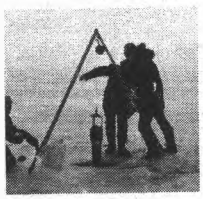
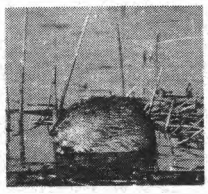
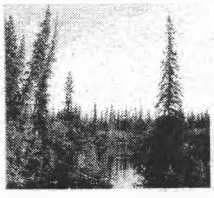
Canada Alberta Northwest Territories

Northern River Basins Study



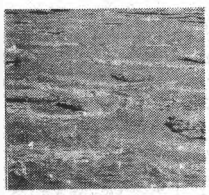


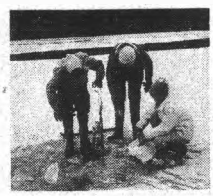




NORTHERN RIVER BASINS STUDY PROJECT REPORT NO. 145

HISTORICAL COMPILATION OF FISH TISSUE CONTAMINANT DATA






DATE DUE

Prepared for the
Northern River Basins Study
under Project 2340-B1

by

D. A. Westworth and Associates

NORTHERN RIVER BASINS STUDY PROJECT REPORT NO. 145

HISTORICAL COMPILATION OF FISH TISSUE CONTAMINANT DATA

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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.

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

F. J. Wrona — 14 May 96
(Dr. Fred J. Wrona, 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 — 24 May 96
(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**

Lucille Partington — May 29/96
(Lucille Partington, Co-chair) (Date)

Robert McLeod — May 21/96
(Robert McLeod, Co-chair) (Date)

HISTORICAL COMPILATION OF FISH TISSUE CONTAMINANT DATA

STUDY PERSPECTIVE

A major goal of the Northern River Basins Study (NRBS) is to determine the effects of contaminants from industrial and municipal sources on the aquatic ecosystem of the Peace, Athabasca and Slave rivers. Contaminant information for these basins was lacking and additional research needed to be done to describe the nature and distribution of chemical contaminants entering the rivers. Residents concerns were commonly reduced to the question; "can I drink the water and eat the fish".

Human health fish consumption advisories were existing on different sections of the Peace, Athabasca and Slave rivers prior to the onset of NRBS. The advisories concerned mercury, dioxin-furans and toxaphene. Although additional collections and analyses were to be undertaken by NRBS, historical contaminant information would be useful to assist determination of trends and distribution.

This report documents historical fish tissue contaminant information but it provides no interpretation. Some of the initial analytical work done under NRBS is included and should be ignored. A more complete description of the NRBS samples analysed and their results are contained in the report "*A Database of Environmental Samples Collected and Analysed for the Northern River Basins Study* (NRBS Project Report No. 142).

Related Study Questions

4a)	*Describe the contents and nature of the contaminants entering the system and describe their distribution and toxicity in the aquatic ecosystem with particular reference to water, sediment and biota.*
8)	*Recognizing that people drink water and eat fish from these rivers systems, what is the current concentration of contaminants in water and edible fish tissue and how are these levels changing through time and by location?*
13a)	*What predictive tools are required to determine the cumulative effects of man-made discharges on the water and aquatic environment?*
13b)	*What are the cumulative effects of man-made discharges on the water and aquatic environment?*

Although the report provides a compilation of different data sets never previously presented in one database structure, the variability of information available with the data sets creates a data base that at times appears incomplete. Work under this report revealed the need for some common conventions for collecting, analysing and handling contaminant data. As a result of this work, NRBS undertook to develop a database for work done under the Study that would provide the information needed for assessment and comparative purposes (NRBS Project Report No. 142).

ACKNOWLEDGEMENTS

The study team gratefully acknowledges the contributions made by many individuals and government departments during the course of the study. Particular thanks are extended to K. Crutchfield and G. Wagner of the Northern River Basin Study department for their cooperation and patience throughout the project. Thanks are also extended to Dr. L. Lockhart, Department of Fisheries and Oceans; staff at Rivers, Lakes, & Lands Ltd.; staff at Environmental Management Associates Ltd.; L. Steves, Weyerhaeuser Ltd.; M. Drouin, Alberta Fish and Wildlife Services; J. Moore, Vegreville Environmental Research Centre; G. Stevens, Northwest Territories Water Resources; D. Donald, Environment Canada; G. Byrtus, Alberta Environment, Waste and Chemical Division; L. Noton, Alberta Environment; and T. VanMere, Syncrude Ltd. for kindly making available fish contaminant data for use in this project.

We are also grateful to the following members of the study team for their diligent efforts throughout the study: T. Dahm, L. Donnelly, and C. Machtans.

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1.0 INTRODUCTION

The boreal forests of northern Alberta, have received considerable interest from forest companies in recent years. Greater demands for hardwood products in conjunction with traditional use of softwood species clearly indicates that the forest industry will have an increasingly important influence on fish populations and habitat throughout Alberta. This is particularly true in northern Alberta where several large-scale pulp mills have either been built or are currently under construction. To understand and characterize the cumulative effects of these types of developments on the aquatic environment, the Northern River Basins Study (NRBS) was initiated in 1991.

Historically, information on fish contaminants in Alberta's northern river basins has been collected by a variety of public and private sector agencies. This information, however, exists in a variety of locations and formats throughout northern Alberta. As a result, no common database exists for storing, retrieving, and accessing information on fish contaminants. In response, the Northern River Basin Study Office initiated a project to compile all of the existing information regarding fish contaminants in northern Alberta into one common database.

2.0 DATA COMPILATION AND DATABASE DESIGN

Based on discussions with NRBS personnel (Appendix A), a number of criteria were developed for use in data compilation and development of the database:

a) Historical information on fish contaminants should be easy to access and update using an industry standard database product.

b) The database should be able to accommodate all historical as well as any new fish contaminants data collected on behalf of the NRBS.

c) The information contained in the database should be able to be exported to a wide variety of geographical information system computer software products.

Historical information to relating the analyses of contaminants in fish samples were compiled from various private (eg., laboratories, mills, consultants) and government (eg., provincial, federal) agencies. Information requests were made with a brief introductory phone call followed by an official letter of request on behalf of the Northern River Basins Study Office. Of the various public and private sector agencies contacted, seven responded to the request for fish contaminants information (Table 1).

Table 1: Summary of Information Sources for the Historical Fish Contaminants Database.

Agency	Laboratory	Data Type
ALPAC	Sentar	Various fish contaminants
Weyerhaeuser	Sentar	Various fish contaminants
Alberta Fish and Wildlife	?	Dioxin/furan fish contaminants
DFO[a]	DFO	Mercury and other contaminants
Alberta Environment Centre	?	Mercury and other contaminants
NRBS Program	Zenon	Chlorinated phenols
Indian and Northern Affairs Canada, Water Resources Div.	Cantest Labs (Van.) Envirotest Labs (Edm.) DFO (Winn./Burl.)	Various fish contaminants

[a] Department of Fisheries and Oceans

Information that was compiled for the historical fish contaminants database was received in a variety of data formats. Table 2 lists the data, and depicts the original format in which the data was presented.

Table 2: Sources and Original Formats of Historical Fish Contaminants Data.

Source	Location Represented	Data Format
DFO[a]	Lake Athabasca	ASCII text files
Alberta Environment Centre	Various locations	Lotus worksheet files
Alberta Fish and Wildlife	Various locations	Lotus worksheet files
Weyerhaeuser data	Wapiti River	dBase III files
Indian and Northern Affairs Canada, Water Resources Division	Slave River	Lotus worksheet files
NRBS program	Various locations	Lotus worksheet files

[a] Department of Fisheries and Oceans

Following a review of the information received from various agencies, Borland dBase IV was used to create the historical fish contaminants database. dBase IV is capable of holding a large number of records, which is especially important from the point of view of needing to update the database as new information is gathered. The program is also widely used in database management, and supports a variety of import/export formats, facilitating data transfer for use in other applications such as geographic information systems.

Historical fish contaminant data files typically contained of two basic types information. The first type of information was related to fish collection and contained such information as UTM coordinates, collection method(s), field handling techniques, dates and times of collection, time to death, time to preservation, site identification, watershed, habitat type, tissue types removed for analysis, collector information, client, and sample preparation location. Data for individual fish included species identification, weight, length, age, sex, and gross pathology.

The second type of information included in the data files contained all relevant analytical data such as type of tissue being analyzed, location, laboratory, archived tissue information, results by compound and concentration, accuracy and detection levels, laboratory sample number, data status, data location, and date of analysis.

3.0 DATABASE STRUCTURE

The structure of the historical fish contaminants database was developed by first examining all of the data contained with the data files, and creating fields for all of the contaminants that were analyzed for and reported by each agency. As discussed earlier, the database was structured to reflect the two basic types of information within the data files received from various private and public agencies including general fish collection information and analytical data. In the case of the analytical data, and chemical contaminants were arranged into six contaminant classes.

3.1 GENERAL FISH COLLECTION INFORMATION

General information associated with fish collection, location, testing sites etc. is contained in the data fields as summarized below:

Field	Data contained in field
ASSIGNED ID.	Historical Database compilation project number
Test Number	Number of test in case of multiple tests being performed on an individual fish
Fish ID	I.D. specific to the project under which fish were collected
Lab #1	"Fish number assigned by the testing laboratory, or alternate fish ID"
Lab #2	"Fish number assigned by the testing laboratory, or alternate fish ID"
Latitude	Latitude of capture location
Longitude	Longitude of capture location
Latitude - Longitude	
Lat-Long coordinates of fish capture location	
UTM	UTM coordinates of fish capture location
UTM_X	UTM - X coordinate of fish capture location
UTM_Y	UTM - Y coordinate of fish capture location
Group Number	Group number as assigned by project under which fish were collected
Field Handling Tech	
"Collection, preservation information"	
Date - Time of Collection	Date and time collection information
Time to Death	Time to fish death
Time to Preservation	The
to fish preservation	
Water Body	Body of water in which fish was captured
Site Identification	Capture site information as recorded by fish collection project
Watershed	Watershed in which fish was collected
Nearby Mill or Feature	Pulp & Paper mill or feature near fish capture location
Habitat Type	Fish habitat type, i.e., rapids, pool, etc."
Collector	Collecting agency or organization
No. Fish in Composite Sample	Number of fish comprising a homogenized sample
Client	Client for which fish were collected and tested
Laboratory	Laboratory performing tests on fish
"Sample Prep. Location	Additional details detailing sample preparation and reasons for collecting fish samples
Sample Type	"Tissue type analyzed, i.e., liver, muscle, fat, etc."
Species	Fish species
Fork Length	"Fish fork length, mean FL in the case of a composite sample"
Fork Length Range	FL Range in the case of a composite sample
Weight	"Fish weight, mean weight in the case of a composite sample"
Weight Range	Weight range in the case of a composite sample
Sex	Sex of fish
Age	Age of fish
Maturity	Fish maturity

Comments	Additional comments concerning fish testing
Status	Status of fish test
Sample Location	Location of fish sample
Tissue Types Removed	Fish tissue types removed for analysis
Tissues Analyzed	Tissue types analyzed
Archive Information	Information concerning archived fish tissues
Detection Limit, Units, and Accuracy	Test detection limits, units and accuracy
Analytical Method	Testing method used
Data Status	Status of fish test data results
Analysis Date	Date test analysis were performed
% Lipid	% Lipid content
%Moist	% Moisture content
%Protein	% Protein content

3.2 ANALYTICAL DATA

3.2.1 Chlorophenol Compound Contaminants

Chlorinated phenolic compounds were grouped together, and the individual compound fields used in the database are shown below:

Field

Pentachloroanisole
2346+2356-TeClAnisole
2345-TeClAnisole
234-Trichloroanisole
235-Trichloroanisole
236-Trichloroanisole
245-Trichloroanisole
246-Trichloroanisole
24-Dichloroanisole
26-Dichloroanisole
26-Dibromoanisole
246-Tribromoanisole
4-Chlorocatechol
"3,4-Dichlorocatechol"
"3,5-Dichlorocatechol"
"4,5-Dichlorocatechol"
"3,4,5-Trichlorocatechol"
"3,4,6-Trichlorocatechol"
Tetrachlorrocatechol
4-Chloroguaiacol
5-Chloroguaiacol
6-Chloroguaiacol
2-Chlrorphenol
4-Dichlorophenol
"2,4-Dichlorophenol"
"2,3,4-Triclhloropehnol"
"2,3,5-Trichlorophenol"
"2,3,6Triclorophenol"
"2,4,5-Trichlorophenol"
"2,4,6-Trichlorophenol"
"2,3,4,5-Tetrachloropenol"
"2,3,4,6-Tetrachlorophenol"

Pentachlorophenol
5-Chloroquiacol
6-Chloroquaiacol
"3,4-Dichloroquaiacol"
"4,6-Dichloroquaiacol"
"4,5-Dichloroquaiacol"
"3,4,5-Trichloroquaiacol"
"3,4,6-Trichloroquaiacol"
"4,5,6-Trichloroguaiaicol"
"4,5,6-Trichloroquaiacol"
Tetrachloroquaiacol
6-Chlorovanillin
"5,6-Dichlorovanillin"
"4,5-Dichloroveratrole"
2-Chlorosyringaldehyde
"2,6-Dichlorsyringaldehyde"
"3,4,5-Trichlorosyringol"
"4,5,6-Trichlorosyringol"
"3,4,5-Trichloroveratrole"
Tetrachloroveratrole
Extractable Organic Bromines (EOBR)
Extractable Organic Chlorides (EOCL)
"1,1-Dichlorodimethylsulfane"
"1,1,2-Trichloromethylsulfane"
Trichloromethoxybenzene

3.2.2 Dioxin and Furan Compound Contaminants

Dioxin and furan contaminant compounds were also grouped together. This contaminant class was further subdivided according to congener, surrogate, and homologue compounds. The compounds in the database are represented by the fields below:

Compound Type	Field
Congener compounds	2378 TCDD
	12378 PECDD
	123478 HXCDD
	123678 HXCDD
	123789 HXCDD
	1234678 HPCDD
	OCDD
	2378TCDF
	12378 PECDF
	23478 PECDF
	123478 HXCDF
	123678 HXCDF
	123789 HXCDF
	234678 HXCDF
	1234678 HPCDF
	1234789 HPCDF
	OCDF
Surrogate Compounds	13C12-2378-TCDD (measured as percent recovery)
	13C12-2378-TCDF
	13C12-12378-PECDD
	13C12-12378-PECDF
	13C12-23478-PECDF
	13C12-123478-HXCDD

	13C12-123678-HXCDD
	13C12-123478-HXCDF
	13C12-123678-HXCDF
	13C12-234678-HXCDF
	13C12-123789-HXCDF
	13C12-1234678-HXCDD
	13C12-1234789-HPCDF
	13C12-OCDD
Homologue compounds	TCDD
	Total TCDD's
	PECDD
	Total PCEDD
	HXCDD
	Total HXCDD
	HPCDD
	Total HPCDD
	Total PCDD's
	TCDF
	Total TCDF
	PECDF
	Total PECDF
	HXCDF
	Total HXCDF
	HPCDF
	Total HPCDF
	Total PCDF's

3.2.3 Polychlorinated Bi-Phenol Compound Contaminants

Polychlorinated bi-phenol (PCB) compounds was the third major group of contaminants contained in the data files. These compounds are represented in the database according to the following fields:

Field
PCB 28
PCB 32
PCB 44
PCB 49
PCB 52
PCB 56/60
PCB 70/76
PCB 101
PCB 118
PCB 137
PCB 138
PCB 153
PCB 170
PCB 180
pcb fat
pcb muscle
TOTAL PCB

3.2.4 Resin and Acid Compound Contaminants

Resin and acid contaminant compounds were grouped together in the database and represented in the database by the following fields:

Field

12-Chlorodehydroabietic acid
14-Chlorodehydroabietic acid (#1)
Abietic acid
Dehydroabietic acid
Isopimaric acid
Levopimaric acid
Linoleic acid
Myristic acid
Neoabietic acid
Oleic acid
Palmitic acid
Palustic acid
Pimaric acid
Sandaracopimaric acid
Stearic acid

3.2.5 Insecticide and Pesticide Compound Contaminants

Insecticide and pesticide contaminant compounds were grouped into a contaminant class and are represented in the database by the following fields:

Field

alpha BHC
gamma BHC
delta BHC
cis-chlordane
trans-chlordane
trans-nona-chlordane
gamma Chlordane
alpha Chlordane
ddd
ddd pp'
dde
"p,p DDE"
"p,p TDE"
DDT op
"p,p DDT"
sigma DDT
total ddt
aldrin
dieldrin
endrin
beta Endosulfan
Endosulfan I
Endosulfan II
Endosulfan sulphate
mirex
PhotoMirex

hcb
hch
Hexachlorobenzene
heptachlor
heptachlor epoxy
Octachlorostyrene
Octachloronaphthalen
lindane
methoxychlor
oxychlordane
Toxaphene

3.2.6 Heavy Metal Contaminants

The last major class of contaminants for which analytical results were reported included the heavy metals. These contaminants are represented in the database by the following fields:

Field

Aluminum
Antimony
Arsenic
Barium
Beryllium
Bismuth
Boron
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Magnesium
Manganese
"Mercury, Inorganic"
"Mercury, Methyl"
"Mercury, Total"
"Mercury, % Methyl"
Molybdenum
Nickel
Phosphorus
Potassium
Selenium
Silver
Sodium
Strontium
Tin
Titanium
Vanadium
Zinc

4.0 DATA PROCESSING

Because of the variety of formats the data files were received in (Appendix B), special measures were required in each case to prepare the data for inclusion in the historical fish contaminants database (Appendix B). The following section details the steps that were taken to prepare each data set for the database:

4.1 DEPARTMENT OF FISHERIES AND OCEANS DATA FILES

Data files from the Department of Fisheries and Oceans contained information on pesticide, chlorinated phenol, and PCB fish test results from Lake Athabasca and were received in ASCII text file format. In order to incorporate this data into the historical fish contaminants database, the following steps were used:

a) ASCII data files were imported into Microsoft Excel (Version 4.0) and parsed (a method used to assign data to unique fields).

b) An examination of the data at this point revealed that a number of tests were performed on each fish, although the data was not arranged so that the range of test results for each fish could be grouped together. Spreadsheet data was sorted on three fields, LOCATION, LENGTH, and WEIGHT, thus enabling test results to be grouped for each fish.

c) A routine was written in dBase IV programming language to identify, extract, and re-plot fish test results against fish individuals. A routine was also written to convert test results presented in parts per billion (PPB) to parts per million (PPM).

d) Following extraction, 2665 records were produced and are represented on the database by 1 to 2665.

4.2 ALBERTA ENVIRONMENT CENTRE HISTORICAL DATA FILES

Alberta Environment Centre Historical (AECHIST) data files consist of historical fish contaminants data. Pesticide, chlorinated phenol, and pcb data are represented in the data files. The format of these files was such that no major adjustments were required in order to import them to the NRBS historical fish contaminants database. The steps that were required to prepare the data for the database were as follows:

a) Test results for fat and muscle are presented separately in the AECHIST files. Consequently, it was decided that two records per

sample would be used to represent this data in the NRBS database; one record for the set of for test results for fat, one for test results of muscle.

b) Data from the AECHIST data files represent record numbers 2666 to 3698 in the NRBS database.

4.3 FISH AND WILDLIFE HISTORICAL DATA FILES

The data format of Alberta Fish and Wildlife Historical (FWHIST) data files was similar to that of the AECHIST data files and was comprised of dioxin and furan contaminant fish results. No major processing was necessary to import this information into the NRBS historical fish contaminants database. The FWHIST data:

a) consists of one record per fish, and

b) forms record numbers 3699 to 3922 in the NRBS historical fish contaminants database.

4.4 WEYERHAEUSER DATA FILES

The data files obtained from Weyerhaeuser were comprised of fish contaminant test results obtained from the Wapiti River between 1990 and 1992. Contaminants tested for included dioxins, furans, and chlorinated phenol compounds. Data files were originally presented in dBase III format, and required extensive manipulation for incorporation into the NRBS historical fish contaminants database. Details of the steps required were as follows:

a) The Weyerhaeuser study was comprised of two phases. Phase I fish originated from study years 1990 and prior while Phase II fish originated from study years 1991 and after. This distinction is important since locational nomenclature is not consistent between Phase I and II.

b) The original data set was transposed (the X and Y ordinates switched) to ensure compatibility with the structure of the NRBS historical fish contaminants database. Further adjustments to the database were also made to account for missing and/or corrupt data.

c) Weyerhaeuser data forms record numbers 3923 to 4097 in the NRBS historical fish contaminants database.

4.5 INDIAN AND NORTHERN AFFAIRS CANADA DATA FILES

The Water Resources Division of Indian and Northern Affairs Canada provided data files containing contaminant test results for fish collected from the Slave River. The test results contained in these data files were patchy, portions of files were corrupt, and exhibited a variable degree of information redundancy. Part of the redundancy problem encountered in the data was attributed to the fact that contaminant test results originated from at least three different laboratories (Table 3):

Table 3. Summary of Contaminants Analyzed by Different Laboratories for the Slave River Data.

Contaminant	Laboratory	Location
Metals	Cantest	Vancouver
Chlorinated Phenols	Envirotest	Edmonton
Dioxin/Furans	Envirotest	Edmonton
EOCL scan data	Envirotest	Edmonton
Dioxin/Furan, Organochlorine, Toxaphene, PCB's	DFO[a]	Burlington

[a] Department of Fisheries and Oceans

To minimize the duplication of information (i.e., to reduce the size of the data set), and to incorporate the data files into the NRBS historical fish contaminants database, a number of changes were made:

a) Several computer routines written in dBase IV programming language were developed in order to perform extensive comparisons among separate data files, identifying individual fish and matching test results. Fish identifications were made based on species, weight and length comparisons, similarity of test results and lab test numbering where available.

b) Once the individual fish were identified, redundancies in the reported test results were deleted, and a single Slave River data set was constructed.

c) Information retrieved from the Slave River data files provided by the Water Resources Division, Indian and Northern Affairs Canada comprise records 4098 to 4471 in the NRBS historical fish contaminants database.

An additional data set for the Slave River was also available from the Water Resources Division. These data files provided the results of contaminant tests performed on composite fish samples from Slave River. Unlike the first data set described above, these composite fish data files only required transposition to comply with the structure of the NRBS historical fish contaminants database.

a) The composite fish samples collected from the Slave River comprise record numbers 4472 to 4486 in the NRBS database.

4.6 NORTHERN RIVER BASINS STUDY - PHASE I DATA

NRBS data from Phase I of the study consists of multiple files of fish contaminant test results. Compounds that were tested for include chlorinated phenols, PCB's, and pesticide/herbicide contaminants. Details of the file handling techniques are described below:

a) RAP fish naming conventions were used in the data files.

b) Data was transposed to comply with the data structure developed for the NRBS historical fish contaminants database.

4.7 LOCATION INFORMATION

Information on fish collection sites varied considerably among the data files that were received. Some data files included detailed locations of fish collection sites while other only included qualitative description (Table 4).

Table 4. Summary of Location Information for Data Files Included in the NRBS Historical Fish Contaminants Database.

Data File	Locational Information	Conversion to UTM Coordinates
Lake Athabasca Data	Latitude - Longitude data	YES
AECHIST Data	Qualitative description	NO
FWHIST 1, 2&3 Data	Qualitative description	NO
FWHIST 4 Data	Legal Land Description	NO
Sentar Data	Latitude - Longitude data	YES
Slave River Data	Sparse locational data	SOME
Zenon Data	Latitude - Longitude data	YES

As described in the Terms of Reference, latitude/longitude data was converted to UTM coordinates using an external conversion program. Conversions required latitude/longitude information and (where possible) were accomplished as follows:

Lake Athabasca Data:	A latitude-longitude value is presented for each piece of test data. A text based editor was used to separate the data into latitude/longitude coordinates for input to the conversion program. UTM coordinates were produced for incorporation to the NRBS database.
AECHIST Data:	Since qualitative descriptions of fish collection locations were only provided (i.e., Bow River at Calgary), conversion to UTM coordinates was not possible.
FWHIST 1, 2&3:	Since qualitative descriptions of fish collection locations were only provided (i.e., Bow River at Calgary), conversion to UTM coordinates was not possible.
FWHIST 4:	FWHIST 4 data files contains only legal land descriptions of fish collection sites. Conversion to UTM coordinates was not possible.
Sentar Data:	A latitude-longitude value was presented for each piece of test data. A text based editor was used to separate the data into latitude/longitude coordinates for input to the conversion program.
Slave River Data:	Patchy locational information was present, however, precise locations were difficult to determine with these data.
Zenon Data:	A latitude/longitude value was presented for some of the data. A text based editor was used to separate the data into latitude/longitude coordinates for input to the conversion program.

5.0 CONCLUSIONS

The NRBS historical fish contaminants database represents the compilation of many different data sets that were combined into a single database structure. Combining different data sets from a range of fish contaminant monitoring programs with different objectives has resulted in a database that appears "blocky or patchy" (Appendix D) where certain information and/or analytical results are not available for particular locations or contaminants. The database does, however, represent an attempt to compile all available historical fish contaminant testing under one common database, and is open for the inclusion of subsequent contaminant testing results and research. The data that has been included in the database retains its precision and all attributes that were associated with it. Enough information is present in this database to construct advanced retrieval SQL (structured query language) systems to fine tune and enhance data retrieved from the system. The planar nature of the database ensures compatibility, portability, and expendability to database systems with more powerful capabilities (such as ORACLE) or to various types of geographic information systems.

APPENDIX A: Database Development

Database Development

Discussions were held May 14, 1993 with the NRBS office regarding the form that the database should take. At that time, it was revealed that the NRBS database project may serve as an interim database until fish contaminant and other data would be transferred to a larger Oracle based system. It was initially decided that NRBS data would be compiled in the form of a spreadsheet, thereby facilitating later transfer to the Oracle based system. It was also decided that fish contaminant data in the form of a spreadsheet could still be used by scientists to generate area specific reports and satisfy needs for the production of synthesized product.

The production of a historical fish contaminants spreadsheet resulted in the generation of an extremely large spreadsheet file very quickly. After the first 1000 records, computer hardware and software limitations were such that it became apparent that a spreadsheet would not be able to adequately handle the data. dBase IV was then selected for database construction because of its suitability for handling large volumes of data. The database structure was kept as simple as possible, avoiding linked files and generated fields so that future transfer of the fish contaminant data to an Oracle-based system would be as easy as possible.

APPENDIX B: DATA MANIPULATION NOTES

Table 5. Data Files Used in the Developing the NRBS Historical Fish Contaminants Database.

SOURCE	LAB	FILE NAME	ORIG. FORM	dBASE #
Weyerhaeuser	Sentar	FCHLPH91.DBF	dBase	N/A*
Weyerhaeuser	Sentar	FDIOXH.DBF	dBase	N/A*
Weyerhaeuser	Sentar	FEOC.DBF	dBase	N/A*
Weyerhaeuser	Sentar	FEOC91.DBF	dBase	N/A*
Weyerhaeuser	Sentar	FEOCB.DBF	dBase	N/A*
Weyerhaeuser	Sentar	FBR&FA.DBF	dBase CORRUPT	NON-USABLE
Weyerhaeuser	Sentar	FCGE90.DBF	dBase	N/A*
Weyerhaeuser	Sentar	FCGE.DBF	dBase	N/A*
Weyerhaeuser	Sentar	FDIOXC.DBF	dBase	N/A*
Weyerhaeuser	Sentar	FPPP.DBF	dBase CORRUPT	NON-USABLE
Northern Affairs	Cantest	SFCMRT.WK1	Lotus 123 v. 2.3	N/A*
Northern Affairs	Envirotest	SFECPA.WK1	Lotus 123 v. 2.3	N/A*
Northern Affairs	Envirotest	SFEDFA.WK1	Lotus 123 v. 2.3	N/A*
Northern Affairs	Envirotest	SFEEOCA.WK1	Lotus 123 v. 2.3	N/A*
Northern Affairs	DFO Winnipeg	SFHISOA.WK1	Lotus 123 v. 2.3	Isotope data not used
Northern Affairs	DFO Winnipeg	SFLMFOA.WK1	Lotus 123 v. 2.3	MFO data not used
Northern Affairs	DFO Burlington	SFWDATA.WK1	Lotus 123 v. 2.3	N/A*
Northern Affairs	DFO (Winnipeg?)	SFWINFO.WK1	Lotus 123 v. 2.3	N/A*
NRBS Phase I	Zenon	03024279.WK1	Lotus 123 v.3	Series A**
NRBS Phase I	Zenon	03036479.WK1	Lotus 123 v.3	Series A**
NRBS Phase I	Zenon	03036478.WK1	Lotus 123 v.3	Series A**
NRBS Phase I	Zenon	03036477.WK1	Lotus 123 v.3	Series A**
NRBS Phase I	Zenon	03036477.WK1	Lotus 123 v.3	Series A**
NRBS Phase I	Zenon	03036476.WK1	Lotus 123 v.3	Series A**
NRBS Phase I	Zenon	03036475.WK1	Lotus 123 v.3	Series A**
NRBS Phase I	Zenon	03036474.WK1	Lotus 123 v.3	Series A**
NRBS Phase I	Zenon	03036473.WK1	Lotus 123 v.3	Series A**

SOURCE	LAB	FILE NAME	ORIG. FORM	dBASE #
NRBS Phase I	Zenon	03036472.WK1	Lotus 123 v.3	Series A**
NRBS Phase I	Zenon	03036471.WK1	Lotus 123 v.3	Series A**
NRBS Phase I	Zenon	03035445.WK1	Lotus 123 v.3	Series C**
NRBS Phase I	Zenon	03033880.WK1	Lotus 123 v.3	Series D**
NRBS Phase I	Zenon	03033879.WK1	Lotus 123 v.3	Series C**
NRBS Phase I	Zenon	03033878.WK1	Lotus 123 v.3	Series E**
NRBS Phase I	Zenon	03033877.WK1	Lotus 123 v.3	Series F**
NRBS Phase I	Zenon	03033876.WK1	Lotus 123 v.3	Series G**
NRBS Phase I	Zenon	03033875.WK1	Lotus 123 v.3	Series B**
NRBS Phase I	Zenon	03033874.WK1	Lotus 123 v.3	Series B**
NRBS Phase I	Zenon	03026228.WK1	Lotus 123 v.3	Corrupt
NRBS Phase I	Zenon	03024279.WK1	Lotus 123 v.3	Series A**
NRBS Phase I	Zenon	03026034.WK1	Lotus 123 v.3	Series A**
NRBS Phase I	Zenon	03026028.WK1	Lotus 123 v.3	Series A**
Fisheries & Oceans	DFO	ATHABASC1.TXT	ASCII Text	
Fisheries & Oceans	DFO	ATHABASC2.TXT	ASCII Text	

N/A* denotes that data was merged into one or more composite files.

Series A* denotes a combination of twelve separate files.

Series B*, Series C* denotes a combination of two files.

Series D*, Series E*, Series F*, Series G* denotes single file component.

APPENDIX C: Porting and Data Manipulation

Porting and Data Manipulation

Since most of the data was received in spreadsheet form, Microsoft Excel ver. 4.0a was used to manipulate and prepare many aspects of the data. Extensive use was made of the internal transpose and sorting functions provided by Excel. Where data required extensive comparisons with other data sets (i.e., to determine the identity of test results and other parameters) the data was exported to dBase IV where a number of sorting and data manipulation routines were developed.

During data processing, some difficulties with the data files were encountered periodically. For example, numeric data contained in some of the data sets were being expressed as character variables. This situation was discovered through systematic checks of data that were imported into the dBase IV database. Because the dBase file was set up to accept numeric test results, *numeric* data expressed as *character* data would default to a null value when imported to dBase IV. The problem was not present in all data files that were imported, and a pattern was not discernable in the type of file that would be affected. Subtle software and data incompatibilities resulted in data mis-handling throughout the compilation project, requiring that constant attention be paid to avoid the introduction of errors in the main NRBS historical fish contaminants database.

APPENDIX D: Anomalies Present in the Fish Contaminant Database

Anomalies Present in the Fish Contaminant Database

The NRBS historical fish contaminants database represents the combination of a large number of different data files originating from a variety of different monitoring programs. Data for a group of contaminants may result from a single testing project (i.e., PCB contaminant data may arise singularly from one experimental program). Data compiled for this database showed that most fish contaminant monitoring programs in Alberta are performed on a narrow range of components (such as heavy metals), and are not designed to include a broader spectrum of contaminants (such as heavy metals, chlorophenols, PCB's etc.)

This historical pattern of contaminant testing in fish in northern Alberta results in a "blocky" or discontinuous database. Table 5 provides an example of structure of the database. In this hypothetical database example, fish numbered 115-118 were part of a contaminant monitoring program which tested for the presence of chlorophenols only. Consequently, fish numbers for this test series have data present (shown as "#####" in Table 5) in only the Polychlorinated compounds section of the database. This is also true fish numbered 119-123 where analyses were conducted for chlorophenol compounds only. In comparison, fish numbered 124-131 may have collected for a contaminant monitoring program designed to detect levels of dioxins and heavy metals in fish. All blank fields in the historical fish contaminants database indicate that those particular contaminants were not tested for during a specific fish contaminant monitoring program. Therefore, the database will contain numerous blank fields, resulting in a "blocky or patchy" distribution of information.

Table 6. Example of NRBS Database Data Characteristics.

ID #	Chlorophenols	Dioxins	Polychlorinated	Resins	Insecticides	Heavy Metals
115			#####			
116			#####			
117			#####			
118			#####			
119	#####					
120	#####					
121	#####					
122	#####					
123	#####					
124		#####				#####
125		#####				#####
126		#####				#####
127		#####				#####
128		#####				#####
129		#####				#####
130		#####				#####
131		#####				#####

Appendix E: Field Identifiers, Portability & Compatibility

Field Identifiers, Portability & Compatibility

The inclusion of data from a variety of private and public sector agencies involved in different fish contaminant monitoring programs results in the compilation of a data that presents unique standardization problems in creating a single database. Some of the problems include:

1) Measurement of different parameters among different tests; i.e., UTM locational coordinates versus latitude/longitude coordinates. Typical treatment of this type of disparity would be the use of separate fields for UTM and latitude - longitude coordinates.

2) Lack of measurement of certain parameters; i.e., "water body" and "site identification" information measured in some but not all data sets used in database construction. Typical treatment of this type of disparity would be the inclusion of blank fields for water body and site identification fields where the data was not present.

3) Use of different units; i.e., parts per billion (PPB) versus parts per thousand (PPT) for the same measured compound. Treatment of this type of disparity required the creation of a separate field, a special "units" field, to describe the type of measurement system that was used in a test program. Simple conversion from PPB to PPT or vice versa is not technically feasible in this case, as the resulting number becomes too large or insignificant. Including the separate "Detection Limit, Units and Accuracy" field ensures the integrity of the data is preserved, and individual data sets retain information they originally contain.

Field Specific Comments

Anomalies specific to individual fields are addressed in this section.

Field A "ASSIGNED ID"

This field contains a sequential number series unique to the NRBS historical fish contaminants database. Each fish in the database has been assigned a number. Some fish have a second record i.e., 535A and 535B. In this case, data is present for test results performed on a single fish, but for tissue types such as muscle and kidney. 535A would represent test results performed on fish number 535 muscle tissue, and 535B would represent test results performed on the same fish, but on kidney tissue.

Field B "TEST NUMBER"

This field will be blank, or contain either #1/2 or #2/2. Some contaminant monitoring programs present the results of a second series of tests on the same fish for quality control. In this case, results are presented as test numbered one of two (1/2) or two of two (2/2). For the majority of test results that use only one test per fish, this field is blank.

Field C "FISH ID"

This heterogeneous field results from the direct inclusion of fish ID data from the various test results. Heterogeneity results from the variety of identification schemes used specific to individual contaminant monitoring programs. Question marks present in this field (i.e., SA90??) reflect uncertainty recorded as such and being already present in the data prior to inclusion to the NRBS contaminant database.

Fields D and E "LAB #1 and LAB #2)

Some test results provide Lab 1 and Lab 2 identifiers, and some data sets present test results on the same fish but from different laboratories as a means to ensure quality control.

Fields F, G and H "LAT, LONG AND LAT-LONG"

These fields include latitude/longitude data exactly as provided for in the data sets.

Fields I, J and K "UTM, UTM_X and UTM_Y"

These fields represent data that was present in the original data sets. Accuracy of data contained in these fields has not been verified, but has rather been directly transferred from the original data sets.

Fields L to AO

These fields directly represent information included in the original data sets. Heterogeneity in these fields arises from the presence of a variety of classification schemes used among the testing programs. Efforts have not been made to standardize classification schemes and categories due to the wide variety in testing procedure and difficulty in determining the applicability of any one individual scheme to the various contaminant monitoring programs.

Fields that are entirely blank, i.e., O and P, (time to death and time to preservation), S (watershed), U (habitat type), AK, AL, AM and AM (status, sample location, tissues removed for analysis and archive information) are fields for which no data was available in any of the data sets but are included for the purpose of being filled in at a later date if required by a particular study or the results of further research.

Field AP "Detection Limit, Units and Accuracy"

This field contains detailed information concerning detection limits, units and test accuracy for individual test program results. Using this field, the exact nature and results of testing programs can be reconstructed without losing numerical precision or accuracy.

Fields AQ to AV

These fields contain data as transferred directly from the data sets used in the NRBS database. Field AS (analysis date) includes a variety of data formats at various levels of precision; day-month-year, and year-month, etc.

Fields AW to IU

Contaminant test results in the body of the database consist of blocks of information as discussed in this manual. Where a specific contaminant has not been tested for, the field will appear blank. For some contaminants such as PCBs, data may be present in less than 100 records.

Appendix F: Terms of Reference

NORTHERN RIVER BASINS STUDY
TERMS OF REFERENCE

Project 2340-B1: Historical Compilation of Fish Tissue Contaminant Data

A. PURPOSE

1. Information compiled into one common database.

2. Accessible and compatible to update in an electronic database software format readily available to a large number of PC users e.g., DBase IV.

3. Can be enlarged to include "new" contaminants and data.

4. Can accommodate all Alberta fish species and all the chemical compounds being analyzed for under the Northern River Basins Study program, Schedule A.

5. Electronic database can be loaded and interact with the Atlas Map, Atlas Pro GIS software.

B. NEEDS

1. Allow easy access to an broad set of information about a sample including results of various analyses.

2. Database can be manipulated without endangering database integrity.

3. Capable of producing a variety of data computations, e.g., information and data by watershed, by species, by point description, by watercourse reach, etc.

4. A sample numbering system to implement for future fish collection/analysis that takes into consideration the possibility that one fish may have a number of different analysis done on the same or different tissues. The system has to be practical for field use and control.

C. SPECIFIC REQUIREMENTS

1. Sample identification code.

2. Collection information.

a) UTM coordinates
b) means of collection
c) field handling techniques e.g., ice, whirl pak, dry ice, temperature
d) date/time of collection
e) time to death
f) time to preservation
g) site identification
h) watershed
i) habitat type e.g., eddy, pool, riffle, backwater, wetland, falls, open water, under cover, near effluent source, mouth of stream
j) tissue types removed for analysis, preservation technique
k) collector
l) client
m) sample preparation location e.g., field, laboratory
n) reason for collection and analysis

3. Fish data.

a) species
b) weight
c) length (fork, whole etc.)
d) age (method of ageing)
e) sex,status of maturity
f) gross pathology examination (ability to note disease and parasitic status)

4. Analytical data.

a) type of tissue being analyzed, location (left, right, dorsal, ventral etc.) amount, laboratory, QA/QC protocol followed, whose QA/QC?
b) type of tissue archived? What kind of sample (whole, single, composite)? where? amount and type of tissue remaining
c) results by compound and concentration, level of accuracy, level of detection, analytical method
d) analytical laboratory number for sample
e) status of data e.g., not available, under review, challenged, unacceptable, raw, provisional, limited distribution
f) location of data
g) date of analysis

5. All reasonable efforts are to be made to recover data from likely sources but not limited to the following: government agencies (Alberta Environmental Protection [Fish & Wildlife, Environmental Assessment], Alberta Agriculture, Environment Canada, Fisheries and Oceans Canada, NWT - Renewable Resources), Industry (Weldwood, Daishowa, Weyerhaeuser, Alpac, Suncor, Syncrude), municipalities, universities.

6. Review the Northern River Basins Study - Sample Inventory Database and design capability to interface, interact and exchange data with this database.

D. REPORTING REQUIREMENTS

1. Ten copies of the DRAFT report are to be submitted to the Project Liaison Officer (Ken Crutchfield, Office of the Science Director, Northern River Basins Study Office, by March 31st., 1993.

2. Three weeks after the receipt of review comments on the draft report, the contractor is to submit ten cerlox bound copies and two unbound, camera-ready originals or the final report to the Project Liaison Officer. An electronic copy of the report, in Word Perfect 5.1 format is to be submitted with the final report. The final report is to contain a table of contents, executive summary, list of figures & tables, acknowledgements and appendix containing the Terms of Reference for this contract.

APPENDIX G: Installing the Database

Appendix G: Installing the Database

This Appendix is provided on the disk bound as the last page of this report; it contains a compilation of historical fish tissue contaminant data. Data entry and coding to the data is described in NRBS Project Report No. 145.

The disk comprising this Appendix contains three files, using 309,269 bytes.

1. INSTALL.BAT; being 80 bytes in size.
2. PR145.EXE; being 328,416 bytes in size.
3. DISCLAIM.TXT; being 486 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 5 files totalling 23,504,900 bytes. To use the files with extension .DBF and .MDX requires dBASE IV. To use the files with the extension .XLS requires Excel, version 4.0a.

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 from the use of the data; individuals using this data do so entirely at their own risk. The NRBS will not update the data except as deemed necessary for its own purposes.