYSICAL PARAMETERS, METALS, ORGANICS, NON-METAL ORGANICS
KEY_ANIMAL	
KEY_PLANT	
KEY_MCROBE	BACTERIA
KEY_MEDIA	WATER
KEY_MISC1	SEWAGE TREATMENT, PROCTER & GAMBLE, PULP MILL, EFFLUENT, NAQUADAT, WATER QUALITY, MODEL, RIVER
KEY_MISC2	SAMPLING
KEY_MISC3	

AUTHOR	EVS Consultants Ltd.
DATE	**1992**
DUP_DATE	**a.**
TITLE	**Volume III - 1991, 1991 Operational Monitoring of the Lesser Slave River.**
OTHER1	**Prepared for Slave Lake Pulp Corporation, Edmonton.**
PUBLISHER	**EVS Consultants Ltd., North Vancouver, B.C.**
OTHER2	**April 1992.**

ANNOTATION *Operational monitoring of the Lesser Slave River reported in this volume includes the results of field work from May to September, 1991 and a comparison with the two years of pre-operational data. The surveys included sediment chemistry, water chemistry for a wide range of parameters including total phosphorus and nitrogen (nitrite, nitrate, ammonia and total Kjeldahl), diurnal dissolved oxygen, organics and metals in water, sediments and fish tissue, bacteriological studies, periphyton, benthos and fisheries. Epilithic periphyton was sampled by scraping natural rock substrates and analyzed for chlorophyll a. Benthic invertebrates were sampled (three replicates per sample) in May and October using a Ponar grab for silty areas and a Hess sampler for riffle areas.*

KEY_WATER	LESSER SLAVE, ATHABASCA
KEY_GEOG	ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	OXYGEN DEMAND, METAL, TOXIC, ORGANICS, OXYGEN, PHYSICAL PARAMETERS, NON-METAL INORGANICS
KEY_ANIMAL	VERTEBRATE, INVERTEBRATE
KEY_PLANT	ALGAE, CHLOROPHYLL
KEY_MCROBE	BACTERIA
KEY_MEDIA	WATER
KEY_MISC1	PULP MILL, MONITORING, RIVER, WATER QUALITY, BENTHOS, ORGANOCHLORINE, NUTRIENT, FISH, SURVEY, EIA
KEY_MISC2	SLAVE LAKE, REPRODUCTION, BASELINE
KEY_MISC3	

AUTHOR	EVS Consultants Ltd.
DATE	**1992**
DUP_DATE	**b.**
TITLE	**Review and Analysis of ANC River Monitoring Studies on the Athabasca River. Final Report.**
OTHER1	**Prepared for Alberta Newsprint Company, Whitecourt, Alberta.**
PUBLISHER	**EVS Consultants, North Vancouver, B.C.**
OTHER2	**EVS Project No. 3/561-01.2. July 1992.**

ANNOTATION

The report is divided into two tasks:

1) Task I - Review of ANC River Monitoring Studies on the Athabasca River. "This report provides a brief review and critique of three Beak/Sentar reports on benthic monitoring studies conducted on the Athabasca River in the vicinity of the ANC paper mill (1990, 1991, 1992)." (cited from document) Data are presented for chemical analyses (total phosphorus (mg/l), dissolved oxygen (ppm and % saturation)), benthic communities, EEM protocols and recommendations.

2) Task II. Comparison of Pre- and Post-Operational Benthic Communities. It is a statistical comparison of benthic communities studied by Beak/Sentar in the Athabasca River in the vicinity of the ANC paper mill (1990, 1991, 1992). "The objective of these analyses was to determine if spatial patterns of the macroinvertebrate communities changed in a manner consistent with the presence of impacts from the ANC mill discharge." (cited from document)

KEY_WATER	ATHABASCA
KEY_GEOG	ALBERTA, WHITECOURT
KEY_NTROGN	
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	OXYGEN, OXYGEN DEMAND,
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	WATER
KEY_MISC1	BENTHOS, RIVER, ANC, WATER QUALITY, INVENTORY, SURVEY, NUTRIENT
KEY_MISC2	
KEY_MISC3	

AUTHOR	EVS Consultants Ltd.
DATE	**1992**
DUP_DATE	**c.**
TITLE	**Presentation: SLPC Biological Monitoring Studies on the Lesser Slave River.**
OTHER1	**Presented by Gary Vigers, May 1992.**
PUBLISHER	**EVS Consultants Ltd.**
OTHER2	
ANNOTATION	*This report contains the material on the slides which supported a presentation. Contains summary tables and graphs of benthic invertebrate and total phosphorus results. There are no raw data.*
KEY_WATER	LESSER SLAVE
KEY_GEOG	ALBERTA
KEY_NTROGN	
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	OXYGEN, METALS, ORGANICS
KEY_ANIMAL	VERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	BACTERIA
KEY_MEDIA	WATER
KEY_MISC1	MONITORING, WATER QUALITY, HYDROLOGY, BENTHOS, FISH, SALMONID, CONTAMINANT, HUMAN HEALTH, FOOD CHAIN
KEY_MISC2	SAMPLING, PULP MILL
KEY_MISC3	

AUTHOR	EVS Consultants Ltd.
DATE	**1991.**
DUP_DATE	
TITLE	**Volume II Baseline Environmental Studies of the Lesser Slave River.**
OTHER1	**Prepared for: Slave Lake Pulp Corporation, Edmonton.**
PUBLISHER	**EVS Consultants Ltd., North Vancouver, B.C.**
OTHER2	**May, 1991. EVS Project No. 3/405-03.**

ANNOTATION *Pre-operational baseline studies of the Lesser Slave River reported in this volume include the results of field work in the spring and fall of 1990 and a comparison with the 1989 pre-operational data. The surveys included water chemistry for a wide range of parameters including total phosphorus and nitrogen (nitrite, nitrate, ammonia and total Kjeldahl), dissolved oxygen modelling, dioxins and furans, bacteriological studies, periphyton, benthos and fisheries. Epilithic periphyton was sampled by scraping natural rock substrates and analyzed for chlorophyll a. Benthic invertebrates were sampled (3 replicates per sample) in May and October using a Ponar grab for silty areas and a Hess sampler for riffle areas.*

KEY_WATER	LESSER SLAVE, ATHABASCA
KEY_GEOG	ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	METAL, TOXIC, ORGANICS, OXYGEN, PHYSICAL PARAMETERS, OXYGEN DEMAND, NON-METAL INORGANICS
KEY_ANIMAL	VERTEBRATE, INVERTEBRATE
KEY_PLANT	ALGAE, CHLOROPHYLL
KEY_MCROBE	BACTERIA
KEY_MEDIA	WATER, BIOTA, SEDIMENT
KEY_MISC1	PULP MILL, BASELINE, RIVER, FISH, EIA, NUTRIENT, BENTHOS, ORGANOCHLORINE, SURVEY, WATER QUALITY
KEY_MISC2	SLAVE LAKE, REPRODUCTION
KEY_MISC3	

AUTHOR	EVS Consultants Ltd.
DATE	**1990.**
DUP_DATE	
TITLE	**Volume I Baseline Environmental Studies of the Lesser Slave River.**
OTHER1	**Prepared for Slave Lake Pulp Corporation, Edmonton.**
PUBLISHER	**EVS Consultants, North Vancouver, B.C.**
OTHER2	**August, 1990. EVS Project No. 3/405-01.**

ANNOTATION *Pre-operational baseline studies of the Lesser Slave River reported in this volume include the results of field work in the spring and fall of 1989 and the winter of 1990. The surveys included a habitat survey, water chemistry for a wide range of parameters including total phosphorus and nitrogen (nitrite, nitrate, ammonia and total Kjeldahl), organics, metals, dissolved oxygen modelling, bacteriological studies, periphyton, benthos and fisheries. Epilithic periphyton was sampled by artificial substrates (ceramic tiles) and analyzed for chlorophyll a. Benthic invertebrates were sampled (three replicates per sample) in May and October using a Ponar grab for silty areas and a Hess sampler for riffle areas.*

KEY_WATER	LESSER SLAVE, ATHABASCA
KEY_GEOG	ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	METAL, NON-METAL INORGANICS, ORGANICS, OXYGEN, OXYGEN DEMAND, PHYSICAL PARAMETERS, TOXIC
KEY_ANIMAL	VERTEBRATE, INVERTEBRATE
KEY_PLANT	ALGAE, CHLOROPHYLL
KEY_MCROBE	BACTERIA
KEY_MEDIA	WATER
KEY_MISC1	PULP MILL, BASELINE, RIVER, FISH, HYDROLOGY, EIA, NUTRIENT, BENTHOS, SAMPLING, SURVEY
KEY_MISC2	WATER QUALITY
KEY_MISC3	

AUTHOR	EVS Consultants Ltd.
DATE	**1986.**
DUP_DATE	
TITLE	**Biological Effects Study of Dredged Material Discharge to the Athabasca River near Fort McMurray, Alberta.**
OTHER1	**Prepared for Environmental Affairs, Suncor, Inc., Oil Sands Division, Fort McMurray, Alberta.**
PUBLISHER	**EVS Consultants Ltd.**
OTHER2	
ANNOTATION	*Natural and artificial substrates were used to collect benthic invertebrates at seven sites within the Athabasca River located upstream and downstream of the summer 1986 dredging of the raw water pond at the Suncor oil sands operation. Dredging had no appreciable effect.*
KEY_WATER	ATHABASCA
KEY_GEOG	ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	PHYSICAL PARAMETERS
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	FUNGI, BACTERIA, MICROBE
KEY_MEDIA	WATER, SEDIMENT
KEY_MISC1	SUNCOR, BENTHOS, OIL, EFFLUENT, IMPACT, RIVER, SURVEY
KEY_MISC2	
KEY_MISC3	

AUTHOR	EVS Consultants.
DATE	**1984.**
DUP_DATE	
TITLE	**Suncor Tailings Ponds Water Quality and Reclamation, 1984.**
OTHER1	**Presentation to Suncor, Inc., November 29, 1984.**
PUBLISHER	**EVS Consultants.**
OTHER2	**11th Annual Aquatic Toxicity Workshop. Introductory comments by John Sprague.**
ANNOTATION	*This report contains the material on the overheads which supported a presentation to Suncor, Inc. Contains summary tables and graphs of limnological (chemistry, biology, toxicology) studies on tailings ponds. Not directly related to Athabasca River.*
KEY_WATER	ATHABASCA
KEY_GEOG	ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	METAL, NON-METAL INORGANICS, PHYSICAL PARAMETERS, OXYGEN, OXYGEN DEMAND, ORGANICS, TOXIC
KEY_ANIMAL	VERTEBRATE, INVERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	BACTERIA
KEY_MEDIA	WATER, SEDIMENT
KEY_MISC1	ECOLOGY, FISH, STUDIES, MONITORING, SAMPLING, SUNCOR, OIL, WATER QUALITY, SURVEY, HYDROLOGY
KEY_MISC2	
KEY_MISC3	

AUTHOR	Exner, K.K. and T.B. Reynoldson.
DATE	**1976.**
DUP_DATE	
TITLE	**Macrobenthic Fauna Surveys of the Lower Wapiti River, 1973-1975.**
OTHER1	
PUBLISHER	**Pollution Control Division, Alberta Environment. 37 pp.**
OTHER2	
ANNOTATION	*The Water Quality Control Branch undertook annual biological surveys of the lower Wapiti River. Data on benthic invertebrates were collected by kick sampling in 1973 and a cylinder sampler in 1974 and 1975. Five replicates were collected at seven locations from Wembley Ferry to above the Smoky River. No significant change in benthic invertebrates attributable to the Procter & Gamble pulp mill was measured in the first two years of operation.*
KEY_WATER	WAPITI, SMOKY
KEY_GEOG	ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	BIOTA, WATER
KEY_MISC1	RIVER, SURVEY, BENTHOS, PULP MILL, PROCTER & GAMBLE, SAMPLING
KEY_MISC2	
KEY_MISC3	

AUTHOR	Gregoire, P.E. and A.M. Anderson.
DATE	**1987.**
DUP_DATE	
TITLE	**Athabasca River Zoobenthic Survey in the Vicinity of Athabasca, Fall 1985.**
OTHER1	**Environmental Assessment Division Internal Report.**
PUBLISHER	**Alberta Environment, Pollution Control Division, Edmonton. 18 pp.**
OTHER2	

ANNOTATION *This study uses the benthic invertebrate community in the Athabasca River as an indicator of the impact on water quality from the sewage treatment plant at the Town of Athabasca. A survey was conducted on the Athabasca River in the fall of 1985. The invertebrate community was measured using total numbers of invertebrates, population of individual taxa, percent composition of major taxa and multivariate analysis.*

KEY_WATER	ATHABASCA
KEY_GEOG	ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	BIOTA
KEY_MISC1	SEWAGE, RIVER, BENTHOS
KEY_MISC2	
KEY_MISC3	

AUTHOR	Hamilton, H.R., M.V. Thompson and L. Corkum.
DATE	**1985.**
DUP_DATE	
TITLE	**Water Quality Overview of the Athabasca River Basin.**
OTHER1	**Prepared for Planning Division, Alberta Environment.**
PUBLISHER	**Nanuk Engineering Ltd.**
OTHER2	**117 pp. + Appendices.**

ANNOTATION

This report is an overview of water quality patterns for the Athabasca River and its tributaries. The information is taken from historical water quality records collected since 1970 and sampling surveys from 1984 and early 1985. The surveys were of mainstream and tributary sites, as well as effluents from municipal and pulp mill sources on the river. The parameters examined include organics, inorganics, metals, toxic compounds, oxygen demands and nutrients (nitrogen and phosphorus). The forms of nitrogen studied are nitrite-nitrate, ammonia and total nitrogen concentrations (mg/L). Concentrations of particulate and dissolved forms of phosphorus are presented as well. Biological data collected include chlorophyll a, total and fecal coliforms, algae and macrophytes. NAQUADAT codes are provided.

KEY_WATER	ATHABASCA
KEY_GEOG	HINTON, WHITECOURT, ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	PHYSICAL PARAMETERS, ORGANICS, NON-METAL INORGANICS, TOXIC, OXYGEN DEMAND, OXYGEN, METALS
KEY_ANIMAL	
KEY_PLANT	ALGAE, CHLOROPHYLL, MACROPHYTE
KEY_MCROBE	BACTERIA
KEY_MEDIA	EFFLUENT, WATER
KEY_MISC1	PULP MILL, SEWAGE, EFFLUENT, WATER QUALITY, SURVEY, BASIN, NAQUADAT
KEY_MISC2	
KEY_MISC3	

AUTHOR	Hartland-Rowe, R.C.B., R.W. Davies, M. McElhone and R. Crowther.
DATE	**1979.**
DUP_DATE	
TITLE	**The Ecology of Macrobenthic Invertebrate Communities in Hartley Creek, Alberta.**
OTHER1	**Prepared for Alberta Oil Sands Environmental Research Program.**
PUBLISHER	**Department of Biology, University of Calgary.**
OTHER2	**AOSERP Report 49. WS 1.3.3. March 1979. 144 pp.**
ANNOTATION	*This is an ecological study of benthic macroinvertebrates, algae and bacteria in Hartley Creek, a tributary of the Muskeg River in the oil sands area of Alberta. Samples were collected at six sites in 1976 and 1977 using a variety of samplers.*
KEY_WATER	HARTLEY, ATHABASCA, MUSKEG
KEY_GEOG	FORT MCMURRAY, ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	BACTERIA
KEY_MEDIA	BIOTA, WATER
KEY_MISC1	REPRODUCTION, ECOLOGY, BENTHOS, STUDIES, OIL, SAMPLING
KEY_MISC2	
KEY_MISC3	

AUTHOR	HBT AGRA Limited.
DATE	**1992.**
DUP_DATE	
TITLE	**Environmental Monitoring Studies in the Vicinity of the Peace River Pulp Division Mill at Peace River, Alberta, May 1992.**
OTHER1	**Prepared for Daishowa Canada Co. Ltd.**
PUBLISHER	**HBT AGRA Limited (formerly Monenco Consultants Ltd.).**
OTHER2	**November 30, 1992. CE 9001-6.**

ANNOTATION *A water quality and benthic invertebrate survey was conducted at 15 sites (5 replicates per site) on the Peace and Smoky rivers upstream and downstream of the Peace River Pulp Division mill during May 21-22, 1992. A Hess cylinder sampler was used. Water quality analysis included nutrients (total phosphorus and total Kjeldahl nitrogen), physical parameters, non-metal organics and metals.*

KEY_WATER	PEACE, SMOKY
KEY_GEOG	ALBERTA, PEACE RIVER
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	OXYGEN, PHYSICAL PARAMETERS, OXYGEN DEMAND, NON-METAL INORGANICS, METAL
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	
KEY_MEDIA	WATER, SEDIMENT
KEY_MISC1	BENTHOS, WATER QUALITY, SAMPLING, DAISHOWA, PULP MILL, MONITORING
KEY_MISC2	
KEY_MISC3	

AUTHOR Hickman, M., S.E.D. Charlton and C.G. Jenkerson.
DATE **1982.**
DUP_DATE
TITLE **A Comparative Study of Benthic Algal Primary Productivity in the AOSERP Study Area.**
OTHER1 **Prepared for Alberta Oil Sands Environmental Research Program.**
PUBLISHER **Department of Botany, University of Alberta and Department of Plant Sciences, University of Western Ontario.**
OTHER2 **AOSERP Report 128. 139 pp.**

ANNOTATION *Studies concentrating upon the epilithic algal community were conducted in five tributary rivers to the Athabasca River: the Muskeg, Steepbank, Hangingstone, MacKay and Ells rivers. Samples were collected at one site in each river in 1978 and 1979. Epilithic algae were collected by scraping a defined area of natural rock. Species were identified and enumerated, chlorophyll a was measured, and primary productivity was measured using the carbon-14 technique. Water chemistry analyses included the nutrients nitrate-nitrogen and phosphate-phosphorus.*

KEY_WATER ATHABASCA, MUSKEG, STEEPBANK, MACKAY
KEY_GEOG ALBERTA
KEY_NTROGN NITROGEN
KEY_PHSFRS PHOSPHORUS
KEY_PARAM
KEY_ANIMAL INVERTEBRATE
KEY_PLANT ALGAE, CHLOROPHYLL
KEY_MCROBE
KEY_MEDIA WATER, BIOTA
KEY_MISC1 BENTHOS, RIVER, OIL, NUTRIENT, SAMPLING
KEY_MISC2
KEY_MISC3

AUTHOR	Holmberg, R.
DATE	**1992.**
DUP_DATE	
TITLE	**Pulp Mills and the Environment: An Annotated Bibliography of Northern Alberta.**
OTHER1	**May 1992.**
PUBLISHER	**Athabasca University, Athabasca; Canadian Circumpolar Institute, University of Alberta, Edmonton; Environmental Research and Study Cenre, University of Alberta, Edmonton.**
OTHER2	
ANNOTATION	*"An annotated list of books, technical reports and periodical articles related to the development and operation of pulp and paper mills in northern Alberta" (cited from document). This is a very general annotated bibliography.*
KEY_WATER	ATHABASCA, CLEARWATER, PEACE, PEACE-ATHABASCA, MACKAY, HARTLEY, MUSKEG, STEEPBANK, BEAVER, WAPITI
KEY_GEOG	ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	TOXIC, ORGANICS
KEY_ANIMAL	FAUNA, INVERTEBRATE, VERTEBRATE
KEY_PLANT	FLORA, ALGAE
KEY_MCROBE	
KEY_MEDIA	
KEY_MISC1	RIVER, PULP MILL, EIA, ORGANOCHLORINE, ALBERTA-PACIFIC, DAISHOWA, MILLAR WESTERN, FISH, OIL, MODEL
KEY_MISC2	BASELINE, WATER QUALITY, BIBLIOGRAPHY, ANNUAL REPORT, EFFLUENT, SUNCOR, SYNDRUDE, BENTHOS
KEY_MISC3	SAMPLING, PROCTER AND GAMBLE, ANC, SLAVE LAKE, HYDROLOGY

AUTHOR	HydroQual Consultants Inc.
DATE	**1988**
DUP_DATE	**b.**
TITLE	**Selection of Water-Quality Modelling Techniques for the Athabasca River Basin - Assignment #1.**
OTHER1	**Prepared for Alberta Environment Planning Division.**
PUBLISHER	**Hydroqual Consultants Inc., Calgary, Alberta.**
OTHER2	**November 1988. 70 pp + Appendices.**

ANNOTATION *This report focuses on water quality modelling for the Athabasca River Basin Planning Program. The information contained includes: 1) a review of the proceedings of a workshop held in Edmonton on April 29-30, 1988 regarding water pollution and water quality modelling issues, 2) an overview of the modelling process, 3) an examination of available models, 4) detailed recommendations relevant to the models to be used by the Athabasca River Basin Planning Committee. Appendices include: discussions of the effects of organic compounds, nutrients (nitrogen and phosphorus), and effluents in general on aquatic systems; water quality standards for the protection of aquatic life; and a water quality model that depicts, in part, a simple phosphorus cycle and a more complex nitrogen cycle.*

KEY_WATER	ATHABASCA
KEY_GEOG	ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	OXYGEN, ORGANICS
KEY_ANIMAL	VERTEBRATES, INVERTEBRATES
KEY_PLANT	ALGAE, MACROPHYTES
KEY_MCROBE	BACTERIA
KEY_MEDIA	
KEY_MISC1	MODEL, PULP MILL, EFFLUENT, WATER QUALITY, ECOSYSTEM
KEY_MISC2	
KEY_MISC3	

AUTHOR	Integrated Environmental Sciences Inc.
DATE	**1986**
DUP_DATE	**a.**
TITLE	**Biological and Water Quality Survey of the Athabasca River, 1986.**
OTHER1	**Prepared for Champion Forest Products (Alberta) Ltd.**
PUBLISHER	**Integrated Environmental Sciences Inc.**
OTHER2	
ANNOTATION	*Athabasca River water samples and benthic invertebrate samples were collected on April 8, 1986 from two stations upstream of the Champion pulp mill effluent and seven stations downstream to a distance of about 43 km below the mill outfall. Water quality analyses included organics, physical parameters and BOD but not nutrients. The benthic invertebrates were collected by a Neill cylinder.*
KEY_WATER	ATHABASCA
KEY_GEOG	ALBERTA, HINTON
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	ORGANICS, PHYSICAL PARAMETERS, OXYGEN, OXYGEN DEMAND
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	WATER, BIOTA
KEY_MISC1	HINTON, WATER QUALITY, MONITORING, SURVEY, SAMPLING, RIVER, PULP MILL, EFFLUENT, IMPACT
KEY_MISC2	
KEY_MISC3	

AUTHOR	Integrated Environmental Sciences Inc.
DATE	**1984**
DUP_DATE	**b.**
TITLE	**Biological and Water Quality Survey of the Athabasca River, 1984.**
OTHER1	**Prepared for St. Regis (Alberta) Ltd., Grande Prairie, Alberta.**
PUBLISHER	**IES Inc.**
OTHER2	**26 pp. + Appendices.**
ANNOTATION	*"To monitor the effects of mill effluent on the Athabasca River, St. Regis (Alberta) Ltd. retained Integrated Environmental Services Inc. to conduct a biological and chemical water quality survey of the river. The study was based on the concept of documenting river water chemistry and benthic macroinvertebrate communities at various selected locations above and below the point where the effluent is discharged into the river. Data collected from locations upstream of the plant outfall (control stations) were compared with data collected from locations downstream of the plant outfall (effluent affected stations) to assess the impact of plant effluent on the Athabasca River" (cited from document).*
KEY_WATER	ATHABASCA
KEY_GEOG	HINTON, ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	PHYSICAL PARAMETERS, OXYGEN DEMAND, OXYGEN, ORGANICS
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	BIOTA, WATER
KEY_MISC1	WATER QUALITY, SURVEY, RIVER, BENTHOS, PULP MILL, EFFLUENT, SAMPLING, IMPACT
KEY_MISC2	
KEY_MISC3	

AUTHOR	Jaakko Poyry Oy.
DATE	**1990.**
DUP_DATE	
TITLE	**Complementary Scientific Review of the Proposed Alberta-Pacific Pulp Mill Project Environmental Impact Assessment, Main Report.**
OTHER1	**Prepared for Alberta Research Council, ARC Contribution Series 1855. June 1990.**
PUBLISHER	
OTHER2	

ANNOTATION

This report was "carried out to study the earlier environmental impact assessment on the proposed Alberta-Pacific Pulp Mill Project (Athabasca River), and to find complementary scientific data to better assess the potential and probable effects of the proposed development. Unlike the previous Review Board the team has also reviewed the effluent releases and water pollution control measures in the context of the entire Athabasca and Peace River watersheds.... The terms of reference for this project were to review all of the available data on the effects of chlorinated organic compounds and the biological oxygen demand that would be discharged in the pulp mill effluents.... The review has attempted to provide a detailed environmental evaluation of all pulp mills in the study area so that an assessment can be made of the potential cumulative effects" (cited from document).

Nutrient data are provided: 1) contributions from various pulp mill effluents of total phosphorus (mg/l) into the Athabasca River, and 2) mass load estimates of total phosphorus and total dissolved phosphorus (kg/d) into the Athabasca River system.

KEY_WATER	ATHABASCA, PEACE
KEY_GEOG	ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	TOXIC, ORGANICS, OXYGEN DEMAND, METAL, NON-METAL INORGANICS, PHYSICAL PARAMETERS, OXYGEN
KEY_ANIMAL	VERTEBRATE, INVERTEBRATE
KEY_PLANT	ALGAE, CHLOROPHYLL
KEY_MCROBE	
KEY_MEDIA	EFFLUENT
KEY_MISC1	PULP MILL, RIVER, ALBERTA-PACIFIC, EIA, EFFLUENT, ORGANOCHLORINE, FISH, NUTRIENT, WATER QUALITY
KEY_MISC2	PROCTER & GAMBLE, WELDWOOD, DAISHOWA, ALBERTA-PACIFIC
KEY_MISC3	

AUTHOR	Lock, M.A., R.R. Wallace, D.R. Barton and S. Charlton.
DATE	**1981.**
DUP_DATE	
TITLE	**The Effects of Synthetic Crude Oil on Microbial and Macroinvertebrate Benthic River Communities: Part II - The Response of an Established Community to Contamination by Synthetic Crude Oil.**
OTHER1	**In Environmental Pollution (Series A) 24(1981): 263-275, edited by Kenneth Mellanby.**
PUBLISHER	**Applied Science Publishers Ltd., Essex, England.**
OTHER2	
ANNOTATION	*The effects of synthetic crude oil and its major components (naphtha, kerosene and gas/oil) on benthic macroinvertebrates, algae and bacteria were tested in the Muskeg River, northeastern Alberta, using limestone bricks as substrates. Oiled and unoiled bricks were studies for 161 days in 1977.*
KEY_WATER	MUSKEG, ATHABASCA
KEY_GEOG	FORT MCMURRAY, ATHABASCA, ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	BACTERIA
KEY_MEDIA	WATER
KEY_MISC1	OIL, RIVER, BENTHOS, SPILL, STUDIES, CONTAMINANT, NUTRIENT
KEY_MISC2	
KEY_MISC3	

AUTHOR	Lutz, A. and M. Hendzel.
DATE	**1977.**
DUP_DATE	
TITLE	**A Survey of Baseline Levels of Contaminants in Aquatic Biota of the AOSERP Study Area.**
OTHER1	**Prepared for Alberta Oil Sands Environmental Research Program.**
PUBLISHER	**Fisheries and Environment Canada. Freshwater Institute.**
OTHER2	**AOSERP Report 17. Project AF 2.1.1. 51 pp.**
ANNOTATION	*"Analyses are given for up to 12 metals and 4 pesticides with PCBs, of aquatic environmental samples from 15 study sites along or near the Athabasca River from Fort McMurray north to the confluence of the Peace and Slave Rivers. There were 560 fish (8 species), 15 water, 14 sediments and a few phytoplankton and invertebrate samples. Methods of analysis (by AAS and GLC) are outlines, and standard deviations and detection limits given. In a few cases, where suspected, elevated concentrations of metals and pesticides are discussed" (as cited in document).*
KEY_WATER	ATHABASCA
KEY_GEOG	ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	METALS, TOXIC, ORGANICS
KEY_ANIMAL	VERTEBRATE, INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	WATER, BIOTA, SEDIMENT
KEY_MISC1	OIL, FISH, BENTHOS, CONTAMINANTS, SAMPLING, ORGANOCHLORINE
KEY_MISC2	
KEY_MISC3	

AUTHOR	MacDonald, D.D. and S.L. Smith.
DATE	**1990.**
DUP_DATE	
TITLE	**An Approach to Monitoring Ambient Environmental Quality in the Slave River Basin, Northwest Territories: Toward a Consensus.**
OTHER1	**Prepared for Water Resources Division, Renewable Resources and Environment, Indian and Northern Affairs Canada.**
PUBLISHER	**MacDonald Environmental Sciences Ltd., Ladysmith, British Columbia.**
OTHER2	

ANNOTATION

"The territorial portion of the Slave River basin is a pristine watercourse which provides a host of benefits to Canadians, in general, and residents of the NWT, in particular. The system supports a variety of economically and sociologically important water uses. Specifically, the Slave River provides raw water for domestic water supply and an abundance of aquatic life that are essential to local area residents. Recreation is an emerging water use in the basin that has the potential to benefit residents and visitors to the area, alike.

...The present report provides a framework for environmental quality monitoring in the Slave River by incorporating the suggestions from the Strategy Session into the draft monitoring program design recommended by MacDonald (1990). The resultant integrated multi-media monitoring program is designed to provide baseline data on levels of contaminants in water, suspended sediment and biota in the territorial portion of the Slave River basin. As such, the monitoring program design provides recommendations on the location of sampling sites, sampling frequency, sampling methods, sample archiving, and quality assurance/quality control. In addition, a complete listing of variables which should be measured in each environmental compartment (ie. water, suspended sediment, and biota) is provided" (as cited in document).

KEY_WATER	SLAVE
KEY_GEOG	NORTHWEST TERRITORIES
KEY_NTROGN	NITROGEN
KEY_PHSFRS	
KEY_PARAM	PHYSICAL PARAMETERS, OXYGEN, NON-METAL INORGANICS, ORGANICS, TOXIC, METALS
KEY_ANIMAL	INVERTEBRATE, VERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	
KEY_MEDIA	WATER
KEY_MISC1	ORGANOCHLORINE, RIVER, BASIN, SAMPLING, MONITORING, MODEL, WATER QUALITY, FISH, CONTAMINANT
KEY_MISC2	REPRODUCTION, BIOACCUMULATION, ECOSYSTEM, GEOLOGY, NUTRIENT

AUTHOR	MacDonald, G. and B.R. Taylor.
DATE	**1990.**
DUP_DATE	
TITLE	**Implementation of Water Quality Models for the Wapiti-Smoky and Peace River Systems.**
OTHER1	**Prepared for Alberta Environment, Standards and Approvals Division.**
PUBLISHER	**HydroQual Canada Ltd.**
OTHER2	**127 pp + Appendices.**

ANNOTATION

Water quality models were implemented to evaluate the effects of pulp mill effluents on the Wapiti, Smoky and Peace Rivers. The model input file uses information collected by Alberta Environment in 1988 and 1989 for the Peace River, and in 1989 and 1990 for the Wapiti-Smoky Rivers. The collected data include: river flow, effluent quality and quantity, dissolved oxygen, sediment oxygen demand, biochemical oxygen demand, suspended solids, and water chemistry.

The water chemistry analyses include the following parameters: colour, organics, toxic organics, metals, ions, non-filterable residue, total nitrogen and total phosphorus. Data as concentrations (mg/L) and effluent loads (kg/day) are provided. Future model applications and recommendations are outlined. A hydraulic analysis (by NANUK Engineering, 1990) is included in the Appendix.

KEY_WATER	WAPITI, SMOKY, PEACE
KEY_GEOG	GRANDE PRAIRIE, PEACE RIVER, ALBERTA
KEY_NTROGN	
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	METAL, NON-METAL INORGANICS, ORGANICS, OXYGEN, OXYGEN DEMAND, TOXIC
KEY_ANIMAL	
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	EFFLUENT, SEDIMENT, WATER
KEY_MISC1	PULP MILL, EFFLUENT, RIVER, MODEL, WATER QUALITY
KEY_MISC2	
KEY_MISC3	

AUTHOR	MacDonald, G. and H.R. Hamilton.
DATE	**1989.**
DUP_DATE	
TITLE	**Model Calibration and Receiving Water Evaluation for Pulp Mill Developments on the Athabasca River: 1. Dissolved Oxygen.**
OTHER1	**Prepared for Standards and Approvals Division, Alberta Environment, Edmonton, Alberta.**
PUBLISHER	**HydroQual Consultants Inc., Calgary, Alberta.**
OTHER2	**June 1989. 44 pp + Appendices.**
ANNOTATION	*"This report describes in detail the updated Athabasca River oxygen model calibration, procedures for evaluating future BOD effluent loading scenarios, and results of a few select scenario evaluations. The appendices include the complete model input files... and graphical model output" (cited from document). The scenario evaluations include the Weldwood, ANC, Millar Western, A.E.C., and Alberta Pacific pulp mills, and are based on surveys from 1988 and 1989. Data includes: BOD oxidation rates, settling rates, loading (kg/day), and ratios - SOD (mg/L/day), and dissolved oxygen (mg/L). There is no data relevant to nutrient loading in the Athabasca River.*
KEY_WATER	ATHABASCA
KEY_GEOG	HINTON, WHITECOURT, SLAVE LAKE, ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	OXYGEN, OXYGEN DEMAND
KEY_ANIMAL	
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	SEDIMENT, WATER
KEY_MISC1	PULP MILL, EFFLUENT, MODEL, ALBERTA-PACIFIC, WELDWOOD, ANC, SLAVE LAKE, MILLAR WESTERN, RIVER
KEY_MISC2	
KEY_MISC3	

AUTHOR	McCart, P., P. Tsui, W. Grant and R. Green.
DATE	**1977.**
DUP_DATE	
TITLE	**Baseline Studies of Aquatic Environments in the Athabasca River near Lease 17. Volume 1: Baseline Studies.**
OTHER1	**Environmental Research Monograph 1977-2.**
PUBLISHER	**Syncrude Canada Ltd., Edmonton, Alberta.**
OTHER2	

ANNOTATION *This baseline study of the Athabasca River was carried out in 1974 and 1975 at the request of Syncrude Canada Limited in the vicinity of Lease Number 17, which borders the west bank of the Athabasca River north of Fort McMurray. Benthic invertebrates were collected from 15 stations using artificial substrate samplers and a modified Ekman-type grab sampler. Three replicates were usually collected at each site monthly from June to October, 1975. Periphyton samples were collected monthly from December 1974 to October 1975 using glass microscope slides as artificial substrates. Periphyton biomass was estimated and taxa were identified and enumerated. Chemical analyses included the nutrients, total dissolved nitrogen, total dissolved phosphorus and reactive silica. The baseline also included a fisheries study. Species were collected by electrofishing.*

KEY_WATER	ATHABASCA
KEY_GEOG	FORT MCMURRAY, ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	
KEY_ANIMAL	VERTEBRATE, INVERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	
KEY_MEDIA	WATER, BIOTA
KEY_MISC1	FISH, BENTHOS, RIVER, BASELINE, SYNCRUDE, OIL, WATER QUALITY, SURVEY, SAMPLING, NUTRIENT
KEY_MISC2	
KEY_MISC3	

AUTHOR	McCart, P., P. Tsui, W. Grant, R. Green and D. Tripp.
DATE	**1978.**
DUP_DATE	
TITLE	**Baseline Study of the Water Quality and Aquatic Resources of the Mackay River, Alberta.**
OTHER1	**Environmental Research Monograph 1978-4.**
PUBLISHER	**Syncrude Canada Ltd., Edmonton, Alberta.**
OTHER2	
ANNOTATION	*This baseline study of the MacKay River, a tributary to the Athabasca River, includes water quality, periphyton, benthic macroinvertebrate, fish and habitat data collected in 1977 and/or 1978. Chemical analyses for nutrients included nitrate, total nitrogen, total phosphates and ortho-phosphate. Three sampling techniques were used for periphyton and two methods, Surber sampler and artificial substrate, were used for invertebrates. Stations at the upper, middle and lower reaches of the river were sampled.*
KEY_WATER	MACKAY
KEY_GEOG	ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	
KEY_ANIMAL	VERTEBRATE, INVERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	
KEY_MEDIA	WATER, BIOTA
KEY_MISC1	FISH, RIVER, BENTHOS, BASELINE, OIL, SYNCRUDE, SURVEY, WATER QUALITY, NUTRIENT, SAMPLING
KEY_MISC2	
KEY_MISC3	

AUTHOR	McCubbin, N. and J. Folke.
DATE	**1992.**
DUP_DATE	
TITLE	**Review of Literature on Characteristics of Effluent from Pulp and Paper Mills in Northern River Basins of Alberta, BC and Northwest Territories.**
OTHER1	**Prepared for Northern River Basins Study.**
PUBLISHER	**N. McCubbin Consultants Inc., Foster, Quebec.**
OTHER2	**Project No. 2085. 84 pp.**

ANNOTATION

"This report is a brief overview of the literature on the characteristics of pulp and paper mill effluents which are relevant to the Northern River Basins in Alberta. Topics include: 1) pulp manufacturing processes (wood preparation, kraft pulp, bleaching of kraft pulp, recovery of kraft pulping chemicals, mechanical-sulphite spectrum of pulping), 2) effluent treatment (wastewater treatment classification, biological treatment processes, nutrients, removal of metals in biological treatment), and 3) effluent characteristics (chemical characterization, general wastewater variables (including nutrients), resin acids, steroids, chelating substances, AOX, organochlorine compounds, lipophilic/neutral organochlorines, PCDD/PCDF, chlorate, metals)" (cited from document).

Summary data are provided on dioxin (pg/l, ug/day, ug/ton), AOX (kg/day, kg/t), color (kg/d, kg/t), phenols (mg/l, g/day, g/t pulp), resins and fatty acids (ug/l, kg/day, g/t), and metals (ug/l) for selected pulp mills' effluents. No data summary is given for nutrients in effluents.

A discussion is given for the additions and characteristics of nutrients in pulp mill effluents: total Kjeldahl nitrogen, ammonia/ammonium and phosphorus. Information is brief.

KEY_WATER	ATHABASCA, SLAVE, PEACE, WAPITI
KEY_GEOG	ALBERTA, BRITISH COLUMBIA, NORTHWEST TERRITORIES
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	METAL, NON-METAL ORGANICS, ORGANICS, OXYGEN, OXYGEN DEMAND, PHYSICAL PARAMETERS, TOXIC
KEY_ANIMAL	
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	WATER, EFFLUENT
KEY_MISC1	DAISHOWA, EFFLUENT, NUTRIENT, ORGANOCHLORINE, PULP MILL, RIVER, WATER QUALITY, PROCTER AND GAMBLE
KEY_MISC2	WELDWOOD, MILLAR WESTERN, SLAVE LAKE, ANC
KEY_MISC3	

AUTHOR	Mobius, C.H.
DATE	**1991.**
DUP_DATE	
TITLE	**Nitrogen and Phosphorus Limits for Nutrient Deficient Industrial Wastewaters.**
OTHER1	
PUBLISHER	**Wat. Sci. Tech. 24(3/4):259-267.**
OTHER2	
ANNOTATION	*This paper relates to the operation of waste water treatment plants. It addresses the nutrient requirements of biological treatment to assure optimal BOD removal.*
KEY_WATER	
KEY_GEOG	
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	
KEY_ANIMAL	
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	WATER, EFFLUENT
KEY_MISC1	EFFLUENT, NUTRIENT, WATER QUALITY, INDUSTRY
KEY_MISC2	
KEY_MISC3	

AUTHOR	Monenco Consultants Ltd.
DATE	**1992**
DUP_DATE	**a.**
TITLE	**Environmental Monitoring Studies in the Vicinity of the Peace River Pulp Division Mill at Peace River, Alberta, April, 1991.**
OTHER1	**Prepared for Daishowa Canada Co. Ltd.**
PUBLISHER	**Monenco Consultants Ltd., Calgary, Alberta.**
OTHER2	**January 3, 1992.**

ANNOTATION *A water quality and benthic invertebrate survey was conducted at 10 sites (5 replicates per site) on the Peace and Smoky rivers 14 km upstream and 30 km downstream of the Daishowa Peace River Pulp Division mill during April 26-30, 1991. A Hess cylindrical sampler was used. Water quality characteristics examined included nutrients (total phosphorus (mg/l) and total Kjeldahl nitrogen (mg/l)), oxygen demand, physical parameters, metals and non-metal organics.*

KEY_WATER	PEACE, SMOKY
KEY_GEOG	ALBERTA, PEACE RIVER
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	OXYGEN DEMAND, PHYSICAL PARAMETERS, METALS, NON-METAL ORGANICS
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	
KEY_MEDIA	WATER, SEDIMENT
KEY_MISC1	PULP MILL, DAISHOWA, MONITORING, RIVER, BENTHOS, SAMPLING, WATER QUALITY, HYDROLOGY, SURVEY
KEY_MISC2	EFFLUENT, IMPACT
KEY_MISC3	

AUTHOR	Monenco Consultants Ltd.
DATE	**1992**
DUP_DATE	**b.**
TITLE	**Environmental Monitoring Studies in the Vicinity of the Peace River Pulp Division Mill at Peace River, Alberta, October, 1991.**
OTHER1	**Prepared for Daishowa Canada Co. Ltd.**
PUBLISHER	**Monenco Consultants Ltd., Calgary, Alberta.**
OTHER2	**January 3, 1992.**

ANNOTATION *A water quality and benthic invertebrate survey was conducted at 13 sites (5 replicates per site) on the Peace and Smoky rivers 14 km upstream and 30 km downstream of the Daishowa Peace River Pulp Division mill during October 5-6, 1991. A Hess cylindrical sampler was used. Water quality characteristics examined included nutrients (total phosphorus (mg/l) and total Kjeldahl nitrogen (mg/l)), oxygen demand, physical parameters, metals and non-metal organics.*

KEY_WATER	PEACE, SMOKY
KEY_GEOG	ALBERTA, PEACE RIVER
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	NON-METAL ORGANICS, OXYGEN DEMAND, METALS, PHYSICAL PARAMETERS, ORGANICS, OXYGEN
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	
KEY_MEDIA	WATER, SEDIMENT
KEY_MISC1	PULP MILL, DAISHOWA, MONITORING, RIVER, WATER QUALITY, EFFLUENT, SAMPLING, BENTHOS
KEY_MISC2	
KEY_MISC3	

AUTHOR	Monenco Consultants Ltd.
DATE	**1991**
DUP_DATE	**a.**
TITLE	**Environmental Monitoring Studies in the Vicinity of the Peace River Pulp Mill at Peace River, Alberta, September, 1990.**
OTHER1	**Prepared for Daishowa Canada Co. Ltd.**
PUBLISHER	**Monenco Consultants Ltd., Calgary, Alberta.**
OTHER2	**January 9, 1991.**

ANNOTATION *A water quality and benthic invertebrate survey was conducted at 13 sites (5 replicates per site) on the Peace and Smoky rivers 14 km upstream and 55 km downstream of the Peace River Pulp Division mill during September 17-19, 1990. A Hess cylindrical sampler was used. Water quality characteristics examined included nutrients (total phosphorus (mg/l) and total Kjeldahl nitrogen (mg/l)), oxygen demand, physical parameters, metals and non-metal organics.*

KEY_WATER	PEACE, SMOKY
KEY_GEOG	ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	OXYGEN DEMAND, NON-METAL ORGANICS, METALS
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	
KEY_MEDIA	WATER
KEY_MISC1	PULP MILL, DAISHOWA, MONITORING, RIVER, BENTHOS, WATER QUALITY, SAMPLING
KEY_MISC2	
KEY_MISC3	

AUTHOR	Monenco Consultants Ltd.
DATE	**1990**
DUP_DATE	**a.**
TITLE	**Environmental Monitoring Studies in the Vicinity of the Peace River Pulp Company Mill at Peace River, Alberta, July, 1989.**
OTHER1	**Prepared for Daishowa Canada Co. Ltd.**
PUBLISHER	**Monenco Consultants Ltd., Calgary, Alberta.**
OTHER2	**January 1, 1990.**

ANNOTATION *A water quality and benthic invertebrate survey was conducted on the Peace and Smoky rivers upstream and downstream of the Daishowa Peace River Pulp Division mill during July 7-9, 1989. A Hess cylindrical sampler was used to collect 5 replicate samples per site. Nutrient analyses included total phosphorus (mg/l) and total Kjeldahl nitrogen (mg/l).*

KEY_WATER	PEACE, SMOKY
KEY_GEOG	ALBERTA, PEACE RIVER
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	WATER
KEY_MISC1	PULP MILL, DAISHOWA, MONITORING, RIVER, BENTHOS, WATER QUALITY
KEY_MISC2	
KEY_MISC3	

AUTHOR	Monenco Consultants Ltd.
DATE	**1990**
DUP_DATE	**b.**
TITLE	**Environmental Monitoring Studies in the Vicinity of the Peace River Pulp Company Mill at Peace River, Alberta, September 1989.**
OTHER1	**Prepared for Daishowa Canada Co. Ltd.**
PUBLISHER	**Monenco Consultants Ltd., Calgary, Alberta.**
OTHER2	**February 9, 1990.**
ANNOTATION	*A water quality and benthic invertebrate survey was conducted at 14 sites (5 replicates per site) on the Peace and Smoky rivers upstream and downstream of the Peace River Pulp Division mill during September 26 to October 1, 1989. A Hess cylindrical sampler was used. Nutrient analysis included total phosphorus and total Kjeldahl nitrogen.*
KEY_WATER	PEACE
KEY_GEOG	ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	
KEY_ANIMAL	
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	
KEY_MISC1	PULP MILL, MONITORING, DAISHOWA, RIVER, BENTHOS, WATER QUALITY
KEY_MISC2	
KEY_MISC3	

AUTHOR	Monenco Consultants Ltd.
DATE	**1990**
DUP_DATE	**d.**
TITLE	**Environmental Monitoring Studies in the Vicinity of the Peace River Pulp Company Mill at Peace River, Alberta, April, 1990.**
OTHER1	**Prepared for Daishowa Canada Co. Ltd.**
PUBLISHER	**Monenco Consultants Ltd., Calgary, Alberta.**
OTHER2	**November 15, 1990.**
ANNOTATION	*A water quality and benthic invertebrate survey was conducted at 11 sites (5 replicates per site) on the Peace and Smoky rivers upstream and downstream of the Daishowa Peace River Pulp Division mill during April 21-24, 1990. A Hess cylindrical sampler was used. Nutrient analyses included total phosphorus (mg/l) and total Kjeldahl nitrogen (mg/l).*
KEY_WATER	PEACE, SMOKY
KEY_GEOG	ALBERTA, PEACE RIVER
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	
KEY_ANIMAL	
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	WATER
KEY_MISC1	DAISHOWA, PULP MILL, MONITORING, RIVER, BENTHOS, WATER QUALITY
KEY_MISC2	
KEY_MISC3	

AUTHOR	Monenco Inc.
DATE	**1993.**
DUP_DATE	
TITLE	**Sediment Oxygen Demand Investigations, Athabasca River, January to March, 1992.**
OTHER1	**Prepared for the Northern River Basins Study under Project 2221-A1.**
PUBLISHER	**Northern River Basins Study, Edmonton, Alberta.**
OTHER2	**February 1993.**
ANNOTATION	*This report "details the results of sediment oxygen demand investigations conducted on the Athabasca River during 28 January - 26 March 1992" (cited from document). Collections and measurements were conducted using open and closed SOD chambers and the sediment core method. Parameters analyzed include dissolved oxygen, water velocity, water depth, substrate characteristics, percent organic content and percent total organic content. Nutrients are not discussed.*
KEY_WATER	ATHABASCA
KEY_GEOG	ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	OXYGEN DEMAND, PHYSICAL PARAMETERS
KEY_ANIMAL	
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	SEDIMENT
KEY_MISC1	RIVER
KEY_MISC2	
KEY_MISC3	

AUTHOR	Moore, J.E. and R.J. Love.
DATE	1977.
DUP_DATE	
TITLE	**Effect of a Pulp and Paper Mill Effluent on Periphyton and Phytoplankton.**
OTHER1	
PUBLISHER	**J. Fish. Res. Board Can. 34: 856-862.**
OTHER2	
ANNOTATION	*The short-term effect of a kraft mill effluent on the productivity of periphyton and phytoplankton from Nipigon Bay of Lake Superior was examined. Periphyton were collected using artificial substrates. Periphyton and phytoplankton were incubated in dilutions of raw effluent in 1974. Photosynthesis was reduced at high effluent concentrations due mainly to changes in pH.*
KEY_WATER	
KEY_GEOG	CANADA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	
KEY_MEDIA	WATER, EFFLUENT, BIOTA
KEY_MISC1	PULP MILL, EFFLUENT, STUDIES, SAMPLING, BENTHOS
KEY_MISC2	
KEY_MISC3	

AUTHOR	Munn, N. and E.E. Prepas.
DATE	**1986.**
DUP_DATE	
TITLE	**Seasonal Dynamics of Phosphorus Partitioning and Export in Two Streams in Alberta, Canada.**
OTHER1	
PUBLISHER	**Can. J. Fish. Aquat. Sci. 43:2464-2471.**
OTHER2	
ANNOTATION	*"In 1983, phosphorus (P) export was quantified for two streams in Alberta, Canada. The influence of changes in discharge on P concentration and partitioning was examined on an annual and seasonal basis and these data were used to develop empirical models to predict P concentrations. Phosphorus export peaked during summer storms; 68% of annual total P loading was transported during 12 d in early summer. Annual total P exports were 7.5 and 13.0 mg/m2 (watershed area) for the two streams, primarily in the fine particulated fraction. The empirical models presented are the first based on detailed data from watershed with the following characteristics: (1) trees predominantly coniferous, (2) deep glacial till overlying sedimentary bedrock, and (3) climatic regime where most P is exported during summer storms. These results underscore the need for intensive sampling regimes in streams in a variety of regions (especially at high discharge) so factors controlling P levels can be better understood" (cited from document abstract).*
KEY_WATER	ATHABASCA
KEY_GEOG	ALBERTA
KEY_NTROGN	
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	
KEY_ANIMAL	
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	WATER
KEY_MISC1	RIVER, NUTRIENT, HYDROLOGY, SAMPLING, STUDIES
KEY_MISC2	
KEY_MISC3	

AUTHOR	National Council of the Paper Industry for Air and Stream Improvement, Inc. (NCASI).
DATE	**1989**
DUP_DATE	**b.**
TITLE	**Pulping Effluents in the Aquatic Environment - Part II: A Review of Unpublished Studies of In-Stream Aquatic Biota in the Vicinity of Pulp Mill Discharges.**
OTHER1	
PUBLISHER	**NCASI, New York, New York.**
OTHER2	**Technical Bulletin No. 573. October 1989.**
ANNOTATION	*"This technical bulletin is the second of two containing the results of a compilation of the published and unpublished information on pulping effluents in the aquatic environment. It contains (a) summaries of largely unpublished company-sponsored studies of resident in-stream biota in the vicinity of pulp mill wastewater discharges, (b) a synopsis of the studies, and (c) a preamble prepared by NCASI summarizing the important findings of these studies" (cited from document).*
KEY_WATER	
KEY_GEOG	
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	TOXIC,
KEY_ANIMAL	VERTEBRATE, INVERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	
KEY_MEDIA	WATER
KEY_MISC1	PULP MILL, EFFLUENT, BIBLIOGRAPHY, RIVER, BENTHOS, EXPERIMENT, WATER QUALITY
KEY_MISC2	
KEY_MISC3	

AUTHOR	Northern River Basin Study.
DATE	**1992**
DUP_DATE	**(Draft).**
TITLE	**1992/93 Program Update, Northern River Basins Study.**
OTHER1	**July 20, 1992.**
PUBLISHER	
OTHER2	

ANNOTATION

"This document re-states the Study objectives, the Study Board's Vision, the investigative philosophy underlying the 1992/93 Program, and provides a brief update on the Spring and Summer Program .... The report addresses future challenges facing the Study and poses a number of questions requiring consideration by SAC. A series of appendices are included which contain the Study's 16 questions, further details on project status, a list of proposed project reviewers and project information sheets which constitute the Fall and Winter Program." (cited from document)

The purpose of the "Nutrients and Eutrophication" project is to describe existing nutrient conditions and effects, and to the extent possible, to quantify nutrient-biota-aquatic fate relationships. Data and information review, model development, and further forseeable investigations are discussed.

KEY_WATER	ATHABASCA, PEACE, WAPITI, SMOKY, SLAVE
KEY_GEOG	ALBERTA, NORTHWEST TERRITORIES
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	
KEY_ANIMAL	VERTEBRATE, INVERTEBRATE, FAUNA
KEY_PLANT	ALGAE
KEY_MCROBE	
KEY_MEDIA	WATER
KEY_MISC1	BASIN, INVENTORY, MODEL, NUTRIENT, BENTHOS, FISH, RIVER, WATER QUALITY,
KEY_MISC2	
KEY_MISC3	

AUTHOR	Northern Rivers Intergovernmental Task Force.
DATE	1990
DUP_DATE	a.
TITLE	**Water Resource Database Assessment for the Peace-Athabasca-Slave River Basin.**
OTHER1	**Report to Peace-Athabasca-Slave Basins Federal/Provincial Steering Committee.**
PUBLISHER	**Northern Rivers Intergovernmental Task Force.**
OTHER2	**June 1990. 40 pp.**

ANNOTATION *Between October 1989 and June 1990 the Northern River Intergovernmental Task Force prepared an overview of ongoing programs, initiatives and data gaps pertaining to the Peace-Athabasca-Slave River Basins. The objectives were to: 1) identify the jurisdictional responsibilities for water resource management, 2) assess existing and emerging water-related resource issues, 3) document existing data describing the physical, chemical and biological quality of the aquatic ecosystem, as well as the patterns of water use and development, 4) describe conditions within the aquatic environment of the study area, 5) assess the information deficiencies, 6) recommend Terms of Reference and arrange a study program to address these deficiencies. Collected data pertain to hydrology/hydraulics, water use, water quality, fisheries and wildlife. The water quality study mentions the existence of nutrients in pulp mill effluent, but no specific data are presented.*

KEY_WATER	PEACE, ATHABASCA, SLAVE
KEY_GEOG	ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	
KEY_ANIMAL	
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	
KEY_MISC1	PULP MILL, WATER QUALITY, NUTRIENTS, RIVER, FISH, HYDROLOGY
KEY_MISC2	
KEY_MISC3	

AUTHOR	Northern Rivers Intergovernmental Task Force.
DATE	**1990**
DUP_DATE	**b.**
TITLE	**Water Resource Database Assessment for the Peace-Athabasca-Slave River Basin. Appendix.**
OTHER1	**Report to Peace-Athabasca-Slave Basins Federal/Provincial Steering Committee. June 1990.**
PUBLISHER	
OTHER2	**Appendix.**

ANNOTATION

Appendices include: 1) a summary and classification of hydrological/hydraulic data collection sites, operated from 1910 to 1990, in the Slave River basin and delta, 2) water use in the Athatbasca/Peace/Slave River basins as it pertains to industrial and municipal withdrawls and licencing, 3) maps and descriptions of NAQUADAT water quality stations within the basins, 4) fisheries data for the Slave River and Great Slave Lake including life history information for identified species, and 5) annotated bibliographic information on wildlife; North of 60o and Alberta reports. Each section listed above provides an annotated bibliography.

This document provides general data on the characteristics of and uses within the basins. It does not provide specific data on nutrients.

KEY_WATER	PEACE, ATHABASCA, SLAVE
KEY_GEOG	ALBERTA, NORTHWEST TERRITORIES
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	
KEY_MISC1	HYDROLOGY, NAQUADAT, BIBLIOGRAPHY, LICENCE, RIVER, BASIN, FISH
KEY_MISC2	
KEY_MISC3	

AUTHOR	Noton, L.R.
DATE	1992
DUP_DATE	a.
TITLE	**Water Quality in the Wapiti-Smoky River System Under Low-Flow Conditions 1987-1991: A Synopsis of Government Surveys and Monitoring.**
OTHER1	
PUBLISHER	**Environmental Quality Monitoring Branch, Environmental Assessment Division, Alberta Environment.**
OTHER2	**May 1992. Supplement - 3 pp. + Appendices.**

ANNOTATION *This report provides an update on water quality conditions in relation to pulp mill and municipal effluents in the Wapiti and Smoky River systems. Outlined are government surveys from 1987 to 1991. The surveys encompass effluent effects, water quality, sediments, benthic biota (algae and invertebrates), and fish. Some of the variables included in the surveys are physical parameters, oxygen, some metals, toxic compounds, organics, ammonia-N, total nitrogen, total phosphorus, and bacteria. Observed water quality is compared to objectives and guidelines. The appendices contain the specific water quality data. The Supplement provides brief notes and graphs that describe the water quality variables that were non-compliant with objectives or guidelines. The type of analytical codes provided is not identified.*

KEY_WATER	WAPITI, SMOKY
KEY_GEOG	ALBERTA, GRANDE PRAIRIE
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	OXYGEN, ORGANICS, NON-METAL INORGANICS, PHYSICAL PARAMETERS, TOXIC, METALS
KEY_ANIMAL	INVERTEBRATE, VERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	BACTERIA
KEY_MEDIA	SEDIMENT, WATER
KEY_MISC1	PULP MILL, EFFLUENT, SEWAGE TREATMENT, WATER QUALITY, RIVER, BENTHOS, ORGANOCHLORINE
KEY_MISC2	
KEY_MISC3	

AUTHOR	Noton, L.R.
DATE	**1992**
DUP_DATE	**b.**
TITLE	**Water Quality in the Wapiti-Smoky River System Under Low-Flow Conditions, 1987-1991: A Synopsis of Government Surveys and Monitoring. Supplement.**
OTHER1	
PUBLISHER	**Environmental Quality Monitoring Branch, Environmental Assessment Division, Alberta Environment.**
OTHER2	**June 1992. Supplement - 9 pp. + Appendices.**
ANNOTATION	*This document supplements the Synopsis as listed in the title. That Synopsis "provided a brief update on recent water quality conditions in the Wapiti-Smoky River system" (cited from Noton, 1992a). "This Supplement provides graphs and short notes on water quality variables that were non-compliant with objectives or guidelines, in order to better support the conclusions in the Synopsis and to illustrate the degree and frequency of non-compliance" (cited from document). Data on odour, color, TDS, sulphide, total chromium, manganese, total nitrogen (mg/l), total phosphorus (mg/l), phenolics, coliforms and 2,4-DCP are provided.*
KEY_WATER	WAPITI, SMOKY
KEY_GEOG	ALBERTA, GRANDE PRAIRIE
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	PHYSICAL PARAMETERS, METALS, NON-METAL INORGANICS, TOXIC, ORGANICS, OXYGEN DEMAND
KEY_ANIMAL	INVERTEBRATE, VERTEBRATE
KEY_PLANT	ALGAE, CHLOROPHYLL
KEY_MCROBE	BACTERIA
KEY_MEDIA	WATER
KEY_MISC1	PROCTER & GAMBLE, RIVER, PULP MILL, NUTRIENT, WATER QUALITY, ORGANOCHLORINE, EFFLUENT, BENTHOS
KEY_MISC2	
KEY_MISC3	

AUTHOR	Noton, L.R.
DATE	**1990**
DUP_DATE	**a.**
TITLE	**Limnological Aspects of the Peace and Athabasca Rivers.**
OTHER1	**November 1990.**
PUBLISHER	**Environmental Quality and Monitoring Branch, Alberta Environment.**
OTHER2	

ANNOTATION

"This document contains copies of maps, graphs, and diagrams used for a lecture given to the Limnology undergraduate course in the Department of Zoology, University of Alberta, in November 1990" (cited in document). History of the data ranges from 1974 to 1989.

Data is provided for the Athabasca and Peace Rivers. A broad range of water quality data is provided. Invertebrate taxa are given for the Peace River.

Nitrogen data (mg/l) for the Athabasca River include nitrate/nitrite and total nitrogen. Data for the Peace River include nitrate/nitrite, ammonia and total nitrogen. Seasonal patterns for nitrogen in the Peace River are also shown; forms include total nitrogen, particulate nitrogen, nitrate/nitrite nitrogen and dissolved nitrogen.

Phosphorus data (mg/l) for the Athabasca River include dissolved and total phosphorus, and phosphorus vs. suspended solids. Data for the Peace River inlude total and total dissolved phosphorus.

KEY_WATER	ATHABASCA, PEACE, NORTH SASKATCHEWAN
KEY_GEOG	ALBERTA, GRANDE PRAIRIE, HINTON, PEACE RIVER
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	PHYSICAL PARAMETERS, METALS, NON-METAL INORGANICS, ORGANICS, OXYGEN, TOXIC
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	WATER
KEY_MISC1	EFFLUENT, HYDROLOGY, INVENTORY, NUTRIENT, BENTHOS, ORGANOCHLORINE, RIVER, WATER QUALITY, WELDWOOD
KEY_MISC2	PROCTER & GAMBLE
KEY_MISC3	

AUTHOR	Noton, L.R.
DATE	1990
DUP_DATE	c.
TITLE	**Aspects of Nitrogen and Phosphorus in the Athabasca River System.**
OTHER1	
PUBLISHER	**Environmental Quality Monitoring Branch, Environmental Assessment Division, Environmental Protection Services, Alberta Environment. January 1990.**
OTHER2	**January 1990.**
ANNOTATION	*This document consists of two separate reports: "Phosphorus in the Athabasca River System" and "Additional Information on Nitrogen and Phosphorus in the Athabasca River System and in Pulp Mill Effluents". These reports provide data including nutrient loadings, concentrations and ratios.*
KEY_WATER	ATHABASCA
KEY_GEOG	ALBERTA
KEY_NTROGN	
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	
KEY_ANIMAL	
KEY_PLANT	ALGAE, CHLOROPHYLL, MACROPHYTES
KEY_MCROBE	
KEY_MEDIA	EFFLUENT, SEDIMENT, WATER
KEY_MISC1	PULP MILL, EFFLUENT, SEWAGE TREATMENT, RIVER, ALBERTA-PACIFIC
KEY_MISC2	
KEY_MISC3	

AUTHOR	Noton, L.R.
DATE	1989.
DUP_DATE	
TITLE	**The Peace and Athabasca River Systems: A Synopsis of Alberta Environment's Monitoring Programs and the Water Quality Effects of Existing Pulp Mill Effluents.**
OTHER1	
PUBLISHER	**Environmental Quality Monitoring Branch, Environmental Assessment Division, Alberta Environment, Edmonton, Alberta.**
OTHER2	**October 1989. 11 pp.**

ANNOTATION *This document outlines the extent of monitoring done to date, summarizes assessments regarding pulp mill effects, and examines the direction of future river monitoring and assessments for the Peace and Athabasca River systems. Regarding the effects of pulp mill effluent on receiving waters, the factors examined include heat, salts, nutrients (nitrogen and phosphorus), some metals, organic compounds, suspended solids, colour, odour, chlorinated organic compounds, and bacteria. Most of the monitoring is on the effects on water quality, sediment, bacteria, algae, benthic invertebrates and fish. No specific data are presented.*

KEY_WATER	PEACE, ATHABASCA, WAPITI, SMOKY
KEY_GEOG	ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	OXYGEN, ORGANICS, METAL, PHYSICAL PARAMETERS
KEY_ANIMAL	INVERTEBRATE, VERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	BACTERIA
KEY_MEDIA	SEDIMENT
KEY_MISC1	PULP MILL, EFFLUENT, CONTAMINANT, MONITORING, RIVER
KEY_MISC2	
KEY_MISC3	

AUTHOR	Noton, L.R. and N.R. Chymko.
DATE	**1978.**
DUP_DATE	
TITLE	**Water Quality and Aquatic Resources of the Beaver Creek Diversion System.**
OTHER1	**Environmental Research Monograph 1978-3.**
PUBLISHER	**Syncrude Canada Ltd., Edmonton, Alberta.**
OTHER2	

ANNOTATION *The Beaver Creek Diversion System, a tributary to the Athabasca River, was investigated from March to November, 1977 to describe post-diversion conditions in Beaver Creek, Ruth Lake and Poplar Creek. Ten sites were sampled for physical-chemical parameters, phytoplankton, zooplankton and benthic macroinvertebrates. An Eckman dredge was used to collect macroinvertebrates. Chemical analyses included the nutrients: total Kjeldahl nitrogen and total phosphorus on non-filtered samples, and orthophosphate (as P) and nitrate-nitrite (as N) on filtered samples. The diversion was undertaken by Syncrude Canada Ltd. to permit mining and extraction of bitumen.*

KEY_WATER	BEAVER
KEY_GEOG	ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	PHYSICAL PARAMETERS
KEY_ANIMAL	INVERTEBRATE, VERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	
KEY_MEDIA	WATER, BIOTA
KEY_MISC1	WATER QUALITY, SURVEY, BENTHOS, FISH, SAMPLING, SYNCRUDE
KEY_MISC2	
KEY_MISC3	

AUTHOR	Noton, L.R. and R.D. Shaw.
DATE	**1989.**
DUP_DATE	
TITLE	**Winter Water Quality in the Athabasca River System, 1988-1989.**
OTHER1	
PUBLISHER	**Environmental Quality Monitoring Branch, Environmental Assessment Division, Environmental Protection Services, Alberta Environment, Edmonton, Alberta.**
OTHER2	**August 1989. 200 pp.**

ANNOTATION

"This report presents and interprets the findings of two water quality surveys that were carried out on the Athabasca River in 1988, from February to March, and three surveys that were carried out in 1989, from January to March. The objectives of these surveys were to obtain additional data that could be used for 1) water quality protection planning, 2) to define a baseline for present winter water quality conditions, and 3) to better assess the impacts of existing effluents on river water quality" (cited from document).

Water quality and contaminant issues discussed include nutrients (nitrate/nitrite nitrogen, ammonium, total Kjeldahl nitrogen, total nitrogen, total phosphorus and total dissolved phosphorus), metals, non-metal organics and organics. Methods for water quality analyses are provided in the report's appendices.

KEY_WATER	ATHABASCA
KEY_GEOG	ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	PHYSICAL PARAMETERS, OXYGEN, OXYGEN DEMAND, METALS, NON-METAL ORGANICS, ORGANICS, TOXIC
KEY_ANIMAL	
KEY_PLANT	
KEY_MCROBE	BACTERIA
KEY_MEDIA	WATER
KEY_MISC1	NAQUADAT, RIVER, PULP MILL, WATER QUALITY, EFFLUENT, SAMPLING, SURVEY
KEY_MISC2	
KEY_MISC3	

AUTHOR	Noton, L.R., A.M. Anderson, D. Krochak and L. Steeves.
DATE	**1992.**
DUP_DATE	
TITLE	**Zoobenthos and Water Quality During Winter Low Flow in a River Receiving Treated Bleached Kraft Mill Effluent and Sewage.**
OTHER1	**Presentation at 19th Aquatic Toxicology Workshop, Edmonton, Alberta, October 1992.**
PUBLISHER	
OTHER2	

ANNOTATION *Document exclusively contains data (tables and figures) pertaining to river and zoobenthos conditions in the Wapiti River. The section of river studied was the area receiving pulp mill effluent (Procter & Gamble) and sewage. General water quality information (from late fall and winter of 1990-91 and 1991-92) includes oxygen concentrations, physical parameters, dissolved organic carbon, calcium, nitrogen (nitrite + nitrate-N, total Kjeldahl nitrogen), and phosphorus (dissolved and total). Other information (from February 1991 and/or January 1992) includes: numbers and density of invertebrates in the river, epilithic chlorophyll a, and concentrations of toxic variables.*

KEY_WATER	WAPITI
KEY_GEOG	GRANDE PRAIRIE, ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	OXYGEN, ORGANICS, NON-METAL ORGANICS, TOXIC, PHYSICAL PARAMETERS
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	CHLOROPHYLL
KEY_MCROBE	
KEY_MEDIA	BIOTA, WATER
KEY_MISC1	PULP MILL, SEWAGE TREATMENT, EFFLUENT, PROCTER & GAMBLE, RIVER, WATER QUALITY, BENTHOS
KEY_MISC2	
KEY_MISC3	

AUTHOR Noton, L.R., A.M. Anderson, T.B. Reynoldson and J. Kostler.

DATE **1989.**

DUP_DATE

TITLE **Water Quality in the Wapiti-Smoky River System Downstream of the Procter and Gamble Pulp Mill, 1983.**

OTHER1

PUBLISHER **Environment Quality Monitoring Branch, Alberta Environment, Edmonton, Alberta.**

OTHER2 **113 pp.**

ANNOTATION *This document assesses the "effects of the Procter & Gamble pulp mill on water quality and aquatic biota in the Smoky River" and increases the water quality data base for that river system. Sampling at various sites along the Wapiti-Smoky-Peace River System took place four times in 1983: March, May, September and November.*

The parameters examined include: inorganics, organics, physical river conditions, metals, oxygen demand, acute toxicity and nutrients. The nutrients include various forms of nitrogen (nitrite and nitrate, ammonia-nitrogen, total Kjeldahl nitrogen), and phosphorus (dissolved, particulate). Nutrients are reported in concentrations (mg/L), estimated loads (kg/day), and load ratios for background river water quality and Procter & Gamble effluent quality.

Samples of benthic macroinvertebrates, algae and bacteria were collected to study the effects of the effluent on aquatic biota. Acute toxicity of the effluent was measured by testing its lethality to rainbow trout. Possible effects on water use were also examined with respect to drinking water and municipal supply, recreation, aquatic life and agriculture. NAQUADAT codes are provided.

KEY_WATER WAPITI, SMOKY

KEY_GEOG ALBERTA

KEY_NTROGN NITROGEN

KEY_PHSFRS PHOSPHORUS

KEY_PARAM METAL, NON-METAL ORGANICS, ORGANICS, OXYGEN, OXYGEN DEMAND, PHYSICAL PARAMETERS, TOXIC

KEY_ANIMAL INVERTEBRATE, VERTEBRATE

KEY_PLANT ALGAE, MACROPHYTE

KEY_MCROBE BACTERIA

KEY_MEDIA EFFLUENT, WATER

KEY_MISC1 PULP MILL, PROCTER & GAMBLE, EFFLUENT, WATER QUALITY, RIVER, NAQUADAT, FISH

KEY_MISC2

KEY_MISC3

AUTHOR	Peace-Athabasca Delta Implementation Committee, Canada, Alberta, Saskatchewan.
DATE	1987
DUP_DATE	b.
TITLE	**Peace-Athabasca Delta Water Management Works Evaluation. Apendix B, Biological Assessment.**
OTHER1	
PUBLISHER	**The Peace-Athabasca Delta Implementation Committee.**
OTHER2	

ANNOTATION *This report assessed the performance of the Riviere des Rochers and Revillon Coupe weirs from a biological perspective. Biological monitoring programs for vegetation, waterfowl, muskrat and fish are summarized and assessed. Quantitative assessment included statistical analysis of lake levels, waterfowl populations, fish passage at the weirs, and a wildlife simulation model. The report does not contain raw data.*

KEY_WATER	PEACE-ATHABASCA
KEY_GEOG	ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	
KEY_ANIMAL	FAUNA, FISH
KEY_PLANT	FLORA
KEY_MCROBE	
KEY_MEDIA	WATER, BIOTA
KEY_MISC1	RIVER, SURVEY, STUDIES, FISH
KEY_MISC2	
KEY_MISC3	

AUTHOR	Peace-Athabasca Delta Project.
DATE	**1973.**
DUP_DATE	
TITLE	**The Peace-Athabasca Delta Project - Technical Appendices: Vol. II Ecological Investigations.**
OTHER1	
PUBLISHER	
OTHER2	
ANNOTATION	*"The first four papers include species lists of plants, fisheries, birds and mammals occurring in the Delta. Sections E, F and G describe the status of three fish species: the walleye, goldeye and lake trout inhabiting the Delta and Lake Athabasca. The next section deals with information on plankton and bottom invertebrates of the Delta lakes and marshes" (cited from McGregor and Cary, 1991).*
KEY_WATER	PEACE-ATHABASCA
KEY_GEOG	ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	
KEY_ANIMAL	FAUNA
KEY_PLANT	FLORA
KEY_MCROBE	
KEY_MEDIA	
KEY_MISC1	DELTA, LAKE
KEY_MISC2	
KEY_MISC3	

AUTHOR	Peace-Athabasca-Slave River Basin Intergovernmental Task Force.
DATE	**1991.**
DUP_DATE	
TITLE	**Northern River Basins Study Proposed Program Description.**
OTHER1	**Report on the Study Board from the Peace-Athabasca-Slave River Basin Intergovernmental Task Force.**
PUBLISHER	**Northern River Intergovernmental Task Force.**
OTHER2	**October 1991.**

ANNOTATION *Description of a proposed program for the study of the cumulative effects of industrial development on the aquatic environment in the Peace-Athabasca-Slave River Basin. The study was proposed to take place from 1991-1995 and was designed to cover four components: 1) hydrology/hydraulics, 2) water quality, 3) fish and fish habitat, 4) use of aquatic resources. The proposed water quality component includes the investigation and quantification of "nutrient budgets, nutrient/biomass interactions, nutrient dynamics and downstream implications".*

KEY_WATER	PEACE, ATHABASCA, SLAVE
KEY_GEOG	ALBERTA
KEY_NTROGN	
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	
KEY_ANIMAL	VERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	
KEY_MEDIA	SEDIMENT, WATER
KEY_MISC1	RIVER, NUTRIENT, WATER QUALITY, HYDROLOGY, FISH, WATER RESOURCES, BASIN, INDUSTRY
KEY_MISC2	
KEY_MISC3	

AUTHOR	Perrin, C.J. and M.L. Bothwell.
DATE	n.d.
DUP_DATE	
TITLE	**Chlorate Discharges from Pulp Mills: An Examination of Potential Ecological Effects on River Algal Communities.**
OTHER1	
PUBLISHER	**Limnotek Research and Development Inc., Vancouver, B.C., and Environmental Sciences Division, National Hydrology Research Institute, Environment Canada, Saskatoon, Saskatchewan.**
OTHER2	**NHRI Contribution No. 92052.**

ANNOTATION

Chlorine dioxide, used in the bleaching process of pulp mills, will form chlorate. It is known to have toxic effects in some marine algae. This study examines potential effects of chlorate on freshwater riverine periphytic algal communities. The study includes measurements of effects of nitrate (ug/l) on potential chlorate (ug/l) toxicity. Ammonium (ug/l) was also introduced into the experiment.

The study was conducted at an experimental facility on the South Thompson River at Chase, British Columbia. The year of this study is not actually stated anywhere in the document; however, algal data from the Columbia River is listed and dated from 1991.

KEY_WATER	THOMPSON
KEY_GEOG	BRITISH COLUMBIA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	
KEY_PARAM	TOXIC, NON-METAL INORGANICS
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	ALGAE, CHLOROPHYLL
KEY_MCROBE	
KEY_MEDIA	WATER
KEY_MISC1	EXPERIMENT, RIVER, BENTHOS, PULP MILL, WATER QUALITY
KEY_MISC2	
KEY_MISC3	

AUTHOR	R.L. & L. Environmental Services Ltd.
DATE	**1993.**
DUP_DATE	
TITLE	**Aquatic Macroinvertebrate Identifications on Samples From the Upper Athabasca River.**
OTHER1	**For: Northern River Basins Study, Project 2382 and 2521.**
PUBLISHER	**R.L. & L. Environmental Services Ltd., Edmonton, Alberta.**
OTHER2	**January 1993. 49 pp. + Appendices.**
ANNOTATION	*"Aquatic macroinvertebrate samples were collected from six locations in the upper Athabasca River during April 1992. Samples were collected for contaminant analyses, species composition, morphological deformities and abnormalities, and size distribution. Concurrently, stomach content samples were collected from mountain whitefish and northern pike during spring 1992" (cited from document). This study is part of a pilot program examining the movement of trace contaminants through the food chain. Sites include upstream of Hinton, Weldwood Bridge, Obed Mountain Coal Bridge, Emerson Lakes Bridge, Berland Bridge/Knight Bridge and Windfall Bridge.* *No nutrient data is in this report.*
KEY_WATER	ATHABASCA
KEY_GEOG	ALBERTA, HINTON
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	
KEY_ANIMAL	INVERTEBRATE, VERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	BIOTA
KEY_MISC1	RIVER, INVENTORY, BENTHOS, SAMPLING, FISH
KEY_MISC2	
KEY_MISC3	

AUTHOR	SENTAR Consultants Ltd.
DATE	**1992**
DUP_DATE	**a.**
TITLE	**Winter Water Quality Survey on the Athabasca River, February 1992.**
OTHER1	**Prepared for Millar Western Pulp Ltd. and Alberta Newsprint Company, Whitecourt, Alberta.**
PUBLISHER	**SENTAR Consultants Ltd., Calgary, Alberta.**
OTHER2	**July 1992. Project No. 09-614-01-01.**

ANNOTATION

A 2-day winter water quality monitoring survey on the Athabasca River was conducted during February 1992. This survey was part of an ongoing monitoring program for Millar Western Pulp Ltd. and Alberta Newsprint Company.

Parameters measured include dissolved oxygen, BOD, specific conductance, major ions, metals, nutrients, suspended solids, color, phenols, chelators, coliforms, resin and fatty acids.

Nutrient forms reported (mg/l) are total phosphorus, dissolved phosphorus, nitrate/nitrite nitrogen, total Kjeldahl nitrogen and ammonia nitrogen. Chemical analyses were conducted using "standard methods".

KEY_WATER	ATHABASCA
KEY_GEOG	ALBERTA, WHITECOURT
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	METAL, NON-METAL INORGANICS, OXYGEN, OXYGEN DEMAND, PHYSICAL PARAMETERS, TOXIC
KEY_ANIMAL	
KEY_PLANT	
KEY_MCROBE	BACTERIA
KEY_MEDIA	WATER
KEY_MISC1	RIVER, MONITORING, WATER QUALITY, SURVEY, ANC, MILLAR WESTERN, NUTRIENT, PULP MILL
KEY_MISC2	
KEY_MISC3	

AUTHOR	SENTAR Consultants Ltd.
DATE	**1992**
DUP_DATE	**b.**
TITLE	**Benthic Invertebrate Monitoring Study on the Athabasca River, Whitecourt, Alberta, 1991.**
OTHER1	**Prepared for Alberta Newsprint Company, Whitecourt, Alberta.**
PUBLISHER	**SENTAR Consultants Ltd., Calgary, Alberta.**
OTHER2	**November 1992. Project No. 09-069-01-01.**
ANNOTATION	*Benthic invertebrate sampling (using a modified Neill-Hess Cylinder) was conducted during May 20-23 and October 1-4, 1991 at eight sites (five replicate samples per site) on the McLeod and Athabasca Rivers in the vicinity of the ANC and Millar Western effluent and Town of Whitecourt sewage discharges. Water quality analyses included total phosphorus and total Kjeldahl nitrogen.*
KEY_WATER	ATHABASCA, MCLEOD
KEY_GEOG	ALBERTA, WHITECOURT
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	PHYSICAL PARAMETERS, OXYGEN
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	BIOTA, WATER
KEY_MISC1	BENTHOS, RIVER, MONITORING, ANC, WATER QUALITY, SAMPLING
KEY_MISC2	
KEY_MISC3	

AUTHOR	SENTAR Consultants Ltd.
DATE	**1992**
DUP_DATE	**c.**
TITLE	**A Benthic Invertebrate Monitoring Study on the Athabasca River, Whitecourt, Alberta.**
OTHER1	**Prepared for Alberta Newsprint Company, Whitecourt, Alberta.**
PUBLISHER	**SENTAR Consultants Ltd.**
OTHER2	
ANNOTATION	*Benthic invertebrate and water quality sampling was conducted on May 20-22 and October 1-3, 1991 on the Athabasca River above and below the ANC CTMP mill. Five replicate samples were collected at seven sites using a modified Neill-Hess cylindrical sampler. Water quality analyses included nutrients (total phosphorus and total Kjeldahl nitrogen), physical parameters, metals, organics, oxgyen demand, dissolved oxygen and non-metal organics.*
KEY_WATER	ATHABASCA
KEY_GEOG	WHITECOURT, ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	PHYSICAL PARAMETERS, METALS, ORGANICS, OXYGEN DEMAND, OXYGEN, NON-METAL ORGANICS
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	
KEY_MEDIA	WATER, BIOTA
KEY_MISC1	ANC, PULP MILL, EFFLUENT, SAMPLING, WATER QUALITY, RIVER
KEY_MISC2	
KEY_MISC3	

AUTHOR	Sergy, G.A. and R.G. Ruggles.
DATE	1975.
DUP_DATE	
TITLE	**Toxicity of Wastewater Discharges and Their Effects on Receiving Waters at Northwest Pulp and Power Co. Ltd., Hinton, Alberta.**
OTHER1	**Prepared for Water Pollution Control Section, Environmental Protection Service, Environment Canada, Northwest Region.**
PUBLISHER	**Environment Canada.**
OTHER2	**Surveillance Report EPS 5-NW-75-1. January 1975. 40 pp.**
ANNOTATION	*"Samples of waste water discharges from Northwest Pulp and Power Ltd. were collected in August of 1974, for bacteriological and chemical analysis and toxicity testing. All samples bioassayed exhibited acute lethal toxicity to Rainbow Trout which can be attributed to toxic components in the waste water. Benthic sampling along the banks of the Athabasca River below the main effluent outfall showed little change in diversity and density of bottom organisms except at one location below the mouth of Hardisty Creek. Benthic sampling above and below the bark pile runoff into Hardisty Creek showed drastic changes had occurred in the stream bottom conditions and in the composition of the bottom invertebrate community" (cited from document).*
KEY_WATER	ATHABASCA
KEY_GEOG	HINTON, ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	METALS, PHYSICAL PARAMETERS, OXYGEN DEMAND, TOXIC
KEY_ANIMAL	VERTEBRATE, INVERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	BACTERIA
KEY_MEDIA	WATER, BIOTA, EFFLUENT
KEY_MISC1	PULP MILL, EFFLUENT, FISH, WATER QUALITY, BENTHOS, SAMPLING, RIVER, CONTAMINANT, FATE
KEY_MISC2	
KEY_MISC3	

AUTHOR	Shaw, R.D. and L.R. Noton.
DATE	**1989.**
DUP_DATE	
TITLE	**A Preliminary Assessment of the Impact of Existing Pulp Mills on the Peace River.**
OTHER1	**Prepared for Environmental Quality Monitoring Branch, Environmental Assessment Division, Environmental Protection Services, Alberta Environment.**
PUBLISHER	**Environmental Quality Monitoring Branch, Alberta Environment.**
OTHER2	**October 1989. 15 pp.**
ANNOTATION	*"In 1988, the Environmental Quality Monitoring Branch, Alberta Environment, initiated a baseline survey of water quality in the Peace River system. Based on data collected for the survey, a preliminary evaluation of the impact of the existing pulp mill effluents on the Peace River in Alberta is provided in this report....For the constituents and sites investigated in the 1988-89 surveys, there were no adverse impacts from the existing mills on the water quality of the Peace River mainstem. The lack of impacts reflects the high effluent dilution capacity of the river and/or the assimilation capacity of intervening water bodies....The persistence and effect of chlorinated organic compounds, which emanate from bleached kraft mills on sediment or aquatic biota were not examined" (cited from document).*
KEY_WATER	PEACE
KEY_GEOG	ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	PHYSICAL PARAMETERS, OXYGEN DEMAND, METALS, TOXIC
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	BACTERIA
KEY_MEDIA	WATER, EFFLUENT
KEY_MISC1	PULP MILL, IMPACT, RIVER, WATER QUALITY, HYDROLOGY, CONTAMINANT
KEY_MISC2	
KEY_MISC3	

AUTHOR	Shaw, R.D., L.R Noton, A.M. Anderson, and G.W. Guenther.
DATE	**1990.**
DUP_DATE	
TITLE	**Water Quality of the Peace River in Alberta.**
OTHER1	**June 1990.**
PUBLISHER	
OTHER2	

ANNOTATION *Water quality samples were collected monthly during May through September 1988 and once in December 1988 and February 1989 from ten sites along the Peace River and from ten tributary rivers. A comprehensive list of physical, chemical and biological constituents were analyzed including some trace organics. Benthic invertebrates were sampled (5 replicates) using a modified Neill cylinder in September 1988 in the mainstem with some additional samples in May and September 1987 and July and October 1988. Epilithic chlorophyll a was sampled by scraping rocks in a defined area. Nutrients included total and dissolved phosphorus, nitrate-nitrite nitrogen, ammonia nitrogen and total Kjeldahl nitrogen. Other analyses included major ions, metals, conventional organics and general water quality parameters.*

KEY_WATER	PEACE
KEY_GEOG	ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	PHYSICAL PARAMETERS, ORGANICS, METALS, NON-METAL ORGANICS
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	
KEY_MEDIA	WATER
KEY_MISC1	RIVER, WATER QUALITY, BENTHOS, SAMPLING
KEY_MISC2	
KEY_MISC3	

AUTHOR	Smith, S.B.
DATE	**1981.**
DUP_DATE	
TITLE	**Alberta Oil Sands Environmental Research Program 1975-1980: Summary Report.**
OTHER1	**Prepared for Alberta Oil Sands Environmental Research Program by S.B. Smith Environmental Consultants Limited.**
PUBLISHER	**Alberta Oil Sands Environmental Research Program.**
OTHER2	**AOSERP Report 118. 170 pp.**
ANNOTATION	*"This report summarizes a large number of surveys and some applied research of baseline environmental conditions and describes the manner in which the Alberta Oil Sands Environmental Research Program was carried out. Research gaps are identified and discussed and recommendations for further applied research are presented" (cited from McGregor and Cary, 1991).*
KEY_WATER	ATHABASCA
KEY_GEOG	FORT MCMURRAY, ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	ORGANICS, METALS, TOXIC, NON-METAL ORGANICS, PHYSICAL PARAMETERS
KEY_ANIMAL	VERTEBRATE, INVERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	MICROBE, BACTERIA
KEY_MEDIA	WATER, BIOTA, AIR, SEDIMENT
KEY_MISC1	HYDROLOGY, WATER QUALITY, GEOLOGY, OIL, RIVER, SURVEY, BASELINE, SAMPLING, INDUSTRY, STUDIES
KEY_MISC2	ECOSYSTEM, HUMAN, FISH, CONTAMINANT
KEY_MISC3	

AUTHOR	Sodergren, A. (ed.).
DATE	**1991.**
DUP_DATE	
TITLE	**Environmental Fate and Effects of Bleached Pulp Mill Effluents.**
OTHER1	**Proceedings of a SEPA Conference Held at Grand Hotel Saltsjobaden, Stockholm, Sweden, 19-21 November 1991.**
PUBLISHER	**Swedish Environmental Protection Agency.**
OTHER2	**Report 4031.**

ANNOTATION

This report reviews "the historic data collected through pre- and post-operational surveys conducted by P&G" and "assess the long term trends in water quality and benthic community composition resulting from ongoing treated pulp effluent release" (cited from document). The review encompasses surveys from 1972, 1974, 1975, 1980, 1981, 1982, 1983, 1985, 1987, and 1988 conducted on the Wapiti River at varying sites in the vicinity of the Procter & Gamble Pulp Mill and Grande Prairie Sewage Treatment Plant.

Water quality data include: chemical oxygen demand, biochemical oxygen demand, pH, total residue, suspended solids, conductivity, true colour, and sodium ion concentrations. Approved Alberta Environment procedures were used for laboratory testing. The extent of effluent mixing in the river was also monitored. Benthic macroinvertebrates were collected for basic data (number of organisms and number of taxa), biotic indices (Shannon-Weaver diversity index, equitability, richness, and dominance), and taxonomic analysis (response of indicator species to treated pulp effluent). This report does not specifically document nutrient data.

KEY_WATER	
KEY_GEOG	CANADA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	TOXIC, ORGANICS
KEY_ANIMAL	VERTEBRATE, INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	WATER, EFFLUENT
KEY_MISC1	PULP MILL, EFFLUENT, FISH, FATE, MONITORING, ORGANOCHLORINE, RIVER, SURVEY
KEY_MISC2	
KEY_MISC3	

AUTHOR	Swanson, S. (ed.).
DATE	**1993.**
DUP_DATE	
TITLE	**Wapiti/Smoky River Ecosystem Study.**
OTHER1	**Prepared for Weyerhaeuser Canada, Grande Prairie, Alberta.**
PUBLISHER	
OTHER2	**158 pp. + Appendices.**

ANNOTATION

"This report describes a 2 1/2 year, multidisciplinary study of the Wapiti/Smoky River ecosystem in northwestern Alberta. The Wapiti/Smoky River system receives effluent from the Procter & Gamble Cellulose Ltd. (now Weyerhaeuser Canada Ltd.) bleached kraft pulp mill at Grande Prairie....The main objectives of the study were to: (1) determine the fate and transport of chlorinated organic compounds in the river; (2) examine fish population parameters, as well as individual health parameters; and (3) document the fish habitat types upstream and downstream of the mill, and determine whether the mill effluent has affected habitat quality, with emphasis on spawning habitat....Water, bottom sediments, suspended sediments, fish and insects were collected for analyses of an extensive list of substances, including metals and chlorinated organic compounds. Mountain whitefish and longnose sucker were the main species examined for contaminants" (cited from document).

Contributing authors include R. Schryer, B. Shelast, K. Holley, I. Berkebar, P. Kloepper-Sams. J.W. Owens, L. Steeves, D. Birkholz and T. Marchant.

KEY_WATER	WAPITI, SMOKY, NORTH SASKATCHEWAN
KEY_GEOG	GRANDE PRAIRIE, ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	OXYGEN DEMAND, PHYSICAL PARAMETERS, METALS, ORGANICS, NON-METAL ORGANICS, TOXIC
KEY_ANIMAL	VERTEBRATE, INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	BIOTA, EFFLUENT, SEDIMENT, WATER
KEY_MISC1	PULP MILL, PROCTER & GAMBLE, EFFLUENT, FISH, FATE, WATER QUALITY, RIVER, CONTAMINANT, STUDIES
KEY_MISC2	SURVEY
KEY_MISC3	

AUTHOR	T.W. Beak Consultants Ltd.
DATE	**1973.**
DUP_DATE	
TITLE	**Biological and Water Quality Survey of the Athabasca River, September 1972.**
OTHER1	**For North Western Pulp and Power Ltd., Hinton, Alberta.**
PUBLISHER	**T.W. Beak Consultants Ltd.**
OTHER2	
ANNOTATION	*The water quality and benthic invertebrate survey of the Athabasca River near Hinton in August 1972 indicated that the bulk of the invertebrates were either pollution sensitive species or facultative (intermediate) species, except for the area along the southern bank below the outfall which was occupied by large numbers of pollution tolerant species. The chemical analysis did not include nutrients.*
KEY_WATER	ATHABASCA
KEY_GEOG	HINTON, ALBERTA, ATHABASCA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	PHYSICAL PARAMETERS, OXYGEN DEMAND, OXYGEN, ORGANICS
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	WATER, BIOTA
KEY_MISC1	WATER QUALITY, PULP MILL, EFFLUENT, SAMPLING, STUDIES, BENTHOS, MONITORING
KEY_MISC2	
KEY_MISC3	

AUTHOR	Taylor, B.R., G. MacDonald and H.R. Hamilton.
DATE	**1990.**
DUP_DATE	
TITLE	**Model Calibration and Receiving Water Evaluation for Pulp Mill Developments, Volume II: Nutrients, Resin Acids, Chelators, Phenols, Colour, Suspended Solids.**
OTHER1	**Prepared for: Standards and Approvals Division, Alberta Environment, Edmonton, Alberta.**
PUBLISHER	**HydroQual Consultants Inc., Calgary, Alberta.**
OTHER2	**March 1990. 92 pp.**

ANNOTATION

"This report deals with the implications of existing and proposed chemithermomechanical pulp (CTMP) and Kraft mill wastewater discharges to water quality in the Athabasca River" (cited from document). Information has been compiled from monitoring that took place on the Athabasca River in January and February 1989, and used as input to water quality models. Five pulp mills on the Athabasca River were monitored: 1) Weldwood - Bleached Kraft, 2) Alberta Newsprint Company - CTMP, 3) Millar Western - CTMP, 4) Alberta Energy Company - CTMP, 5) Alberta Pacific - Bleached Kraft. The only active mills during the 1989 surveys were Weldwood and Millar Western.

The following constituents of pulp mill effluent are examined: phenols, resin acids, chelators, colour, suspended solids, and nutrients (nitrogen and phosphorus). The nutrient forms are presented in concentrations (mg/L) and include organic nitrogen; three forms of inorganic nitrogen: ammonia, nitrate, and nitrite; particulate phosphorus; and dissolved phosphorus. Effects on ecosystem productivity are discussed including effects on algae, macrophytes, bacteria, invertebrates, fish eggs, and fish fry.

KEY_WATER	ATHABASCA, LESSER SLAVE
KEY_GEOG	HINTON, WHITECOURT, ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	PHYSICAL PARAMETERS, TOXIC, ORGANICS, NON-METAL INORGANICS
KEY_ANIMAL	VERTEBRATE
KEY_PLANT	ALGAE, MACROPHYTE
KEY_MCROBE	BACTERIA
KEY_MEDIA	EFFLUENT, WATER
KEY_MISC1	RIVER, PULP MILL, EFFLUENT, MODEL, FISH, WELDWOOD, MILLAR WESTERN
KEY_MISC2	
KEY_MISC3	

AUTHOR	Terrestrial and Aquatic Environmental Managers (TAEM) Ltd.
DATE	**1992**
DUP_DATE	**a.**
TITLE	**Benthic Macroinvertebrate and Water Quality Survey of the Wapiti River, January 1992.**
OTHER1	**Prepared for Procter & Gamble Cellulose, Grande Prairie, Alberta.**
PUBLISHER	**TAEM Ltd., Saskatoon, Saskatchewan.**
OTHER2	**April 1992. 40 pp + Appendices.**

ANNOTATION

This report provides data from a biomonitoring survey of the Wapiti River conducted in January 1992. Eleven stations along 42 km of the river near Grande Prairie, Alberta were sampled for river water quality and benthic macroinvertebrates. The effluent sources in the area are the Procter & Gamble Pulp Mill and the Grande Prairie Sewage Treatment Plant.

Water quality data include: physical parameters (including dissolved oxygen), BOD, sodium ion, colour, total residue, non-filtered residue, dissolved organic carbon, ammonia, dissolved phosphorus, and ortho-phosphate. Nutrient/organic parameters are measured as concentrations (mg/L). Approved Alberta Environment test procedures were followed for the laboratory analyses. Water samples were also collected to determine the extent of effluent mixing in the river. Benthic macroinvertebrates were collected for taxonomic identification (mostly to the genus level), enumeration, and response to the pulp effluent.

KEY_WATER	WAPITI
KEY_GEOG	GRANDE PRAIRIE, ALBERTA
KEY_NTROGN	
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	OXYGEN, OXYGEN DEMAND, PHYSICAL PARAMETERS, ORGANICS, NON-METAL INORGANICS
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	BIOTA, EFFLUENT, WATER
KEY_MISC1	PULP MILL, SEWAGE TREATMENT, EFFLUENT, PROCTER & GAMBLE, RIVER, WATER QUALITY, SURVEY, SAMPLING
KEY_MISC2	BENTHOS
KEY_MISC3	

AUTHOR	Terrestrial and Aquatic Environmental Managers (TAEM) Ltd.
DATE	**1992**
DUP_DATE	**b.**
TITLE	**Biological and Water Quality Survey of the Athabasca River, April 1992.**
OTHER1	**Prepared for Weldwood of Canada Limited, Hinton, Alberta.**
PUBLISHER	**TAEM Ltd., Saskatoon, Saskatchewan.**
OTHER2	**September, 1992.**
ANNOTATION	*Athabasca River water samples and benthic invertebrate samples were collected on April 14-15, 1992 from three stations upstream of the Weldwood pulp mill effluent and six stations downstream to a distance of about 44 km below the mill outfall. Water quality characteristics measured included physical parameters, oxygen demand, non-metal organics, dissolved oxygen, organics and nutrients (total phosphorus, total dissolved phosphorus concentrations and total Kjeldahl nitrogen). Benthic invertebrates, collected by a Neill cylinder, and epilithic chlorophyll a were also measured.*
KEY_WATER	ATHABASCA
KEY_GEOG	HINTON, ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	PHYSICAL PARAMETERS, OXYGEN DEMAND, NON-METAL ORGANICS, OXYGEN, ORGANICS
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	
KEY_MEDIA	WATER, BIOTA
KEY_MISC1	BENTHOS, WATER QUALITY, EFFLUENT, HINTON, SAMPLING, RIVER, SEWAGE TREATMENT, PULP MILL
KEY_MISC2	
KEY_MISC3	

AUTHOR	Terrestrial and Aquatic Environmental Managers (TAEM) Ltd.
DATE	**1991**
DUP_DATE	**a.**
TITLE	**Biological and Water Quality Surveys of the Wapiti River, October 1990 and April 1991.**
OTHER1	**Prepared for Procter & Gamble Cellulose, Grande Prairie, Alberta.**
PUBLISHER	**TAEM Ltd., Saskatoon, Saskatchewan.**
OTHER2	**July 1991. 53 pp. + Appendices.**

ANNOTATION *This report provides data from a biomonitoring survey of the Wapiti River conducted in October 1990 and April 1991. Eleven sites (six control sites, five observation sites) along 42 km of the river near Grande Prairie, Alberta were sampled for river water quality and benthic macroinvertebrates. The effluent sources in the area are the Procter & Gamble Pulp Mill and the Grande Prairie Sewage Treatment Plant.*

Water quality data include: physical parameters, dissolved oxygen, BOD, non-metal organics, organics and nutrients (total Kjeldahl nitrogen, dissolved phosphorus, and ortho-phosphate (mg/L)). Benthic macroinvertebrates were collected for taxonomic identification, enumeration and response to the pulp effluent.

KEY_WATER	WAPITI
KEY_GEOG	GRANDE PRAIRIE, ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	OXYGEN, OXYGEN DEMAND, PHYSICAL PARAMETERS, ORGANICS, NON-METAL ORGANICS
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	CHLOROPHYLL
KEY_MCROBE	
KEY_MEDIA	BIOTA, EFFLUENT, WATER
KEY_MISC1	PULP MILL, SEWAGE TREATMENT, EFFLUENT, PROCTER & GAMBLE, RIVER, WATER QUALITY, SURVEY, SAMPLING
KEY_MISC2	BENTHOS
KEY_MISC3	

AUTHOR	Terrestrial and Aquatic Environmental Managers (TAEM) Ltd.
DATE	**1991**
DUP_DATE	**b.**
TITLE	**Biological and Water Quality Survey of the Athabasca River 1990.**
OTHER1	**Prepared for Weldwood of Canada Limited, Hinton, Alberta.**
PUBLISHER	**TAEM Ltd., Saskatoon, Saskatchewan.**
OTHER2	**March 1991.**
ANNOTATION	*Athabasca River water samples and benthic invertebrate samples were collected on October 10-12, 1990 from three stations upstream of the Weldwood pulp mill effluent and six stations downstream to a distance of about 44 km below the mill outfall. Water quality parameters measured included physical parameters, oxygen demand, non-metal organics, oxygen, organics and nutrients (total phosphate, total Kjeldahl nitrogen). Benthic invertebrates (collected by a Neill cylinder) and epilithic chlorophyll a were measured.*
KEY_WATER	ATHABASCA
KEY_GEOG	HINTON, ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	PHYSICAL PARAMETERS, OXYGEN DEMAND, NON-METAL ORGANICS, OXYGEN, ORGANICS
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	
KEY_MEDIA	WATER, BIOTA
KEY_MISC1	BENTHOS, WATER QUALITY, EFFLUENT, HINTON, SAMPLING, RIVER, SEWAGE TREATMENT, PULP MILL
KEY_MISC2	
KEY_MISC3	

AUTHOR	Terrestrial and Aquatic Environmental Managers (TAEM) Ltd.
DATE	**1991**
DUP_DATE	**c.**
TITLE	**Biological and Water Quality Survey of the Athabasca River, April 1991.**
OTHER1	**Prepared for Weldwood of Canada Limited, Hinton, Alberta.**
PUBLISHER	**TAEM Ltd., Saskatoon, Saskatchewan.**
OTHER2	**August, 1991.**
ANNOTATION	*Athabasca River water samples and benthic invertebrate samples were collected on April 17-18, 1991 from three stations upstream of the Weldwood pulp mill effluent and six stations downstream to a distance of about 44 km below the mill outfall. Water quality characteristics measured included physical parameters, oxygen demand, non-metal organics, dissolved oxygen, organics and nutrients (total phosphorus, total dissolved phosphorus and total Kjeldahl nitrogen). Benthic invertebrates, collected by a Neill cylinder, and epilithic chlorophyll a were also measured.*
KEY_WATER	ATHABASCA
KEY_GEOG	HINTON, ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	PHYSICAL PARAMETERS, OXYGEN DEMAND, NON-METAL ORGANICS, OXYGEN, ORGANICS
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	
KEY_MEDIA	WATER, BIOTA
KEY_MISC1	BENTHOS, WATER QUALITY, EFFLUENT, HINTON, SAMPLING, RIVER, SEWAGE TREATMENT, PULP MILL
KEY_MISC2	
KEY_MISC3	

AUTHOR	Terrestrial and Aquatic Environmental Managers (TAEM) Ltd.
DATE	**1990.**
DUP_DATE	
TITLE	**An Historical Review of the Biological and Water Quality Surveys of the Wapiti River, 1970-1988.**
OTHER1	**Prepared for Procter & Gamble Cellulose, Grande Prairie, Alberta.**
PUBLISHER	**TAEM Ltd., Saskatoon, Saskatchewan.**
OTHER2	**May 1990. 32 pp. + Appendices.**

ANNOTATION

This report reviews "the historic data collected through pre- and post-operational surveys conducted by P&G" and "assesses the long term trends in water quality and benthic community composition resulting from ongoing treated pulp effluent release" (cited from document). The review encompasses surveys from 1972, 1974, 1975, 1980, 1981, 1982, 1983, 1985, 1987, and 1988 conducted on the Wapiti River at varying sites in the vicinity of the Procter & Gamble Pulp Mill and Grande Prairie Sewage Treatment Plant.

Water quality data include: dissolved oxygen, oxygen demand, physical parameters and non-metal organics. Benthic macroinvertebrates were collected for basic data.

KEY_WATER	WAPITI
KEY_GEOG	GRANDE PRAIRIE, ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	OXYGEN, OXYGEN DEMAND, PHYSICAL PARAMETERS, NON-METAL ORGANICS
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	BIOTA, EFFLUENT, WATER
KEY_MISC1	PULP MILL, SEWAGE TREATMENT, EFFLUENT, PROCTER & GAMBLE, RIVER, WATER QUALITY, SURVEY, SAMPLING
KEY_MISC2	BENTHOS
KEY_MISC3	

AUTHOR	Terrestrial and Aquatic Environmental Managers (TAEM) Ltd.
DATE	**1989**
DUP_DATE	**b.**
TITLE	**Biological and Water Quality Survey of the Athabasca River, 1989.**
OTHER1	**Prepared for Weldwood of Canada Limited, Hinton, Alberta.**
PUBLISHER	**TAEM Ltd., Saskatoon, Saskatchewan.**
OTHER2	
ANNOTATION	*Athabasca River water samples and benthic invertebrate samples were collected on April 14-15, 1992 from three stations upstream of the Weldwood pulp mill effluent and six stations downstream to a distance of about 44 km below the mill outfall. Total phosphorus, total dissolved phosphorus concentrations and total Kjeldahl nitrogen were measured. Benthic invertebrates, collected by a Neill cylinder, and epilithic chlorophyll a were also measured.*
KEY_WATER	ATHABASCA
KEY_GEOG	ATHABASCA, HINTON, ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	PHYSICAL PARAMETERS, OXYGEN, OXYGEN DEMAND, ORGANICS
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	ALGAE
KEY_MCROBE	
KEY_MEDIA	WATER
KEY_MISC1	BENTHOS, EFFLUENT, HINTON, PULP MILL, RIVER, SAMPLING, WATER QUALITY, WELDWOOD
KEY_MISC2	
KEY_MISC3	

AUTHOR	Walder, G.L. and D.W. Mayhood.
DATE	**1985.**
DUP_DATE	
TITLE	**An Analysis of Benthic Invertebrate and Water Quality Monitoring Data from the Athabasca River.**
OTHER1	
PUBLISHER	**Research Management Division, Alberta Environment, Edmonton.**
OTHER2	
ANNOTATION	*This report presents a detailed statistical analysis including principal components analysis of water quality and benthic invertebrate data from previous studies on the Athabasca River. Benthic invertebrate data were from a 1981 study. The Athabasca River from the Horse River upstream of Fort McMurray to the Tar River confluence was the study area. Six water quality monitoring stations and eight benthic invertebrate stations were included. Water quality data for the period 1976 to 1983 were analyzed. The influence of the Clearwater River and other east bank tributaries as well as nutrient enrichment from the Fort McMurray sewage treatment plant was discerned. There was no evidence of differences due to the Suncor development.*
KEY_WATER	ATHABASCA
KEY_GEOG	FORT MCMURRAY, ALBERTA
KEY_NTROGN	
KEY_PHSFRS	
KEY_PARAM	PHYSICAL PARAMETERS
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	WATER, BIOTA
KEY_MISC1	RIVER, WATER QUALITY, BENTHOS, NUTRIENT, SUNCOR
KEY_MISC2	
KEY_MISC3	

AUTHOR	Weldwood of Canada Limited.
DATE	**n.d.**
DUP_DATE	
TITLE	**Technical Department Reports, 1972-1992.**
OTHER1	**Collection of Technical Department Reports from Weldwood of Canada (formerly St. Regis/North Western Pulp and Power Ltd.).**
PUBLISHER	**Weldwood of Canada Ltd.**
OTHER2	**File 1600-3.**
ANNOTATION	*The bleached kraft pulp mill located at Hinton conducted water quality surveys on the Athabasca every year from 1972 to 1992. Since 1976 they have included at least one winter survey. Nutrients were not measured. Dissolved oxygen surveys under ice covered conditions began in 1988. Monitoring increased with more stringent license requirements. In 1991 analyses were extended to include resin and fatty acids, chlorinated phenolics, AOX, sulphide, total and dissolved phosphorus, nitrogen forms (total Kjeldahl, ammonia, nitrate and nitrite) and other measurements.*
KEY_WATER	ATHABASCA
KEY_GEOG	HINTON, ALBERTA, ATHABASCA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	PHYSICAL PARAMETERS, OXYGEN DEMAND, OXYGEN, ORGANICS
KEY_ANIMAL	
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	WATER
KEY_MISC1	WATER QUALITY, WELDWOOD, PULP MILL, EFFLUENT, SAMPLING, MONITORING, RIVER, HINTON, SURVEY
KEY_MISC2	
KEY_MISC3	

AUTHOR	Yonge, E.I.
DATE	**1988.**
DUP_DATE	
TITLE	**A Review of Epilithic Algal Biomass, Nutrient, and Nonfilterable Residue Data for Major Alberta River Basins.**
OTHER1	**October 1988.**
PUBLISHER	**Environmental Assessment Division, Alberta Environment, Edmonton Alberta.**
OTHER2	

ANNOTATION *This report reviews existing data and "describes the river course variation of benthic algal biomass, nutrient and nonfilterable residue variables and their relationships in 12 Alberta rivers. Trends in these variables were compared between river basins..." (cited from document). Rivers studied include the Milk River, Oldman River, Bow River, Highwood River, South Saskatchewan River, Red Deer River, North Saskatchewan River, Pembina River, Lovett River, McLeod River, Gregg River and Athabasca River. Parameters examined were chlorophyll a (mg/m2), total phosphorus (mg/l), total dissolved phosphorus (mg/l), nitrite/nitrate nitrogen (mg/l), total Kjeldahl nitrogen (mg/l), dissolved ammonia (mg/l) and nonfilterable residue (NFR). NAQUADAT measurement code numbers for each variable are provided in the report. Principal component and cluster analyses were used to identify important variables within and similarities between river basins and their sample sites. Appendices depict levels of nutrients, chlorophyll a and NFR at sample sites along each of the rivers studied.*

KEY_WATER	MILK, OLDMAN, BOW, HIGHWOOD, SOUTH SASKATCHEWAN, NORTH SASKATCHEWAN, RED DEER, PEMBINA, LOVETT
KEY_GEOG	ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	PHYSICAL PARAMETERS
KEY_ANIMAL	
KEY_PLANT	ALGAE, CHLOROPHYLL
KEY_MCROBE	
KEY_MEDIA	WATER
KEY_MISC1	RIVER, NAQUADAT, BASIN
KEY_MISC2	
KEY_MISC3	

APPENDIX B

ANNOTATED BIBLIOGRAPHY OF ELECTRONIC DATABASES

AUTHOR	Alberta Environment.
DATE	**n.d.**
DUP_DATE	**(inprogrs)**
TITLE	**NAQUADAT.**
OTHER1	
PUBLISHER	**Environmental Assessment Division, Monitoring Branch, Alberta Environment.**
OTHER2	
ANNOTATION	*Alberta Environment's instream water quality monitoring data. Includes synoptic surveys, long term network stations, and medium term network stations. Contact person: Leigh Noton @ 403-427-5893.*
KEY_WATER	ATHABASCA, WAPITI, LESSER SLAVE, SLAVE, PEACE, BEAVER, MCLEOD, CLEARWATER, MUSKEG, SMOKY, BOW, MILK
KEY_GEOG	ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	METALS, NON-METAL INORGANICS, ORGANICS, OXYGEN, OXYGEN DEMAND, PHYSICAL PARAMETERS, TOXIC
KEY_ANIMAL	
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	WATER
KEY_MISC1	BASIN, DATABASE, LAKE, NAQUADAT, NUTRIENT, RIVER, SAMPLING, SLAVE LAKE, SURVEY, WATER QUALITY
KEY_MISC2	
KEY_MISC3	

AUTHOR	Alberta Environment.
DATE	**n.d.**
DUP_DATE	**(inprogrs)**
TITLE	**Water Quality Industrial Discharge Database.**
OTHER1	
PUBLISHER	**Standards and Approvals Division, Water Quality Branch, Alberta Environment.**
OTHER2	
ANNOTATION	*A database in "dBASE IV" format of effluent monitoring data for industries which discharge effluents into Alberta waters. Contact person: Ian Mackenzie @ 403-427-5888.*
KEY_WATER	ATHABASCA, HINTON, LESSER SLAVE, MCLEOD, NORTH SASKATCHEWAN, PEACE, PEMBINA, SLAVE, SMOKY, WAPITI
KEY_GEOG	ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	METALS, NON-METAL INORGANICS, ORGANICS, OXYGEN, OXYGEN DEMAND, PHYSICAL PARAMETERS, TOXIC
KEY_ANIMAL	
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	EFFLUENT
KEY_MISC1	ALBERTA-PACIFIC, ANC, DAISHOWA, DATABASE, EFFLUENT, HINTON, INDUSTRY, MILLAR WESTERN, MONITORING,
KEY_MISC2	MINING, NUTRIENT, OIL, PROCTER & GAMBLE, PULP MILL, RESOURCES, RIVER, SUNCOR, WELDWOOD, SYNCRUDE,
KEY_MISC3	SLAVE LAKE

AUTHOR	Alberta Environment.
DATE	**n.d.**
DUP_DATE	**(inprogrs)**
TITLE	**Municipal Water and Wastewater Database.**
OTHER1	
PUBLISHER	**Standards and Approvals Division, Water Quality Branch, Alberta Environment.**
OTHER2	
ANNOTATION	*Database of municipal untreated and treated drinking water and untreated and treated wastewater. Some of the database is in NAQUADAT software and some in dBASE and Lotus. Contact person: Garry Halina @ 403-427-5877.*
KEY_WATER	ATHABASCA, WAPITI, LESSER SLAVE, MCLEOD, PEACE, BEAVER, CLEARWATER, PEMBINA, SMOKY, MUSKEG, BOW
KEY_GEOG	ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	METALS, NON-METAL INORGANICS, ORGANICS, OXYGEN, OXYGEN DEMAND, PHYSICAL PARAMETERS, TOXIC
KEY_ANIMAL	
KEY_PLANT	
KEY_MCROBE	BACTERIA
KEY_MEDIA	EFFLUENT, WATER
KEY_MISC1	DATABASE, EFFLUENT, HUMAN HEALTH, MONITORING, NAQUADAT, NUTRIENT, SEWAGE TREATMENT, WATER QUALITY
KEY_MISC2	WATER USE
KEY_MISC3	

AUTHOR	Environment Canada.
DATE	**n.d.**
DUP_DATE	**(inprogrs)**
TITLE	**Envirodat (formerly NAQUADAT).**
OTHER1	
PUBLISHER	**Environmental Science and Evaluation Directorate, Environment Canada.**
OTHER2	
ANNOTATION	*This database includes historical water quality data on about 80 to 100 sample sites in the Peace, Athabasca and Slave River systems. Currently there are 3 active sites in these systems. The database is 99% water quality. There is some recent data on organics in sediment and organochlorines in fish muscle and liver. Contact person in Alberta: Howard Block @ 403-292-5320.*
KEY_WATER	ATHABASCA, PEACE, SLAVE
KEY_GEOG	ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	METALS, NON-METAL INORGANICS, ORGANICS, OXYGEN, OXYGEN DEMAND, PHYSICAL PARAMETERS, TOXIC
KEY_ANIMAL	VERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	BIOTA, SEDIMENT, WATER
KEY_MISC1	DATABASE, FISH, NAQUADAT, NUTRIENT, ORGANOCHLORINE, RIVER, SURVEY, WATER QUALITY
KEY_MISC2	
KEY_MISC3	

AUTHOR	Government of Canada.
DATE	**n.d.**
DUP_DATE	**(inprogrs)**
TITLE	**Slave River Project.**
OTHER1	
PUBLISHER	**Department of Indian and Northern Affairs, Water Resources Division, Government of Canada.**
OTHER2	
ANNOTATION	*This is not a formal database. It contains data on fish, sediment and water from the Slave River in a series of Lotus files. Contact person:* *John Witteman* *Regional Manager, Water Resources Division* *Department of Indian and Northern Affairs* *P.O. Box 1500* *Yellowknife, NWT* *X1A 2R3* *Phone: 403-920-8240* *Fax: 403-873-9318*
KEY_WATER	SLAVE
KEY_GEOG	NORTHWEST TERRITORIES
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	METALS, NON-METAL INORGANICS, ORGANICS, OXYGEN, OXYGEN DEMAND, PHYSICAL PARAMETERS, TOXIC
KEY_ANIMAL	VERTEBRATE
KEY_PLANT	
KEY_MCROBE	
KEY_MEDIA	SEDIMENT, WATER
KEY_MISC1	FISH, MONITORING, NUTRIENT, ORGANOCHLORINE, RIVER, WATER QUALITY
KEY_MISC2	
KEY_MISC3	

AUTHOR	N. McCubbin Consultants Inc.
DATE	**1993.**
DUP_DATE	
TITLE	**Northdat Ver. 1.0.**
OTHER1	
PUBLISHER	**N. McCubbin Consultants Inc.**
OTHER2	**March 1993.**
ANNOTATION	*A program which will extract user specified data on pulp mill effluents from the industrial waste water database. It will generate one dBASE III and one Lotus file for each set of specified data.*
KEY_WATER	ATHABASCA, HINTON, LESSER SLAVE, MCKAY, MACKENZIE, PEACE, SMOKY, WAPITI
KEY_GEOG	ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	METALS, NON-METAL INORGANICS, ORGANICS, OXYGEN, OXYGEN DEMAND, PHYSICAL PARAMETERS, TOXIC
KEY_ANIMAL	INVERTEBRATE
KEY_PLANT	
KEY_MCROBE	BACTERIA
KEY_MEDIA	EFFLUENT
KEY_MISC1	ANC, DAISHOWA, CONTAMINANT, DATABASE, EFFLUENT, HINTON, MILLAR WESTERN, MONITORING, NUTRIENT, RIVER
KEY_MISC2	ORGANOCHLORINE, PROCTER & GAMBLE, PULP MILL, WELDWOOD
KEY_MISC3	

AUTHOR	SENTAR Consultants Ltd.
DATE	**n.d.**
DUP_DATE	**(inprogrs)**
TITLE	**Effluent Characteristics of Municipal and Non-Pulp Mill Effluents Discharging Into the Athabasca, Peace and Slave Rivers.**
OTHER1	**Project 2112-B1 - Northern Rivers Basin Study.**
PUBLISHER	**Under contract - work in progress.**
OTHER2	
ANNOTATION	*A geo-referenced dBASE IV database of all municipal and non-pulp mill effluents which discharge into the Athabasca, Peace and Slave Rivers and their tributaries.*
KEY_WATER	ATHABASCA, WAPITI, LESSER SLAVE, SLAVE, PEACE, BEAVER, MCLEOD, CLEARWATER, PEMBINA, SMOKY, MUSKEG
KEY_GEOG	ALBERTA
KEY_NTROGN	NITROGEN
KEY_PHSFRS	PHOSPHORUS
KEY_PARAM	METALS, NON-METAL INORGANICS, ORGANICS, OXYGEN, OXYGEN DEMAND, PHYSICAL PARAMETERS, TOXIC
KEY_ANIMAL	
KEY_PLANT	
KEY_MCROBE	BACTERIA
KEY_MEDIA	EFFLUENT
KEY_MISC1	CONTAMINANT, DATABASE, EFFLUENT, INDUSTRY, MINING, MONITORING, NUTRIENT, RIVER, SAMPLING, SUNCOR
KEY_MISC2	SEWAGE TREATMENT, WATER USE, SYNCRUDE
KEY_MISC3	

APPENDIX C

TERMS OF REFERENCE

NORTHERN RIVER BASINS STUDY

SCHEDULE A - TERMS OF REFERENCE

PROJECT 2511-B1 Nutrient Data Compilation and Review

I. Objective

The objective of this project is to produce a comprehensive review and synthesis of existing information (literature and data) on nutrient loading (nitrogen and phosphorus), sediment oxygen demand and biotic communities for the Peace (including the Wapiti and Smoky), Athabasca and Slave river systems to define and identify commonalities in the impacts of nutrient loading from various point sources.

II. Requirements

A. Data Collection

1. Obtain existing data on nutrients (N and P) in the study area, screen it for acceptability and compile. Where appropriate, review and evaluate any raw data. Review existing reports relevant to nutrients in the study area rivers. Identify any data bases including their form (i.e. electronic or hardcopy). The Northern River Basins Study Office will assist the Contractor in obtaining relevant data and reports from Alberta Environment.

2. Obtain and compile data and review existing reports on aquatic biota (the benthic biofilm and invertebrates) in the study area relevant to nutrient effects. Identify all databases including their form (i.e. hardcopy or electronic). The Northern River Basins Study Office will assist the Contractor in obtaining relevant data and reports from Alberta Environment.

3. Where appropriate, comment on the quality of the data, quality control/quality assurance measure, experimental design, including methods and replication, and statistical analysis.

B. Annotated Bibliography

1. produce an annotated bibliography of databases, government and non-government reports, journal papers, books, book chapters, student theses, etc. on nutrient loading relevant to the study rivers and its impact on water and sediment chemistry, aquatic organisms and aquatic habitats.

C. Synthesis Report

1. Based on the information reviewed in 1, above, prepare a comprehensive synthesis report on nutrient loading and its effects on the environment in the Peace, Athabasca and Slave river systems. The report should include the following:

- a description of existing nutrient conditions in the river systems with regard to concentrations, fractions, seasonality, longitudinal change and temporal change (trends);
- to the extent possible, provide a description of nutrient sources from headwaters, tributaries, effluents, and instream/diffuse inputs or sinks;
- to the extent possible, provide a discussion of the existing or potential effects of nutrient loading on the aquatic environment (water and sediment chemistry, aquatic organisms, aquatic habitats, etc.);
- identify any data deficiencies;
- outline data requirements to construct a nutrient budget for the northern river systems, and;
- analyze the data to identify commonalities between nutrient impacts from various point sources on sediment chemistry, and benthic biofilm and invertebrate communities.

The report will be produced in consultation with members of the Northern River Basins Study Nutrients Group (Dr. Patricia Chambers, Nutrient Group Leader).

III. Reporting Requirements

1. Provide ten draft copies of the annotated bibliography to the Department's representative by March 15, 1993.

2. Three weeks after receipt of review comments on the draft annotated bibliography, provide the Department's representative with five serlox bound copies and two unbound, camera ready copies of the final report. At the same time, provide to the Department's representative an electronic copy, in WordPerfect V5.1 format, and on 5 1/4 or 3 1/2 inch floppy discs, of the final report. Data for any tables, figures or appendices in the report are also to be submitted in DBase IV format on 5 1/4 or 3 1/2 floppy discs. The final report will include an executive summary.

3. By January 15, 1993, provide the Department's representative and Nutrients Group Leader with an outline for the synthesis report. Based on the review of the draft outline, prepare a draft synthesis report.

4. By March 15, 1993, provide the Department's representative with ten draft copies of the synthesis report.

5. Three weeks after receipt of review comments on the draft synthesis report, provide the Department's representative with five serlox bound copies and two unbound, camera ready copies of the final report. At the same time, provide to the Department's representative an electronic copy, in WordPerfect V5.1 format, and on 5 1/4 or 3 1/2 inch floppy discs, of the final report. Data for any tables, figures or appendices in the report are also to be submitted in DBase IV format on 5 1/4 or 3 1/2 floppy discs. The final report will include an executive summary.

6. Provide the Department's representative with Lotus 1-2-3 files of any databases created or obtained during the course of this project.

APPENDIX D
BIBLIOGRAPHIC DATA FILES

The disk comprising this Appendix contains three files, using 69,594 bytes.

1. BIBLNUTR.EXE; being 69,017 bytes in size.
2. INSTALL.BAT; being 80 bytes in size.
3. DISCLAIM.TXT; being 497 bytes in size.

To install the database copy the three files on this disk to a directory on your hard drive and type install.bat. The result will be 7 files totalling 468,202 bytes.

There is no warranty expressed or implied for the use of this database; the Northern River Basins Study does not guarantee the accuracy of the data. The NRBS does not assume any liability for actions or consequences resulting form the use of the data; individuals using this database do so entirely at their own risk. The NRBS will not update the data except as deemed necessary for its own purposes.