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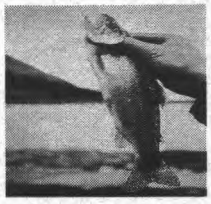
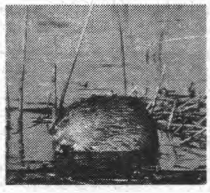
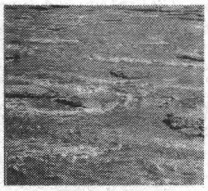


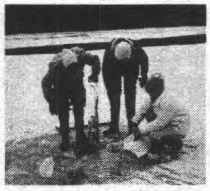





NORTHERN RIVER BASINS STUDY PROJECT REPORT NO. 69

WATER RESOURCES USE AND MANAGEMENT ISSUES FOR THE PEACE, ATHABASCA AND SLAVE RIVER BASINS: RESULTS OF THE HOUSEHOLD AND STAKEHOLDERS SURVEYS JANUARY TO APRIL, 1995



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Prepared for the
Northern River Basins Study
under Project 4121-E2

by

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NORTHERN RIVER BASINS STUDY PROJECT REPORT NO. 69

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PREFACE:

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

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

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

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Reicher, Philippe and Thompson, John, P. 1995. ***Northern River Basins Study Project Report No. 69, Water Resources Use and Management Issues for the Peace, Athabasca and Slave River Basins: Results of the Household and Stakeholders Surveys, January to April, 1995,*** **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 — 10 Jan 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 — Jan 7/96
(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 — Jan. 11/96
(Lucille Partington, Co-chair) (Date)

Robert McLeod — 11/01/96
(Robert McLeod, Co-chair) (Date)

WATER RESOURCES USE AND MANAGEMENT ISSUES FOR THE PEACE, ATHABASCA AND SLAVE RIVER BASINS: RESULTS OF THE HOUSEHOLD AND STAKEHOLDERS SURVEYS JANUARY TO APRIL, 1995

STUDY PERSPECTIVE

In order to assist the Board in discerning the attitudes and concerns of the basin residents on water management issues and possible recommendations, the Other Aquatic Uses component designed a five-step program to obtain the information. The steps included:

1. Identification of Stakeholders;
2. Development of an information gathering strategy;
3. Implementation of data gathering surveys;
4. Analysis of the survey results; and
5. Final synthesis report.

Related Study Questions

3. Who are the stakeholders and what are the consumptive and non consumptive uses of the water resources in the river basins?

16. What form of interjurisdictional body can be established, ensuring stakeholder participation for the ongoing protection and use of the rive basins?

This report represents step four in this program. Surveys of households and stakeholders in the study area were conducted during early 1995. The administration of these surveys is described in "Implementation of a Household Survey" and "Implementation of Stakeholders Surveys " (NRBS Report Numbers 70 and 75).

The purpose of this report is to analyze the results from the surveys and to bring forward the issues, concerns and recommendations offered by the respondents. The answers to the survey questions varied by group and by location. There were some differences between the types of recommendations suggested by the households and the various stakeholder groups. Householders tended to support the NRBS making recommendations that will quickly resolve the current problems with an emphasis on reducing effluent loads, with more monitoring, enforcement and stopping certain activities. Conversely, municipal governments and industry suggested that more research is needed along with basin planning, eventually leading to stricter guidelines. The other stakeholder groups tended to make recommendations that were intermediate between these two groups in terms of the urgency of the situation. Environmental, recreation and agricultural groups generally supported developing stricter regulations for existing activities and stopping or curtailing certain activities.

Between 70 and 80% of households in the study area felt that a management committee for the basin should be established. The purpose of this committee would be to provide advice to the various levels of government, coordinate and conduct research, prepare a basin plan, develop regulations and education programs and oversee enforcement. Interjurisdictional management proposals are discussed further in "Life After NRBS: A Proposal for Interjurisdictional Management of the Peace, Athabasca and Slave River Basins" (NRBS Report Number 84).

The concerns and recommendations brought forward in this report will be reviewed by the Board as part of the formation of their final recommendations.

REPORT SUMMARY

This study was undertaken on behalf of the Northern River Basins Study in response to one of the 16 questions posed by the Study Board at the outset of the study. This question is who are the stakeholders and what are the consumptive and non-consumptive uses of water in the Peace, Athabasca and Slave river basins? This report attempts to answer this question using the results of surveys conducted with stakeholders and a random sample of households in the northern river basins. The information contained in this report is based on completed questionnaires from 718 households (53 percent response rate), and from 183 of 602 stakeholder groups (30 percent response). The results of the surveys are summarized below for individual stakeholder groups.

General Public

The key stakeholders are the residents of the Peace, Athabasca and Slave river basins. In 1991 there were 268,690 people living in the basins, with about 3,000 of these people living in the NWT. The main consumptive use of water for this group is drinking water. While 55 percent of basin residents obtain their drinking water supplies from municipal water systems and 31 percent use groundwater from wells, most of the remainder use water from surface-water sources including rivers, lakes and dug-outs. Between 40 and 55 percent of households that rely on surface water sources employ some form of water treatment. About 10 percent of people who use river water claim that this water has acquired a chlorine taste during the past 10 years, even though none of them use chorine as a water treatment method.

About 72 percent of basin households participate in one or more types of water-based recreation. Total recreational activity amounts to about 1.80 million trips per year. About 34 percent of households use sites along the mainstems of the major rivers in the basin, including the Athabasca and Peace rivers. These sites account for 21 percent of trips to the three sites most preferred by basin residents. About 10 percent of households that participate in water-based recreation believe that the mainstems of the river have become dirtier over the last 10 years.

About 54 percent of basin households go fishing and, on average, they catch 23.3 kilograms of fish per year. Walleye and northern pike account for 25 percent of the total catch. Just over one-third of fishermen eat all or part of their catch and average consumption is 13.6 kilograms per year, although much lower consumption is reported in the Smoky/Wapiti area. About 14 percent of households that participate in water-based recreation have observed various changes in fish populations over the

last 10 years. These changes include reduced fish populations, smaller fish, more disfigurations and growths, and an oily taste to the fish

Municipal and Local Government

Some 321 licences for 28,800 acre-feet of water per year have been issued to municipal and local governments in Alberta for purposes of domestic consumption This use accounts for nine percent of licenced water withdrawals on the Athabasca River and 15 percent of withdrawals from the Peace River. Only three percent of local and municipal governments that responded to the survey believe that their treated drinking water does not meeting drinking water standards. Thirty-six percent of water plant operators believe that the quality of raw water supplies is the most important factor affecting the quality of treated water. About half of plant operators feel that the quality or quantity of their raw water supplies has deteriorated over the last 10 years. About 80 percent of municipal and local governments treat their sewage before release to surface water sources and 54 percent of these use only primary sewage treatment. About 31 percent of households that obtain drinking water from municipal treatment plants are concerned about the quality of this water and 28 percent use some form of additional treatment, usually filtration.

Agriculture

There are about 13,900 farms in the study area. About 26 percent raise livestock while 29 percent produce grains or oilseeds and 41 percent are mixed farmers. The remainder are specialty farms. Farms in the NRBS account for about 17 percent of Alberta cattle production. Watering of livestock and irrigation are the main uses of water. A total of 194 irrigation water licences for 7144 acre-feet of water have been issued in the Alberta portion of the basin. Irrigation accounts for two percent of water withdrawn from the mainstem of the Peace River. About 85 percent of grain and oilseed farms use herbicides. These farms are located mainly in the Peace River drainage above the Town of Peace River. Over 80 percent of these farms also use fertilizers. About 85 percent of livestock operations spread their manure onto their land.

Industrial Water Users

Industry is the biggest consumer of water in the region. Licences totaling 430,600 acre-feet of water have been issued for industrial purposes and 52 percent of this is from the Athabasca River mainstem and eight percent is from the Peace River. Water use practices vary by industry. Companies in the forest sector use between 40 and 80 percent of their allocations, recycle 40

percent and discharge about 60 percent of what they withdraw. In comparison, the majority of oilfield injection companies use more than 60 percent of their licence, recycle about 20 percent and return about 20 percent back to surface-water sources. Less than 10 percent of companies have seen any changes in water quality or quantity in the last 10 years. Companies in the oil and gas sector expect their need for water to decline in the next 10 years, while some forestry operations expect their needs to grow.

Commercial Recreation Companies, Trappers, Commercial Fishermen and River Transportation

Various companies and individuals are directly or indirectly dependent on water resources in the basins for their livelihood. Some of the 51 commercial recreation companies in the basin offer river tours, especially on the Peace and Clearwater rivers, and they are very concerned about water quality and quantity. Although the other types of operations may not directly use northern rivers, any change in water quality or fisheries can affect the tourist potential of the region and affect their businesses. About 50,000 people per year use the services of commercial recreation operations in the basin, including one-quarter of all non-resident visitors to the area.

The commercial fish harvest from lakes in the NRBS area amounts to about 1.4 million kilograms per year. This represents about two-thirds of the total Alberta commercial fish harvest. No commercial fishing occurs in the mainstems of the Peace, Athabasca or Slave rivers. There are about 400 active commercial fishermen in the basin, and they are not currently concerned about water quality in the basin. However, they believe that contaminated fish from river mainstems may move into lakes and affect commercial fish harvests in the future. Commercial fishermen eat part of their catch: about 48 kilograms of fish per year.

There are about 2,400 active trappers in the NRBS area and they produce about $1.3 million in furs per year, mostly beaver, muskrat and coyotes. About one-quarter of these people trap within 10 kilometres of the river mainstems. In most parts of the basin, trapping along the mainstems of the river accounts for less than 10 percent of animals trapped. However, more than 50 percent of the harvest in the Peace-Athabasca Delta comes from river channels. Only 40 percent of trappers have observed a decline in furbearer populations in recent years, and part of this is due to natural cycles.

The mainstem of the Athabasca River is still used as a transportation route, with volumes of freight depending on population growth and economic activity in the Peace-Athabasca Delta.

Stakeholder Issues and Concerns

The surveys provided an opportunity to explore the water management issues and concerns of importance to basin residents and stakeholders.

Households in the basin generally believe that water quality is a problem in the basin. Only 16 percent agree completely or partially with a questionnaire statement that water quality is "not really a major issue at the moment". In contrast, 38 percent agree with the statement that "pollution of northern rivers is only a concern in a few locations", while 75 percent agree that "contamination of northern rivers is a major problem".

Nearly 40 percent of households throughout the basin see pulp mills as the most important factor affecting water quality in the basin. Most stakeholder groups also believe that pulp mills are the prime factor affecting river health. Other major factors of concern to households, in order of importance, include municipal sewage, other industries, logging, and agriculture. In most cases, northern residents feel that these activities have adversely affected fish populations and water quality by introducing contaminants and pollutants into northern rivers. About two-thirds of households concerned about these factors believe that they or members of their household have been directly affected. While impacts on drinking water and human health are of some concern, more households are worried about the effects that these activities are having on fishing and other recreational activities in the basin. In most cases, households feel that increased regulation should be used to better control activities that affect water quality and quantity. About 75 percent of households and 66 percent of basin stakeholders disagree with the statement that "existing water management regulations are interfering with economic development in the basin".

Nearly 55 percent of households throughout the northern river basins propose that water quality be used to assess river health, with measurements being taken on a monthly basis. In describing future monitoring, 40 percent prefer that government be responsible for monitoring water quality while 30 percent want an independent agency to do the job. Only three percent feel that industry should be responsible for monitoring. However, nearly half of households believe that industry should pay for water-quality monitoring.

Households and stakeholders were give the opportunity to list up to three recommendations that they feel should be made by the NRBS Board. Sixty percent of households responded to this question. The most common recommendation, made by 23 percent of households who responded to this question, is that the NRBS Board recommend that effluent loads be reduced. Another 21

percent suggest that industrial activities be better monitored while 17 percent want the NRBS Board to recommend better enforcement of pollution laws. Twelve percent of households want the Board to recommend that certain activities, such as logging and the operations of dams, be stopped or better controlled. While only four percent of households think that the NRBS Board should recommend the development of a basin management plan, 80 percent of households and 75 percent of stakeholders agree with a statement that "no further effluent discharges be allowed until a basin management plan has been completed". The results of the household survey suggest that basin residents want the NRBS Board to make recommendations that will act quickly to resolve current problems.

Future Management of the Basin

In the survey, northern households and stakeholder groups were also asked whether they supported the idea of establishing some sort of ongoing, intergovernmental and stakeholder committee responsible for the protection and use of the northern river basins. The survey included several questions about the functions of such a committee.

Between 70 and 80 percent of households in all regions within the basin support the establishment of a management committee. Some of the stakeholder groups are less supportive of this idea. More than 75 percent of households believe that a committee should be responsible for providing advice to the federal, provincial and territorial governments, coordinating and conducting research, preparing a basin management plan, developing regulations, developing education programs, and overseeing enforcement. In contrast, only 51 percent feel that the committee should issue licences or permits. Industrial stakeholders believe that the committee should only have an advisory, research and education role and should not be responsible for regulatory functions.

Over 82 percent of households are willing to participate on the committee, either as a committee member or as formal or informal advisors. In contrast, less than 37 percent of industrial water users, municipal and local governments, and agricultural groups are willing to participate on the committee.

ACKNOWLEDGMENTS

The completion of this project was made possible because of the contribution and dedication of a number of individuals who assisted the authors in a variety of ways.

First, we thank Cindy Drobot for her data entry and coding skills which allowed for efficient processing and interpretation of the survey data; Matthew Morgenstern for his detailed research on locating specific recreational sites within the northern river basins; Jason Krips for his analysis of commercial fishing in the basin; Diane Roder for her research, Eric Ellehoj for preparing the maps, and Elaine McPhee for her editing.

Second, we thank Dr. John Stager, other members of the Science Advisory Committee, members of the Study Board, and Dr. Bruce MacLock for providing the direction for the study and for their comments on earlier drafts of this report.

Third, we thank the people who responded to the survey. The success of this project was dependent on the willingness of people living in the northern river basins and representatives of various stakeholder groups to take the time to fill out the questionnaires. Without their cooperation, this analysis would not have been possible.

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PART I - INTRODUCTION

1.0 BACKGROUND AND OBJECTIVES

The Northern River Basins Study (NRBS) is a joint project between the governments of Canada, Alberta and the Northwest Territories that commenced in September of 1991. The purpose of the NRBS is "to characterize the cumulative effects of development on the water and aquatic environment of the Study areas by coordinating with existing programs and undertaking appropriate new technical studies". To undertake this study, a Study Board, Study Office and Science Advisory Committee were created. The study area includes the mainstems and main tributaries of the Peace, Athabasca and Slave rivers.

The Study Board developed a vision statement to provide overall guidance for the various technical activities being conducted in support of the study and also identified 16 questions that serve to focus study activities. Eight scientific component groups were established to address these 16 questions and the Other Uses Component was established for the purpose of answering Question #3:

#3. Who are the stakeholders and what are the consumptive and non-consumptive uses of the water resources in the river basins?

This report was written to answer this question.

1.1 Work Program

The Other Uses Component developed a five-step work program to define stakeholders and determine their use of the resources of the river basins. These five steps and the work completed to date are summarized as follows:

1. Identifying stakeholders and uses- Project 4101-B1 (Praxis, 1993) was undertaken in the fall of 1993 and produced a partial list of stakeholder groups (about 290) in the region. This

study also identified the general public as a stakeholder. The list of stakeholders was further developed as part of Project 4121-D1 (South Slave Research, 1994). Consumptive water use was interpreted to mean those where water is withdrawn from a water body and a portion may then be returned in diminished quantity or quality. This includes things like municipal, agricultural and industrial water use. Non-consumptive uses included things like recreation, tourism, commercial fishing, trapping and transportation which depend on the water resources of the basin, even though no actual consumption of water may occur.

2. Developing and information collection strategy. - Strategies for collecting information from the general public and from stakeholder groups were developed in 1994 as part of Project 4121-D1 and 4121-D2 (Golder, 1994). These strategies involved conducting telephone and mail-out surveys with a random sample of northern residents and stakeholders. Surveys were suggested because there are no existing data bases that describe how northern residents use the aquatic resources of the basin. A draft questionnaire and sampling strategy were also developed.

3. Implementation of the information collection strategy. - Implementation of the household and stakeholder surveys commenced in January of 1995 and was completed in mid-April. As part of Project 4121-D4 (Reicher, 1995), nine different types of surveys were developed for specific categories of stakeholders within the basin and questionnaires were sent to approximately 600 different groups and associations. Project 4121-D3 (Drobot Contracting, 1995) involved completion of the household survey. Over 1,400 households in 12 regions were contacted by telephone and agreed to complete a detailed questionnaire which was sent by mail. A total of 718 household and 185 stakeholder surveys were completed, returned, coded and entered into a statistical data base.

4. Analysis of survey results. - The purpose of this project (4121-E2) is to analyze the survey results.

5. Preparation of a summary report. - This final step is to be completed by December, 1995.

1.2 Study Objectives

The primary objective of this study is to prepare a detailed statistical analysis of the results of the household survey and all nine stakeholder surveys. The emphasis of the analysis is on producing descriptive statistics, and testing for significant differences among stakeholder groups and among the 12 regions in the household survey. Where appropriate, survey results have been extrapolated to produce basin-wide estimates of resource use. Analysis focuses on the following:

- An assessment of the representativeness of survey data and potential sources of bias.
- Water use characteristics, both licenced and unlicenced, and consumptive and non-consumptive. Separate discussions of municipal, domestic, industrial, agricultural, recreational, transportation and others water users are provided.
- A description of how water use has changed during the previous 10 to 20 years.
- Current water management issues, comparing results among various types of water uses.
- Suggestions for water management practices and recommendations that could be proposed by the NRBS, comparing survey results among various types of water users.
- Suggestions related to monitoring the health of rivers.
- Potential changes in future water use demands and uses.

This information was to be summarized in a final report that will comprise a major part of the final synthesis paper for the Other Uses Component. A copy of the terms of reference for this project is provided in Appendix 1.

2.0 DATA SOURCES

The primary objective of this report is to summarize information gathered through surveys of residents of the northern river basins and of stakeholders who use the aquatic resources of the basins. This section of the report contains a brief description of the methods used to collect this information. A more detailed description can be found by reviewing the reports for Project 4121-D3 (Drobot Contracting, 1995) and Project 4121-D4 (Reicher, 1995).

2.1 Household Survey

The initial study for the Other Uses Component recommended that residents of the northern basins be considered stakeholders (Praxis, 1993). This study also recommended that a random sample of northern residents be surveyed to determine how they use the aquatic resources of the basin and to identify the water management issues and concerns of greatest concern to the general public.

The final design for this study recommended that an initial survey of northern residents be undertaken by telephone (Golder, 1995). Telephone directories provide a comprehensive and up-to-date listing of most northern residents and allow survey data to be easily extrapolated to provide information about the total population. Although there was some concern that a telephone survey would preclude certain groups (aboriginal households or rural households), this method was chosen because there are no other lists from which a random sample of households could easily be selected. Subsequent analysis showed that the number of households with telephones (89,587) in 1994 is very similar to the number of census households in 1991 (88,987). The similarity of these numbers suggests that only a minimal number of households were precluded from the survey.[1]

[1] The slightly higher number of households with telephones in 1994 partially reflects population growth since 1991.

A second factor in designing the survey was that people living in various parts of the study area are likely to use aquatic resources in different ways and to face different types of water management problems. As a result, the study areas was divided into 12 regions and a random sample of households was then drawn from each region. The boundaries of the regions were selected to match drainage basins with telephone prefixes. Seven of the regions contain various reaches of the mainstems of the Athabasca, Peace and Slave rivers. The other five regions contain major tributary basins. The resulting regions are shown in Figure 2-1.

A third design factor for the survey was sample size. Initially it was decided to obtain completed surveys from 90 households in 10 of the 12 regions plus 180 households in the two regions with very large populations. These numbers were based on a compromise between survey costs and the need for statistical confidence. As the study proceeded and costs proved lower than expected, these numbers were increased slightly to 100 and 200 per region, respectively.

The actual survey involved contacting randomly-selected households by telephone and asking them to complete the survey. This initial screening ended when about 1,350 households had agreed to complete the survey. Questionnaires were then sent out by mail. Completed questionnaires were either returned by mail or, in those regions where the number of responses was less than 50, interviewers conducted the survey over the telephone to boost response rates. By the end of the survey, 718 responses were received. This represents a response rate of 53 percent. As shown in Table 2-1, responses were received from between 0.4 percent and 8.4 percent of households in each of the regions. Overall, the survey was conducted with an average of 0.8 percent of households in the Alberta and Northwest Territories' portion of the Peace, Athabasca and Slave river basins.

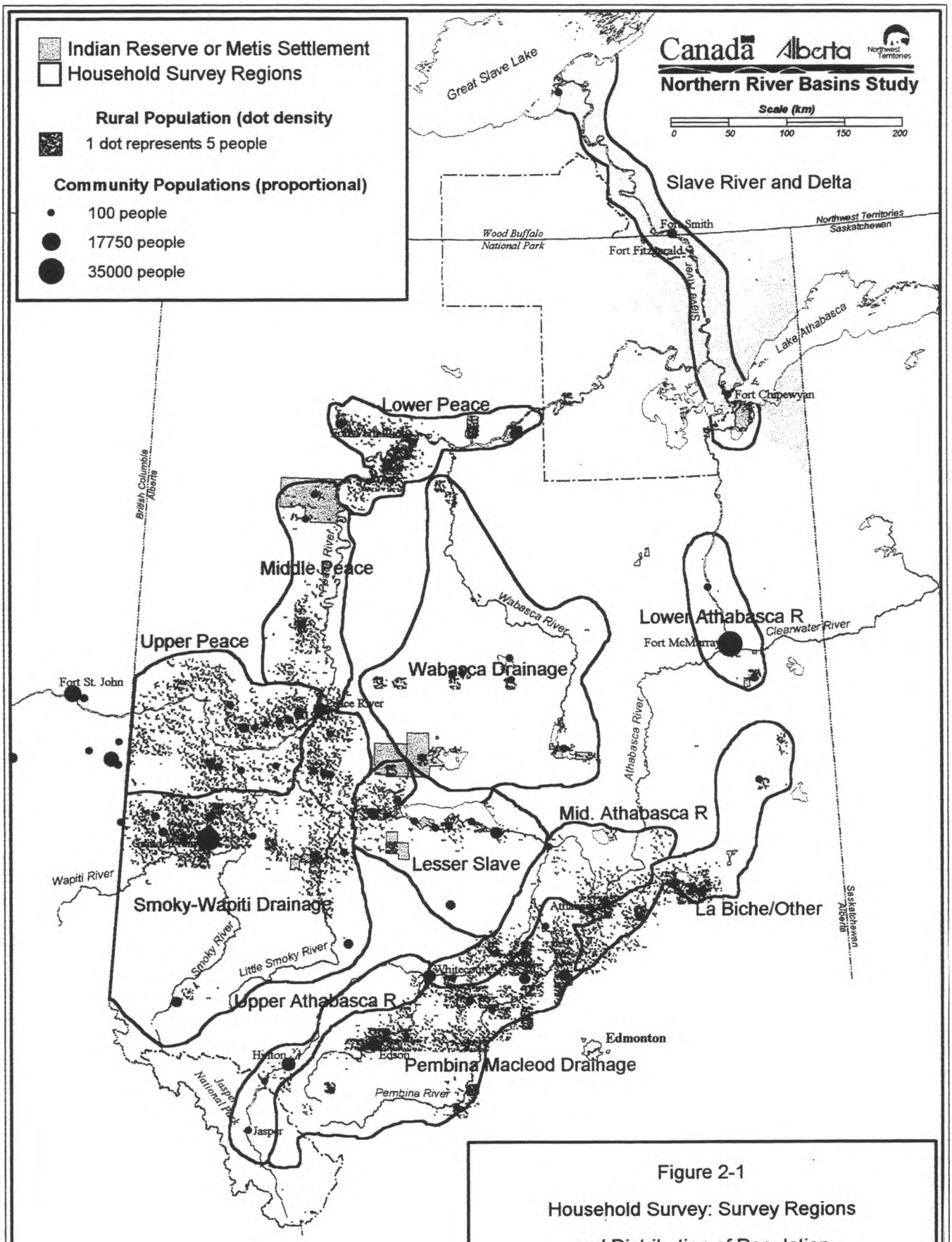

Figure 2-1

Household Survey: Survey Regions and Distribution of Population

2.2 Stakeholder Surveys

There is no comprehensive list of stakeholder groups within the northern river basins. Thus, several previous studies undertaken by the Other Uses Component (Praxis, 1993; South Slave Research, 1994) were designed to build as complete a list as possible and they focused on stakeholder groups likely to have a high interest in water use and water-management issues. This work involved identifying groups by undertaking a review existing published information and then contacting these groups by telephone to verify this information.

The initial work focused on environmental and recreational organizations, but this was eventually expanded to include trappers, agricultural groups (including agricultural service boards), commercial fishermen, licenced industrial water users, local and municipal governments, companies that provide recreational or tourism facilities or services, and companies that are involved in river transportation. The total number of stakeholder groups in each of these categories is summarized in Table 2-2.

The contact lists were reviewed and updated several times before the survey was implemented. Questionnaires were sent out by mail, although in most cases there had been some prior contact by telephone. As shown in Table 2-2, about 30 percent of these questionnaires were completed and returned, although this varied from group to group.

2.3 Questionnaire Design

The questionnaires used for both the stakeholder and householder survey followed a similar format and, in some cases, used exactly the same questions. This allows survey results to be directly compared among households and stakeholders.

The first half of each questionnaire was designed to determine how each group makes use of aquatic resources in the study area. Respondents were asked to describe where they go, what they do, which aquatic resources are used, and their frequency of use. Questions were tailored to

Table 2-1

Household Survey Response Rates and Sampling Fraction, by Region

Region	Total Households		Sample Results		Sample Fraction
	Number	Percent	Number	Percent	
Upper Athabasca	7,782	8.7%	50	6.9%	0.6%
Middle Athabasca	5,342	6.0%	59	8.2%	1.1%
Lower Athabasca	10,369	11.6%	54	7.5%	0.5%
Upper Peace	7,019	7.8%	56	7.8%	0.8%
Middle Peace	4,255	4.7%	48	6.7%	1.1%
Lower Peace	2,717	3.0%	52	7.2%	1.9%
Slave River/Delta	1,017	1.1%	53	7.4%	5.2%
Smoky/Wapiti	22,111	24.7%	92	12.8%	0.4%
Lesser Slave	5,421	6.1%	54	7.5%	1.0%
Pembina/Macleod	19,071	21.3%	97	13.5%	0.5%
Wabasca	642	0.7%	54	7.5%	8.4%
Lac la Biche	3,841	4.3%	49	6.8%	1.3%
Total	89,587	100.0%	718	100.0%	0.8%

Table 2-2

Survey Population and Response Rates for Stakeholder Survey

Stakeholder	Population	Completed Surveys	Response Rate
Agricultural Stakeholders	86	18	20.9%
Agricultural Service Boards	24	9	37.5%
Commercial Fishermen	47	14	29.8%
Commercial Recreation Businesses	51	17	33.3%
Industrial Licence Holders	95	44	46.3%
Municipal & Local Governments	112	35	31.3%
Recreation and Environmental Groups	160	38	23.8%
River Transportation	3	1	33.3%
Trappers	24	9	37.5%
Total	602	183	30.4%

reflect the characteristics of each stakeholder group and employed both parametric and non-parametric measures of use.[1] Respondents were also asked to describe any changes that they had observed in the quality or quantity of water, fish, wildlife or vegetation in the basins during the previous 10 years. Each respondent was also asked to describe their uses of the mainstems of the Athabasca, Peace and Slave rivers.

The second half of the questionnaire was the same for all stakeholder groups and for the household survey. Respondents were asked to identify the key factors that have caused changes in the aquatic resources of the basins over the past 20 years, to describe which aspects of river health ought to be monitored in the future, and what recommendations the NRBS ought to make. The majority of questions were open-ended, allowing respondents to describe things in their own words. Some questions were highly structured using Best/Worst scaling with a fractional factorial survey design, but analysis of these results was conducted by another consultant (Project 4121-E1, Intelligent Marketing Systems, 1995).

Copies of the questionnaires used for each stakeholder group and for the household survey can be found in the reports for projects 4121-D3 and 4121-D4. A copy of the household survey and the survey used for recreation and environmental groups can be found in Appendix IV.

2.4 Report Organization

This report is presented in four parts. Part I introduces the objectives of the survey and describes the methods used to collect the information upon which this report is based. A demographic profile of respondents to the household survey is also presented. This profile is compared to 1991 Census data in order to assess whether the sample population is representative of households within the Northern River Basins.

[1] Parametric tests were used for numeric data where ths data are known to be distributed in a normal manner while non-parametric tests were used for nominal or ordinal measurements (like rankings).

Part II describes how households and stakeholders use the aquatic resources of the basins. Separate sections describe domestic water use (including municipal water systems), subsistence use of fish and wildlife, recreational activities, commercial recreation and tourism, agriculture, industrial water use, commercial fishing, trapping and transportation. Each section provides an overview of activities within the basin and then assesses the importance of the mainstems of the Peace, Athabasca and Slave rivers. This part is based primarily on data from the surveys, but uses information from other sources to help interpret survey results.

Part III summarizes the water management issues of greatest importance to households and stakeholders, and then outlines the recommended actions to address these issues. This part includes a discussion of the factors that have most affected water quality and quantity in the northern rivers basins during the last 20 years and how these changes have directly affected basin residents and stakeholders. It summarizes the types of monitoring required to measure the health of northern rivers. And, it concludes by describing the types of actions that northern residents and stakeholders would like the Study Board to recommend.

Part IV considers the question of what sort of future management structure, including public involvement, is preferred in dealing with future water management issues? This part describes household and stakeholder support for the establishment of an on-going, intergovernmental and stakeholder committee responsible for the use and protection of northern river basins. The suggested roles and responsibilities of this committee are also described.

3.0 METHODOLOGY

In socio-economic research, samples are used as a basis for making generalizations about large populations. To develop a comprehensive assessment of the use aquatic resources by residents of the northern river basins would require questioning each of the 269,000 people living in the region. Time and budget constraints make such a task impossible. As an alternative, the basin was divided into 12 regions and a random sample of households in each region was surveyed with the expectation that the survey results would closely approximate the characteristics of households in each region.

These estimates are not without error. Usually, the smaller the sample size, the greater the potential for error. Statisticians have developed a number of procedures for describing the accuracy of survey results. Some of these procedures have been used to assess the results of the NRBS surveys and these are described below. Potential problems associated with non-response to the survey are also described.

3.1 Analytical Procedures

The accuracy and reliability of estimates for key population characteristics are described throughout this report in terms of confidence intervals (CI). Confidence intervals reflect the variability seen in sample results and describe a range of estimates which probably includes the real value for the population. For this analysis, a 95 percent level of confidence has been selected to describe sample estimates. This means that we are 95 percent confident (19 times out of 20) that the true measure falls within a given confidence interval. Confidence intervals are shown using a "±" sign.

Much of the information presented in the report consists of estimates of proportions (percentages) taken directly from survey results. These estimates are too numerous to warrant calculation of confidence intervals for each one. As an alternative, a general assessment of the confidence intervals for these estimates can be determined by consulting Table 3-1. This

Table 3-1

Confidence Intervals (95%) For Estimates of Proportions

	1% or 99%	10% or 90%	20% or 80%	30% or 70%	40% or 60%	50%
Most Regions Sample Size = 50	± 2.8%	± 8.3%	± 11.1%	± 12.7%	± 13.6%	± 13.9%
Smoky/Wapiti and Pembina/Macleod Regions Sample Size = 90	± 2.1%	± 6.2%	± 8.3%	± 9.5%	± 10.1%	± 10.3%
Northern River Basins Sample Size = 700	± 0.7%	± 2.2%	± 2.9%	± 3.4%	± 3.6%	± 3.7%

table provides confidence intervals for estimates of proportions for households within individual regions as well as for the basin population as a whole. The table shows that if 80 percent of households within a region are estimated to participate in recreation, for example, this estimate is accurate to within ± 11 percent (i.e. the real number is expected to be in the range from 69 to 91 percent, 19 times out of 20). The same estimate for the households in the whole NRBS area would be accurate to within ± 2.9 percent.

Sometimes, survey estimates for various regions appear to be different. Because of the variability in the estimates for several regions, these differences may not be real. Consequently, various tests must be used to determine whether observed differences are statistically significant. Chi-square (χ^2) tests were used to test for significant differences in estimates of distributions while a Scheffé test was used to test for significant differences among sample means. In both cases, tests are performed using a .05 level of significance. This means that we are 95 percent confident that any observed differences among groups are statistically significant. Both tests were run using the SPSS/PC+ software used to analyze survey results. In the remainder of this report, the word "significant" has been used only to describe differences that are statistically significant.

3.2 Non-Response Bias

Any survey that draws information from a random sample of a large population is subject to problems associated with non-response. These problems can occur if a specific segment of the sample is routinely missed during the survey or refuses to answer questions about certain issues. If this occurs, sample results may not accurately describe the population.

There is no comprehensive test to determine the extent of survey bias due to non-response. Instead, survey analysts must compare survey results with any known characteristics of the population being surveyed. In this case, the demographic characteristics of survey households have been compared with 1991 Census information. This analysis is provided in Section 4.10.

4.0 PROFILE OF SURVEY HOUSEHOLDS

One of the objectives of the household survey is to collect information about northern households. This information serves two purposes. First, the information can be used to describe the residents of the NRBS area (public stakeholders) in socio-economic terms and to identify how residents use the aquatic resources of the basin. Second, the survey data can be compared to other information, such as the 1991 Census, to test whether the sample of 718 households can be considered representative of the overall basin population.

4.1 Urban/Rural Setting

The majority of households in the NRBS area are found in cities and towns. As shown in Table 4-1, nearly 60 percent of households live in urban areas. In comparison, just over 30 percent of households live on farms and another nine percent reside in rural subdivisions, acreages and cottages. Less than one percent live in Métis settlements or on Reserves.

While this describes the basin as a whole, there are some very significant differences among regions. The greatest urban concentrations can be found in the Lower Athabasca (Ft. McMurray), Slave River/Delta (Fort Chipewyan, Fort Smith, Fort Resolution) and Upper Athabasca (Jasper, Hinton, Whitecourt) regions. More than 85 percent of households in these regions live in urban areas. The largest proportion of farm households can be found in the Middle Athabasca and Upper Peace regions. The Wabasca region stands out because of the large number of households in Métis settlements and Reserves. Nearly a quarter of households in the Lac la Biche region live in rural subdivisions, cottages or acreages.

4.2 Ethnicity of Households

Survey results suggest that aboriginal and Métis people account for only about 3.6 percent

Table 4-1

Urban/Rural Setting of Households in the Northern River Basins

Region	Town/City	Farm	Cottage/ Acreage Rural Subdivision	Native Reserve	Métis Settlement
Upper Athabasca	86.0%	6.0%	8.0%	0.0%	0.0%
Middle Athabasca	16.9%	64.4%	18.6%	0.0%	0.0%
Lower Athabasca	96.3%	0.0%	3.7%	0.0%	0.0%
Upper Peace	41.1%	50.0%	8.9%	0.0%	0.0%
Middle Peace	50.0%	41.7%	8.3%	0.0%	0.0%
Lower Peace	42.3%	42.3%	11.5%	3.8%	0.0%
Slave River/Delta	88.7%	1.9%	1.9%	1.9%	5.7%
Smoky/Wapiti	65.2%	28.3%	6.5%	0.0%	0.0%
Lesser Slave	68.5%	24.1%	7.4%	0.0%	0.0%
Pembina/Macleod	48.5%	40.2%	11.3%	0.0%	0.0%
Wabasca	31.5%	0.0%	7.4%	38.9%	22.2%
Lac la Biche	32.7%	40.8%	22.4%	0.0%	4.1%
Total	59.7%	30.3%	9.2%	0.4%	0.4%

Table 4-2

Ethnicity of Households in the Northern River Basins

Region	Aboriginal	Métis	Non-native
Upper Athabasca	2.0%	2.0%	96.0%
Middle Athabasca	0.0%	1.7%	98.3%
Lower Athabasca	1.9%	1.9%	96.3%
Upper Peace	0.0%	0.0%	100.0%
Middle Peace	2.2%	2.2%	95.7%
Lower Peace	6.0%	2.0%	92.0%
Slave River/Delta	16.3%	14.3%	69.4%
Smoky/Wapiti	0.0%	2.3%	97.7%
Lesser Slave	1.9%	5.7%	92.5%
Pembina/Macleod	1.1%	0.0%	98.9%
Wabasca	46.2%	15.4%	38.5%
Lac la Biche	0.0%	6.5%	93.5%
Total	1.5%	2.1%	96.4%

(± 0.3 percent) of households in the NRBS area. Aboriginal and Métis people are scattered throughout the basin. As shown in Table 4-2, they are most concentrated in the Wabasca and Slave River/Delta regions, where they account for 61 percent and 31 percent of households, respectively. The observed differences in the ethnicity of households among regions are statistically significant.

The data suggest that there are a total of about 3,300 (± 230) Métis and aboriginal households within the NRBS area. More than half of these (about 1,900) are Métis. Of the aboriginal households, the survey data suggest that 45 percent are registered on tribal rolls.

4.3 Household Size

Survey results indicate that the average size of households in the NRBS area is 3.1 people (± 0.1). Statistics Canada 1991 Census data for the region shows the average size of private households for the NRBS area to be 3.02 people. The similarity between survey results and census data suggests that the sample represents a realistic cross-section of basin residents.

As shown in Table 4-3, average household size is lowest in the Smoky/Wapiti region (2.8 people per household) and highest in the Wabasca area (4.2 people). In most cases, the differences in household size are not statistically significant. However, household size in the Wabasca and Lower Peace regions is significant larger than in the Smoky/Wapiti region. This is partly due to these areas having a high aboriginal population and aboriginal households are significantly larger than Métis and non-native households.

Knowing household size, it is possible to estimate the overall population of the NRBS area and the 12 regions. These calculations are shown in Table 4-3. They suggest the total population of the study area is 278,680 people, with a 95 percent probability of falling between 268,000 and 289,500 people. Census information for 1991 suggests the actual population in that year is 268,960. This falls within the calculated range. However, since the survey was undertaken in early 1995, four years after the Census, a higher population estimate should be expected.

Table 4-3

Average Household Size and Regional Population Estimates

Region	Average Household Size	95% CI	Total Households	Population Estimate	95% CI
Upper Athabasca	2.9	± 0.4	7,782	22,860	± 2,890
Middle Athabasca	3.0	± 0.4	5,342	15,930	± 1,880
Lower Athabasca	3.3	± 0.4	10,369	34,100	± 3,960
Upper Peace	3.2	± 0.4	7,019	22,270	± 2,820
Middle Peace	3.5	± 0.5	4,255	15,040	± 1,950
Lower Peace	4.1	± 0.7	2,717	11,090	± 1,860
Slave River/Delta	3.2	± 0.4	1,017	3,240	± 390
Smoky/Wapiti	2.8	± 0.3	22,111	62,520	± 5,590
Lesser Slave	3.4	± 0.4	5,421	18,390	± 2,250
Pembina/Macleod	3.1	± 0.3	19,071	59,490	± 5,860
Wabasca	4.2	± 0.6	642	2,720	± 380
Lac la Biche	2.9	± 0.4	3,841	11,030	± 1,420
Total	3.1	± 0.1	89,587	278,680	± 10,750

Table 4-4

Composition of Households in the Northern River Basins

Region	Single Person	Couple With No Children	Couple With Children	Extended Family	Single Parent Family	Unrelated Adults	Related Adults
Upper Athabasca	16.0%	20.0%	54.0%	2.0%	2.0%	4.0%	2.0%
Middle Athabasca	8.5%	25.4%	45.8%	5.1%	3.4%	5.1%	6.8%
Lower Athabasca	5.6%	18.5%	64.8%	3.7%	1.9%	1.9%	3.7%
Upper Peace	9.3%	22.2%	51.9%	3.7%	5.6%	0.0%	7.4%
Middle Peace	6.5%	26.1%	58.7%	4.3%	2.2%	0.0%	2.2%
Lower Peace	7.8%	15.7%	64.7%	7.8%	2.0%	0.0%	2.0%
Slave River/Delta	9.6%	23.1%	53.8%	1.9%	7.7%	1.9%	1.9%
Smoky/Wapiti	12.2%	27.8%	38.9%	5.6%	5.6%	4.4%	5.6%
Lesser Slave	3.8%	21.2%	53.8%	5.8%	3.8%	5.8%	5.8%
Pembina/Macleod	7.4%	31.6%	48.4%	3.2%	4.2%	2.1%	3.2%
Wabasca	13.2%	11.3%	52.8%	7.5%	11.3%	3.8%	0.0%
Lac la Biche	4.4%	33.3%	46.7%	2.2%	2.2%	0.0%	11.1%
Total	9.0%	25.5%	49.9%	4.2%	4.0%	2.8%	4.7%

The survey results suggest that the population of the study areas in 1995 was 3.6 percent greater than the 1991 Census. In comparison, Census information shows a 2.3 percent change in population between 1986 and 1991.

4.4 Types of Household

Nearly half of surveyed households in the NRBS area (49.9 percent) consists of couples with children. Table 4-4 shows that 9.0 percent of households are single people and 25.5 percent are couples without children. The proportions of extended families and single family households is very similar, at 4.2 and 4.0 percent respectively. Other types of households include small numbers of unrelated adults (2.8 percent) and related adults (4.7 percent). A comparison of results among regions suggests some differences. For example, single person households are more common in the Upper Athabasca, Wabasca and Smoky/Wapiti regions. However, statistical testing indicates that none of the observed differences are significant.

4.5 Age Composition of Households

The age composition of households in the NRBS area is shown in Figure 4-1. The survey results are compared to both the 1991 Census information for the NRBS area and for Alberta. This information suggests that the sample results may not be completely representative of the NRBS area population. There is some under-representation of households having people in the 20 to 24 range and children under 10. On the other hand, households having people aged between 45 to 64 year are over-represented in the sample.

Figure 4-1 also indicates that the population of the NRBS area is generally younger than the provincial average. Although the age profiles are quite similar for both areas, children under 15 are more numerous in the NRBS area. They account for about 28 percent of the population in the NRBS compared to only 24 percent for Alberta. On the other hand, people over the age of 54 account for nearly 17 percent of the provincial population but only 13 percent of the population in the study area.

Figure 4-1

Age Characteristics of the Survey Households Compared to 1991 Census Information for the Northern River Basin Study Area and Alberta

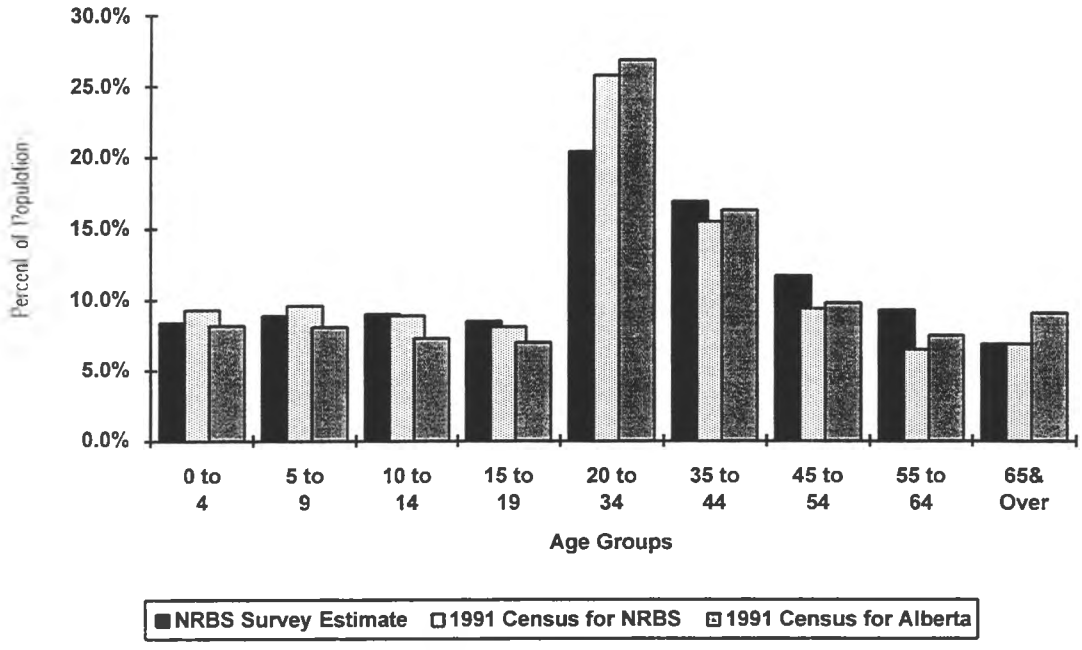

Table 4-5

Age Composition of Survey Households by Region

Region	0 to 4	5 to 9	10 to 14	15 to 19	20 to 34	35 to 44	45 to 54	55 to 64	65 & Over
Upper Athabasca	4.6%	9.3%	10.6%	11.3%	19.9%	23.8%	9.9%	6.0%	4.6%
Middle Athabasca	5.6%	5.6%	5.1%	10.7%	16.9%	14.0%	18.5%	11.2%	12.4%
Lower Athabasca	10.3%	7.1%	12.5%	9.2%	21.7%	22.8%	12.0%	3.8%	0.5%
Upper Peace	5.3%	5.3%	12.4%	11.2%	10.1%	19.5%	13.6%	10.7%	11.8%
Middle Peace	8.6%	8.6%	11.3%	8.6%	18.5%	18.5%	11.9%	9.9%	4.0%
Lower Peace	8.7%	12.1%	13.6%	12.1%	18.5%	13.6%	11.7%	6.8%	2.9%
Slave River/Delta	6.3%	6.3%	10.1%	10.7%	18.9%	17.6%	15.7%	11.3%	3.1%
Smoky/Wapiti	7.1%	9.1%	7.9%	6.0%	23.8%	16.3%	10.3%	11.9%	7.5%
Lesser Slave	17.2%	8.9%	4.4%	8.3%	26.7%	10.0%	11.7%	6.1%	6.7%
Macleod/Pembina	8.2%	12.3%	7.2%	7.2%	20.5%	14.3%	10.2%	10.6%	9.6%
Wabasca	16.7%	0.6%	16.7%	8.9%	27.8%	16.1%	9.4%	1.7%	2.2%
Lac la Biche	12.4%	7.8%	7.0%	8.5%	17.1%	13.2%	14.7%	14.0%	5.4%
Total	8.4%	8.9%	9.0%	8.5%	20.4%	16.9%	11.7%	9.3%	6.9%

A regional breakdown of age compositions is provided in Table 4-5. Considerable differences in the age composition exist among the various regions and they are statistically significant. For example, the highest percentages of people over 54 are found in the Middle Athabasca and Upper Peace regions. This age group accounts for at least 22 percent of the population in these regions. This is due in part to agriculture development which saw these areas populated before many of the other regions.

In contrast, the highest percentages of children under 15 are found in the Wabasca and Lower Peace regions. Here, children account for at least 34 percent of the population. These regions have a high aboriginal population and aboriginal households tend to have larger families than non-native and Métis households.

4.6 Employment

Survey respondents were asked to identify the industries in which household members are employed. For 40 percent of responses, members are employed in more than one industry. Nearly 10 percent of households reported that they are no longer active in the workforce because they are retired, disabled or homemakers. Students are found in about one percent of households while 2.4 percent of households are unemployed. Thus, it is estimated that 86 percent of households actively participate in the workforce. A regional breakdown of employment data is provided in Table 4-6. The lowest household employment is noted in the Lac la Biche region where over 21 percent of households reported being no longer in the workforce. The highest rate of unemployment (10.4 percent of households) is in the Wabasca region. These differences are statistically significant.

A direct comparison of these survey results with Census information is difficult. Survey data are reported on a household basis, while Census information is drawn from individuals. Census data for 1991 indicates a 75.0 percent labour-force participation rate compared to survey estimates of 86.4 percent for households. About 8.0 percent of individuals were unemployed in 1991

Table 4-6

Household Employment and Labour Force Participation

Region	Employed	Student	Unemployed	Not in Workforce
Upper Athabasca	91.7%	0.0%	5.5%	2.7%
Middle Athabasca	87.1%	0.0%	4.6%	8.0%
Lower Athabasca	92.4%	1.3%	1.3%	5.1%
Upper Peace	82.0%	1.4%	1.4%	15.3%
Middle Peace	85.3%	1.4%	4.3%	8.7%
Lower Peace	91.8%	1.4%	4.1%	2.7%
Slave River/Delta	87.1%	1.4%	4.3%	7.1%
Smoky/Wapiti	84.2%	1.6%	2.4%	11.8%
Lesser Slave	89.9%	1.4%	0.0%	8.6%
Pembina/Macleod	86.7%	0.0%	1.4%	11.6%
Wabasca	83.6%	3.0%	10.4%	3.0%
Lac la Biche	71.4%	1.8%	1.8%	21.4%
Total	86.4%	1.0%	2.4%	9.9%

Table 4-7

Sectoral Employment of NRBS Households

Economic Sector	Survey Estimates of Study Area	1991 Census Data for Study Area	1991 Census for Alberta
Primary:			
Agriculture	20.4%	12.3%	6.7%
Fishing &Trapping	1.5%	0.1%	0.0%
Mining/Oil & Gas	20.3%	11.5%	5.7%
Forestry/Logging	5.6%	2.2%	0.4%
Secondary:			
Manufacturing	6.3%	6.0%	7.6%
Construction	6.8%	7.6%	7.3%
Transportation/Utilities	7.9%	7.8%	7.9%
Tertiary:			
Retail/Wholesale	8.6%	14.3%	16.7%
Business Services	5.6%	5.2%	10.7%
Government, Education & Health	14.3%	20.9%	23.1%
Accommodation/Food Services	0.8%	6.5%	6.8%
Personal Services	2.1%	5.7%	6.9%

compared to survey estimates of only 2.4 percent. These differences are likely caused by individual information being ignored when aggregated at a household level.

Survey data on employment by industry show the importance of the primary resource base in the study area. Primary resource industries include agriculture, fishing, trapping, forestry, mining, and oil and gas. Survey results suggest that someone in nearly one of every two households (48 percent) is employed in primary resource industries. As shown in Table 4-7, this is almost double the rate reported in the 1991 Census data for the region (26 percent) and four times greater than for Alberta (13 percent). Household employment in secondary industries is nearly identical to 1991 Census data for the region. These sources show that 21 percent of both households and individuals are involved in manufacturing, construction, transportation or utilities.

Survey results show that about 31 percent of households are employed in tertiary industries, such as sales and service companies. This rate is much lower than 1991 Census data which determined that nearly 53 percent of basin residents were employed in sales and service jobs. At a provincial level, 64 percent of the workforce were employed in tertiary industries. Lower rates in the NRBS area are expected because of the large rural population.

As noted earlier, direct comparison of survey results and Census data is difficult because the survey data relate to households rather than individuals. In the case of employment, another factor may be that much of the initial telephone survey was conducted during working hours for many people in service and sales. Thus, there may have been a higher probability of contacting

Table 4-8

Household Employment by Industry
(Percent of Households)

Region	Agriculture	Fishing & Trapping	Mining, Oil & Gas	Forestry, Logging	Manufacturing	Construction	Transportation Utilities	Retail, Wholesale	Business Services	Government, Education & Health	Accommodation Food Services	Personal Services
Upper Athabasca	1.5%	6.0%	20.9%	10.4%	22.4%	6.0%	3.0%	7.5%	9.0%	4.5%	3.0%	6.0%
Middle Athabasca	39.5%	3.9%	10.5%	6.6%	3.9%	5.3%	3.9%	3.9%	5.3%	13.2%	1.3%	2.6%
Lower Athabasca	0.0%	0.0%	50.0%	4.2%	0.0%	9.7%	4.2%	15.3%	1.4%	11.1%	1.4%	2.8%
Upper Peace	39.0%	1.7%	8.5%	5.1%	1.7%	6.8%	10.2%	6.8%	5.1%	13.6%	0.0%	1.7%
Middle Peace	23.7%	0.0%	13.6%	5.1%	6.8%	5.1%	15.3%	5.1%	5.1%	10.2%	3.4%	6.8%
Lower Peace	29.9%	1.5%	7.5%	17.9%	4.5%	6.0%	6.0%	9.0%	1.5%	16.4%	0.0%	0.0%
Slave River/Delta	1.6%	6.6%	0.0%	3.3%	0.0%	11.5%	9.8%	6.6%	1.6%	57.4%	0.0%	1.6%
Smoky/Wapiti	18.7%	0.0%	16.8%	1.9%	5.6%	7.5%	11.2%	10.3%	6.5%	21.5%	0.0%	0.0%
Lesser Slave	17.5%	1.6%	19.0%	4.8%	7.9%	6.3%	14.3%	1.6%	7.9%	15.9%	0.0%	3.2%
Pembina/Macleod	28.3%	0.8%	21.7%	6.7%	5.8%	5.0%	5.0%	8.3%	5.8%	11.7%	0.0%	0.8%
Wabasca	0.0%	0.0%	30.4%	1.8%	1.8%	5.4%	8.9%	1.8%	41.1%	0.0%	8.9%	0.0%
Lac la Biche	35.0%	5.0%	0.0%	7.5%	7.5%	10.0%	10.0%	10.0%	0.0%	10.0%	0.0%	5.0%
Total	20.4%	1.5%	20.3%	5.6%	6.3%	6.8%	7.9%	8.6%	5.6%	14.3%	0.8%	2.1%

people employed in agriculture[1] or on shift work from forestry and oil and gas operations. The implications of these differences are assessed in Section 4.10.

Survey data on estimated household employment in the 12 regions are provided in Table 4-8. These estimates show that the extent of employment in transportation, utilities, trade and business services is relatively consistent among the 12 regions. However, there are some significant differences among regions in terms of household employment in the resource and service sectors.

Agriculture is the key source of employment in both the Middle Athabasca and Upper Peace regions. Someone in nearly 40 percent of households in these two regions is employed in agriculture. Other important agricultural areas include the Lac la Biche region, the Lower and Middle Peace regions, and the Pembina/Macleod region. Participation in fishing and trapping is relatively consistent throughout the study area. The highest household participation is noted in the Slave River/Delta, Upper Athabasca and Lac la Biche regions.

Employment in the mining, and oil and gas industries is highly variable throughout the basin. There is high household employment in this sector in the Lower Athabasca region (50 percent) where the oil sands plants are located, the Upper Athabasca region (21 percent) where there are several coal mines, the Pembina/Macleod region (22 percent) which has numerous oil and gas wells, and the Wabasca region (30 percent) which provides some labour for regional oil and gas exploration and the oil sands plants.

Employment in the forestry and logging industries is highest in the Lower Peace and Upper Athabasca regions. Many of the pulp and paper mills in the study area are located in these regions.

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[1] The survey was conducted in January and February.

Table 4-9

Length of Residency at Current Location

Region	Less Than 1 Year	Between 1 and 5 Years	Between 5 and 10 Years	Between 10 and 15 Years	Between 15 and 20 Years	More Than 20 Years
Upper Athabasca	4.0%	26.0%	18.0%	10.0%	8.0%	34.0%
Middle Athabasca	1.7%	15.3%	6.8%	10.2%	22.0%	44.1%
Lower Athabasca	0.0%	11.1%	27.8%	27.8%	20.4%	13.0%
Upper Peace	5.5%	12.7%	9.1%	12.7%	7.3%	52.7%
Middle Peace	2.1%	16.7%	14.6%	12.5%	14.6%	39.6%
Lower Peace	7.7%	11.5%	17.3%	19.2%	7.7%	36.5%
Slave River/Delta	3.8%	22.6%	17.0%	9.4%	3.8%	43.4%
Smoky/Wapiti	7.7%	12.1%	16.5%	14.3%	13.2%	36.3%
Lesser Slave	7.4%	27.8%	11.1%	11.1%	9.3%	33.3%
Pembina/Macleod	7.3%	19.8%	21.9%	12.5%	7.3%	31.3%
Wabasca	7.4%	25.9%	11.1%	3.7%	3.7%	48.1%
Lac la Biche	4.2%	16.7%	6.3%	8.3%	18.8%	45.8%
Total	5.4%	16.6%	17.1%	14.2%	12.1%	34.6%

Table 4-10

Length of Residency in the Northern River Basins

Region	Less Than 1 Year	Between 1 and 5 Years	Between 5 and 10 Years	Between 10 and 15 Years	Between 15 and 20 Years	More Than 20 Years
Upper Athabasca	2.0%	18.4%	12.2%	12.2%	10.2%	44.9%
Middle Athabasca	0.0%	10.2%	6.8%	6.8%	15.3%	61.0%
Lower Athabasca	0.0%	5.6%	25.9%	29.6%	20.4%	18.5%
Upper Peace	0.0%	7.1%	5.4%	8.9%	8.9%	69.6%
Middle Peace	0.0%	6.5%	10.9%	15.2%	8.7%	58.7%
Lower Peace	2.1%	6.3%	8.3%	12.5%	4.2%	66.7%
Slave River/Delta	3.8%	13.2%	18.9%	9.4%	3.8%	50.9%
Smoky/Wapiti	5.7%	3.4%	9.2%	4.6%	14.9%	62.1%
Lesser Slave	3.8%	17.0%	9.4%	9.4%	9.4%	50.9%
Pembina/Macleod	1.2%	7.1%	10.7%	15.5%	9.5%	56.0%
Wabasca	3.8%	13.2%	0.0%	1.9%	5.7%	75.5%
Lac la Biche	2.2%	8.7%	6.5%	6.5%	19.6%	56.5%
Total	2.3%	7.9%	11.3%	12.1%	12.6%	53.8%

More than half of the employment in the Slave River/Delta region (57 percent) is reported to be in health, education and government. Although this is more than twice as large as any other region, Fort Smith and Fort Chipewyan are both important centres for aboriginal, local, regional and territorial government.

4.7 Length of Residency

The majority of northern residents have lived in the NRBS area for an extended period of time. The survey results in tables 4-9 and 4-10 indicate that 35 percent of households have lived at their present location for at least 20 years and 54 percent of households have lived somewhere in the basin for more than 20 years. Less than four percent of households have lived in the NRBS area for less than one year.

There are some very significant differences in length of residency for households in the 12 regions. This is likely due to the rate of resource development that has occurred. For example, nearly half of the households in the Lower Athabasca basin have lived there for 10 to 20 years, which coincides with the opening of the oil sands plants near Ft. McMurray. Very few households have lived in this region for more than 20 years.

Households in the Wabasca region, which has the highest percentage of aboriginal and Métis people, reported the longest period of residency in the region. Over 75 percent of households have lived in the region for more than 20 years. A high proportion of long-term residents is also found in the Upper Peace and Middle Athabasca regions. These regions have a large rural, agricultural population; and 76 percent of households reported having lived in these regions for 15 years or more.

About 20 of households in the Upper Athabasca and Lesser Slave regions have lived in these regions for five years or less. The recent influx of people into these regions is likely correlated with expansion of forestry and oil and gas industries.

Table 4-11

Household Distance From Major Rivers
(Distances in Kilometres)

Region	Distance From River	95% CI
Upper Athabasca	2.8 km	(± 0.8 km)
Middle Athabasca	10.5 km	(± 2.6 km)
Lower Athabasca	4.3 km	(± 2.0 km)
Upper Peace	21.9 km	(± 3.9 km)
Middle Peace	16.6 km	(± 9.7 km)
Lower Peace	37.8 km	(±13.7 km)
Slave River/Delta	4.1 km	(± 2.4 km)
Smoky/Wapiti	18.2 km	(± 2.8 km)
Lesser Slave	37.4 km	(± 8.6 km)
Pembina/Macleod	13.1 km	(± 2.4 km)
Wabasca	72.7 km	(±14.9 km)
Lac la Biche	53.9 km	(± 7.4 km)
Total	17.4 km	(± 2.4 km)

4.8 Distance From Rivers

On average, survey households are located about 17.4 kilometres (± 2.4 km) from one of the major rivers in the basin. These major rivers include the mainstems of the Athabasca, Peace and Slave as well as major tributaries like the Macleod, Pembina, Wapiti, Smoky, Little Smoky and Wabasca rivers.

The average distance from these rivers is highly variable among regions. As shown in Table 4-11, households in the Upper Athabasca, Lower Athabasca, Slave River/Delta are typically located within five kilometres of a major river. In these regions, the bulk of the population is located in urban centres that have developed along the river.

Elsewhere, households tended to be located more than 20 kilometres away from a river. These distances are greatest for households located within major tributary basins like the Wabasca, Lac la Biche and Lesser Slave. However, households along the mainstem of the Peace River also live relatively far from the river (23.4 kilometres). Agricultural activity in the Peace basin has led to less-concentrated settlement patterns away from the river mainstems.

4.9 Summary

Using the demographic information from the previous sections, it is possible to characterize the major differences among the 12 regions used in the analysis. Each of the 12 regions is described below:

1. Upper Athabasca: Households in this region are predominantly urban (96 percent) and non-aboriginal. There is a higher than average proportion of people living in single-person households and in the 35 to 44 age group. Household members are typically employed in the mining, oil and gas, and forestry sectors, with a large number in the accommodation services sector. Many people are recent arrivals (one to five years) to the region.

2. Middle Athabasca: This region has a strong agricultural base, with 64 percent of households living on farms. Households are predominantly non-aboriginal and most have lived in the basin for more than 20 years. While the family structure is similar to the study area as a whole, there are more people over the age of 55 than elsewhere in the basin.

3. Lower Athabasca: This is a very urbanized region (96 percent) which has a very high proportion of families with children. Fort McMurray is the major population centre in this region. There are few people over the age of 55 and few aboriginal or Métis people. Household residents are primarily employed in the mining, oil and gas sectors; and more than half moved into the region between five and 15 years ago.

4. Upper Peace: Households in the Upper Peace region are split evenly between farms and urban areas and are almost entirely non-aboriginal. The household structure is similar to that of the overall region, although individuals are older than elsewhere. The region has an agriculture-based economy and has the highest portion of households that have lived in the northern basins for more than 20 years.

5. Middle Peace: The Middle Peace region is quite similar to the upper Peace, although there are slightly fewer long-term residents and more families with children. Households are predominantly non-aboriginal and are evenly split between farms and urban areas. The economic base is also dependent on agriculture but has large mining, oil and gas, and transportation/utilities sectors.

6. Lower Peace: Households in this region share many of the same characteristics as households in the Upper and Middle Peace regions, although there is a higher proportion of families with young children and a higher aboriginal population. There is a fairly even split between urban and farm households; and the economic base of the region consists of agriculture, forestry/logging, and government, health and education. Despite having a younger population, this region also has a large number of households that have lived in the basin for 20 or more years.

7. Slave River/Delta: This region is highly urban (89 percent) and has a large aboriginal and Métis population (30 percent). The family structure is typical of the overall basin but with more people in the 35 to 44 age group. Much of the economy is dependent on government, health and education; but there is also an important fishing and trapping sector. There are a considerable number of long-term residents as well as new arrivals to the region (one to five years).

8. Smoky/Wapiti: The majority of households in this region (65 percent) live in urban areas. Compared to other parts of the basin, there are more single-person households in the Smoky/Wapiti region and above-average numbers of people in the 20 to 34 and 55 and older age groups. This is consistent with the observation that this region has the highest proportion of people who have lived in the basin for less than a year, but the region also has a high percentage of long-term residents. Although agriculture is an important part of the economic base for this region, the government, mining and oil and gas sectors are also important. This region has a small aboriginal population.

9. Lesser Slave: Households in this region tended to be quite similar in size and composition to households in the basin as a whole. The majority of households reside in urban centres and the economic base of the region mirrors that of the overall region. However, the number of young children and adults aged 20 to 34 is higher than in most other regions and there is a significant aboriginal and Métis population (seven percent). This region also has the highest percentage of people who moved into a region within the past one to five years.

10. Pembina/Macleod: This region contains a nearly-equal balance of urban and farm households, with very few aboriginal or Métis people. There are above average numbers of couples without children and there are large numbers of people aged 65 or older. The region has a strong agricultural base, but is otherwise quite similar to the economy of the overall basin. More people moved to the region during the past 10 to 20 years than in any other region.

11. Wabasca: This region has the highest proportion of aboriginal and Métis people in the basin. These peoples account for 62 percent of the population and most live in Métis settlements or Indian Reserves. Households are larger than average, and there are more single parent families and extended families than elsewhere. The proportion of children under five and young parents (20 to 34) is also very high. Important economic sectors include mining, and oil and gas, but there is no agriculture in the region. Despite having a younger population than most areas, this region has more long-term residents (20 or more years) than any other.

12. Lac la Biche: Although this region has a large farm population, it also has the highest proportion of households living in rural subdivisions, cottages and acreages. In this region there is a high proportion of families with no children, and above-average proportions of people aged 45 to 64. A high proportion of people are not in the workforce and the economic base is largely agricultural. Nearly two-thirds of households have lived at their current location for 15 years or more.

4.10 Validity of Survey Results

It is not possible to clearly prove that the results of the survey provide a completely accurate representation of all the characteristics, attitudes and concerns of residents of the northern river basins. When compared with 1991 Census information for the overall basin, there are some noticeable similarities and differences between the survey results for the sample and the demographic characteristics of the population of the basin.

In terms of similarities, the number of Census households in the northern basins in 1991 (88,987 households) proved to be quite similar to the number of active residential telephone numbers in the study area (89,587 telephones). Thus, there is no evidence that use of a telephone survey inadvertently missed any large segments of the population. In addition, estimates of the basin population calculated from survey results are consistent with the 1991 Census population. The larger survey estimate likely reflects population growth since 1991.

On the other hand, the 1991 Census information suggests that households with people aged 20 to 34 and children under 10 are under-represented in the survey while households with people aged 45 to 64 age are over-represented. The accuracy of the estimated proportion and number of aboriginal and Métis households in the study area cannot be determined because there are no clear and consistent Census statistics for comparison.

In terms of employment, the survey shows a higher percentage of people employed in the primary resource sector than was noted in the 1991 Census. This is particularly important in the case of agriculture where survey statistics suggest a much higher number of farm households than was reported by the 1991 Census of Agriculture (see Chapter 8). This is likely due to a higher survey response rate for farm households. However, survey data on the characteristics of farm operations closely match other Census of Agriculture information.

In total, these comparisons suggest a close but imperfect fit beween survey results and actual population characteristics. Survey results appear to be reasonably reliable at the basin level. From a statistical point of view this makes sense because survey results are based on a fairly large number of completed surveys (718). At a regional level, survey estimates are less accurate. This is partly a result of being based on a smaller sample size (48 to 97). In addition, inconsistencies noted at a basin level (such as the the exaggeration in the number of farm households) could be magnified at a sub-basin or regional level. However, the regional characteristics summarized in Section 4.9 are consistent with what is generally known about each region and there do not appear to be any surprises in the survey results. Thus, the results of the survey are concluded to provide a realistic and valid assessment of general conditions in the northern basins.

With a survey of this type, there is a high likelihood that households which represent special interests for a small proportion of the basin population have been missed. To account for this, separate but similar surveys of key representatives of specific stakeholder and interest groups were undertaken. The results of these surveys are also presented in this report. In this way, it is hoped that important issues and concerns have not been missed.

PART II: USE OF AQUATIC RESOURCES

The second half of the question guiding this study was: what are the consumptive and non-consumptive uses of water resources in the basin? To answer this question, the surveys were designed to collect information about specific types of water use.

For basin households, the survey focused on their use of water for drinking and domestic use. The survey also solicited information on recreational and subsistence use of water resources. Questions about agricultural water use and trapping were also included in the survey .

Each stakeholder survey was designed to collect information about how each type of stakeholder group uses water. Thus, industries were asked about industrial water use. Local and municipal governments were asked to describe the operations of their water treatment facilities. Agricultural groups and agricultural service boards were asked to describe how farm operations use water. Commercial fishermen and trappers were questioned about their harvesting and use of fish and wildlife. Companies that offer water-based recreation and tourism opportunities were asked to describe how their clients use rivers and lakes. Representatives of recreational and environmental groups were questioned about their use of basin resources.

For each group, respondents were asked to quantify their use of water and associated aquatic resources in the overall basin and to describe the importance of the mainstems of the Peace, Athabasca and Slave rivers. They were also asked to describe any changes in water, fish, wildlife or vegetation that they may have seen during the last 10 to 20 years. Responses to these questions are summarized in this part of the report.

5.0 DOMESTIC WATER CONSUMPTION

The most widespread use of water resources in the northern river basins is water used for domestic purposes. While all northern residents use water for consumption and other household purposes, the source of this water varies considerably. More than half of northern households (55.3 percent) obtain their household water from municipal water sources. Other households use groundwater wells (31.0 percent), various surface water sources (lakes or rivers -- 4.8 percent) or dug-outs (4.4 percent) while another small percentage (4.4 percent) use bottled water.

As shown in Table 5-1, the percentage of households drawing water from municipal water sources is highly variable and tends to coincide with the proportion of households living in towns and cities (see Table 4-1). In regions with a very large farm population, such as the Middle Athabasca region, very few households rely on municipal systems. Where the majority of households live in urban settings, such as the Lower Athabasca region, there is very high reliance on municipal water systems.

Municipal water systems are considered to be "conventional" sources of water supply. Analysis of the water supplied from these sources has been undertaken by the Drinking Water Component of the NRBS. One objective of this analysis is to determine the extent of use of other, unconventional sources of water and the water management issues associated with these uses.

5.1 Unconventional Source of Drinking Water

Within the northern basins, groundwater represents the most common source of household water from unconventional sources. Within the basin, about 31 percent of households use groundwater. More than 45 percent of households in the Middle Athabasca, Pembina/Macleod, and Lac la Biche regions use groundwater. There is no reported use of groundwater in the Lower Athabasca or Slave River/Delta regions.

Table 5-1

Source of Drinking Water Supplies in the Northern River Basins
(Percent of Households)

Region	Municipal Water	Bottled Water	Well/ Spring	Lake Water	River Water	Dug-outs
Upper Athabasca	72.0%	2.0%	18.0%	0.0%	8.0%	0.0%
Middle Athabasca	18.6%	0.0%	79.7%	0.0%	1.7%	0.0%
Lower Athabasca	98.1%	1.9%	0.0%	0.0%	0.0%	0.0%
Upper Peace	42.6%	1.9%	25.9%	0.0%	1.9%	27.8%
Middle Peace	48.9%	2.8%	23.4%	0.0%	2.1%	12.8%
Lower Peace	66.7%	3.9%	9.8%	2.0%	5.9%	11.8%
Slave River/Delta	92.3%	1.9%	0.0%	3.8%	0.0%	1.9%
Smoky/Wapiti	51.1%	6.7%	31.1%	4.4%	3.3%	3.3%
Lesser Slave	79.2%	1.9%	3.8%	3.8%	3.8%	7.5%
Pembina/Macleod	39.4%	5.3%	53.2%	0.0%	2.1%	0.0%
Wabasca	76.9%	7.7%	3.8%	5.8%	5.8%	0.0%
Lac la Biche	36.2%	4.3%	46.8%	12.8%	0.0%	0.0%
Total (95% CI)	55.3% ±0.4%	4.4% ±0.2%	31.0% ±0.4%	2.0% ±0.1%	2.8% ±0.2%	4.4% ±0.2%

Table 5-2

Household Water Treatment and Concerns: Unconventional Sources
(Percent of Households Using Unconventional Sources)

	Treat Water	Quantity Problems	Quality Problems	Change in Last 10 Years
Upper Athabasca	46.2%	7.1%	21.4%	7.1%
Middle Athabasca	31.3%	16.7%	27.1%	25.0%
Lower Athabasca	0.0%	0.0%	0.0%	0.0%
Upper Peace	43.3%	6.5%	32.3%	19.4%
Middle Peace	26.3%	8.7%	33.3%	20.8%
Lower Peace	27.3%	0.0%	25.0%	31.3%
Slave River/Delta	33.3%	0.0%	0.0%	0.0%
Smoky/Wapiti	30.8%	2.3%	25.0%	13.6%
Lesser Slave	50.0%	18.2%	72.7%	36.4%
Pembina/Macleod	25.9%	1.8%	24.6%	21.1%
Wabasca	55.6%	16.7%	33.3%	18.2%
Lac la Biche	63.3%	23.3%	43.3%	39.3%
Total	33.7%	6.5%	28.4%	20.2%

Dug-outs are another important unconventional source of drinking water. Although they are used by only 4.4 percent of households in the basin, dug-outs are very important in the Peace River basin. Nearly 28 percent of households on the Upper Peace region rely on dug-outs compared to about 12 percent for the two lower reaches of the Peace.

5.1.1 Water treatment

Overall, one-third (33.7 percent) of households that rely on unconventional water sources use some form of water treatment. At least half of households using unconventional sources in the Lac la Biche, Wabasca and Lesser Slave regions treat their water before using it; yet, less than 30 percent of households in the Pembina/Macleod, Lower Peace and Middle Peace regions claim to use some form of water treatment.

One reason for variability in the treatment of unconventional sources of water is the source of water being used. Table 5-3 shows that a higher portion of households using surface water sources (especially lakes) treat this water than do households using well water. In addition, Table 5-4 shows that the types of treatments being used are quite different for the various sources. Although filtering tends to be a common treatment method for all sources, it is the prime treatment practice for river water. High concentrations of minerals, including sodium, calcium and iron, are often found in groundwater, so many households treat their well water to remove these minerals. Dug-outs need treatment to reduce or inhibit the growth of algae; copper sulphate and Reglone are typical water treatments for these sources.

Boiling, distillation and chlorination are three other common types of water treatment used by households that rely on unconventional sources. Boiling is regularly used to treat river water, while about a third of households using well water or lake water distill this water before drinking it.

Table 5-3

Water Treatment and Concerns for Households Using Unconventional Water Sources
(Percent of Households Using Unconventional Sources)

Unconventional Water Source	Treat Water	Quantity Problems	Quality Problems	Change in Last 10 Years
Wells	29.5%	6.4%	26.9%	17.2%
Lake Water	56.8%	4.6%	29.0%	32.8%
River Water	41.7%	4.2%	46.7%	31.3%
Dug-outs	40.4%	14.9%	43.5%	26.7%

Table 5-4

Types of Water Treatment Used for Unconventional Water Sources
(Percent of Households That Treat Their Water)

Unconventional Water Source	Filter	Chlorine	Distill	Boil	Minerals	Copper Sulphate	Reglone
Wells	25.5%	15.0%	29.0%	5.4%	23.0%	0.0%	0.0%
Lake Water	31.3%	19.2%	37.1%	17.4%	0.0%	0.0%	0.0%
River Water	55.3%	0.0%	0.0%	44.7%	0.0%	0.0%	0.0%
Dug-outs	33.2%	21.8%	8.1%	0.0%	0.0%	28.8%	8.1%

Table 5-5

Types of Water Quantity Concerns Associated With Unconventional Water Sources
(Percent of Households Reporting Water Quantity Problems)

Unconventional Water Source	Spring	Summer	Winter	Long Term
Wells	5.3%	10.0%	5.0%	79.7%
Lake Water	0.0%	0.0%	100.0%	0.0%
River Water	0.0%	100.0%	0.0%	0.0%
Dug-outs	21.8%	0.0%	37.2%	41.0%

5.1.2 Water quantity problems

Very few households using unconventional water sources (6.5 percent) have problems with the quantity of water from these sources. Households in the Lac la Biche, Lesser Slave and Middle Athabasca regions report the greatest incidence of quantity problems (see Table 5-2). Water quantity problems also tend to more commonly reported by households using water from dug-outs than from other surface or groundwater sources (see Table 5-3).

Many of the quantity problems tend to be seasonal -- see Table 5-5. Some households report having quantity problems in the spring when high water levels can carry high sediment loads and affect dug-outs and wells. Although this appears to be a quality issue, people do not like to fill dug-outs with sediment-filled water. If dug-outs are not filled during high water periods, there may insufficient water to last for the rest of the year. During the summer, droughts can lead to low river levels and seasonal draw- down of water tables, causing seasonal shortages. In the winter, water sources can freeze-up. This problem is reported by households using wells and dug-outs but is particularly important for households that rely on lake water.

Some of the reported water quantity problems are longer-term concerns. Households that use well-water (nearly 80 percent) are concerned that water tables are dropping and causing their wells to go dry. This is a very large concern in the Lac la Biche and Middle Peace regions. Long-term droughts are also causing problems for households using dug-outs filled by snow and rain. These types of water quantity problems are of greatest concern to households in the Upper and Middle Peace regions.

5.1.3 Water quality problems

About 28 percent of households relying on unconventional water sources report having problems with water quality. As shown in Table 5-2, this percentage is relatively consistent through the northern river basins but is particularly prevalent in the Lesser Slave region where 73 percent of households are concerned about water quality. Quality concerns are greatest for households

Table 5-6

Types of Water Quality Concerns Associated With Unconventional Water Sources
(Percent of Households Reporting Water Quality Problems)

Unconventional Water Source	Chlorine	Bad Taste or Smell	Spring Taste or Smell	Minerals	Biotic Concerns	Sediments	General
Wells	0.0%	10.0%	6.5%	68.4%	0.0%	6.0%	9.1%
Lake Water	0.0%	48.9%	31.4%	0.0%	19.7%	0.0%	0.0%
River Water	24.4%	25.7%	40.7%	0.0%	0.0%	0.0%	9.1%
Dug-outs	0.0%	57.5%	7.8%	6.1%	28.6%	0.0%	0.0%

Table 5-7

Observed Changes in Unconventional Water Sources During the Past 10 Years
(Percent of Households Reporting Changes)

Unconventional Water Source	Chlorine	Bad Taste or Smell	Spring Taste or Smell	Colour, Clarity	Biotic Concerns	Shortages	General
Wells	0.0%	28.9%	0.0%	23.1%	0.0%	48.0%	0.0%
Lake Water	41.2%	17.1%	0.0%	0.0%	13.9%	27.8%	0.0%
River Water	31.3%	46.5%	13.9%	0.0%	0.0%	0.0%	8.3%
Dug-outs	61.3%	21.7%	0.0%	8.5%	8.5%	0.0%	0.0%

drawing water from rivers and from dug-outs. Over 40 percent of households using these two sources have quality problems. In contrast, less than 30 percent of households using lake water or ground water have water quality problems (see Table 5-3).

The type of quality concerns appears is related to the source of water being used. Table 5-6 shows that high concentrations of minerals like iron and sodium account for the majority (68 percent) of problems reported by households using groundwater wells. Sediments are also considered to be a problem by households using wells. On the other hand, many of the problems identified by households using lake water or dug-outs are caused by biotic factors that either caused an algae-like taste to the water or caused diarrhoea.

However, the most usual water quality concern is that of water taste and/or smell, often with no specific cause identified. Nearly half of households using lake water or dug-outs report problems with water taste or smell. Many of these concerns relate to spring run-off. Households that use lake or river water are more likely to have bad tasting or smelling water during run-off. In combination, concerns about taste or smell account for 80 percent of problems reported by households using lake water, 67 percent of households using river water, 65 percent of households using dug-outs, but only 16 percent of households using wells.

5.1.4 Recent changes in water quality and quantity

About 20 percent of basin households that use unconventional water sources have observed some sort of change in water quality or quantity during the past 10 years. Reports of changes in water sources are more common among households in the Lac la Biche, Lesser Slave and Lower Peace regions where nearly one-third of households have observed some sort of change. Changes in water quality or quantity are also more common for households that use surface water sources than for households that use groundwater -- see Table 5-3.

The most common change reported by households is a deterioration in the taste or smell of drinking water. As shown in Table 5-7, this change is mentioned by households using all four

Table 5-8

Household Water Treatment and Concerns: Conventional (Municipal) Sources
(Percent of Households Using Conventional Sources)

Region	Treat Water	Quantity Problems	Quality Problems	Change in Last 10 Years
Upper Athabasca	25.0%	2.8%	36.1%	20.6%
Middle Athabasca	16.7%	0.0%	9.1%	9.1%
Lower Athabasca	38.1%	3.8%	32.1%	23.1%
Upper Peace	23.1%	17.4%	27.3%	9.5%
Middle Peace	0.0%	4.3%	39.1%	31.8%
Lower Peace	36.4%	0.0%	35.3%	21.2%
Slave River/Delta	30.0%	4.2%	21.7%	13.0%
Smoky/Wapiti	10.0%	6.7%	33.3%	27.9%
Lesser Slave	33.3%	7.1%	26.2%	22.5%
Pembina/Macleod	50.0%	8.3%	24.3%	24.2%
Wabasca	20.0%	27.5%	52.5%	41.0%
Lac la Biche	25.0%	5.9%	52.9%	52.9%
Total	27.9%	10.0%	31.4%	23.3%

types of unconventional water sources but is most prevalent for those using river water. For groundwater users, the most significant change is a decline in groundwater levels and water shortages, although reduced water clarity is also of concern. For households using lake water and dug-outs, changes in biotic factors like algae growth and beaver activity are reported. However, the most curious result is that between 30 and 60 percent of households using surface water sources report an increased chlorine taste to their water. The source of this effect is not clear from survey responses. However, given that relatively few of these water users are treating their water with chlorine (see Table 5.4), some external factor or source of chlorine may be involved.

5.2 Conventional Source of Drinking Water

As noted earlier, 55 percent of households reported that they obtain their drinking water from municipal sources. However, survey responses show that many of these households further treat this water before using it. In addition, many households reported problems related to the quality or quantity of water from conventional sources. Water management issues related to use of conventional drinking water sources are summarized below.

5.2.1 Water treatment

Table 5-8 shows that within the basin more than one-quarter of all households (27.9 percent) use some additional type of water treatment. This percentage ranges as high as 50 percent for households in the Pembina/Macleod region. The most common form of water treatment consists of filtration; this method is used by 65 percent of people who treat their water. Boiling and distilling water are other treatment methods used, with about 16 percent of households using each type of treatment. Three percent of households (one respondent) uses reverse osmosis as a method of treating their municipal water.

Table 5-9

Types of Water Quality Concerns Associated With Conventional Water Sources
(Percent of Households Reporting Water Quality Concerns)

Region	Chlorine	Bad Taste or Smell	Spring Taste or Smell	Minerals	Biotic Concerns	Sediments	General
Upper Athabasca	25.0%	16.7%	8.3%	25.0%	0.0%	8.3%	16.7%
Middle Athabasca	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Lower Athabasca	6.3%	18.7%	37.5%	18.7%	0.0%	0.0%	18.7%
Upper Peace	33.3%	16.7%	16.7%	0.0%	0.0%	0.0%	33.3%
Middle Peace	33.3%	44.4%	11.1%	0.0%	0.0%	0.0%	11.1%
Lower Peace	33.3%	25.0%	8.3%	8.3%	8.3%	16.7%	0.0%
Slave River/Delta	10.0%	10.0%	30.0%	0.0%	0.0%	50.0%	0.0%
Smoky/Wapiti	35.7%	28.6%	7.1%	14.3%	0.0%	0.0%	14.3%
Lesser Slave	20.0%	0.0%	30.0%	0.0%	30.0%	0.0%	20.0%
Pembina/Macleod	33.3%	22.2%	33.3%	11.1%	0.0%	0.0%	0.0%
Wabasca	15.8%	57.9%	15.8%	0.0%	0.0%	5.3%	5.3%
Lac la Biche	11.1%	22.2%	11.1%	0.0%	44.4%	11.1%	0.0%
Total	24.9%	22.0%	19.7%	12.3%	4.6%	3.0%	13.5%

Table 5-10

Observed Changes in Conventional Water Sources During the Past 10 Years
(Percent of Households Reporting Changes)

Region	Water Improved	Water Problems					
		Bad Smell, Taste	Spring Taste or Smell	Colour, Clarity	Chlorine	Shortage	Biotic Concerns
Upper Athabasca	0.0%	20.0%	20.0%	0.0%	50.0%	50.0%	0.0%
Middle Athabasca	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%
Lower Athabasca	9.1%	63.6%	0.0%	9.1%	18.2%	0.0%	0.0%
Upper Peace	50.0%	0.0%	0.0%	50.0%	0.0%	0.0%	0.0%
Middle Peace	16.7%	33.3%	0.0%	0.0%	50.0%	0.0%	0.0%
Lower Peace	28.6%	28.6%	14.3%	14.3%	0.0%	14.3%	0.0%
Slave River/Delta	16.7%	0.0%	33.3%	33.3%	16.7%	0.0%	0.0%
Smoky/Wapiti	18.2%	9.1%	18.2%	18.2%	18.2%	18.2%	0.0%
Lesser Slave	40.0%	0.0%	20.0%	20.0%	0.0%	20.0%	0.0%
Pembina/Macleod	0.0%	42.9%	42.9%	0.0%	0.0%	14.3%	0.0%
Wabasca	15.4%	30.8%	0.0%	15.4%	15.4%	15.4%	7.7%
Lac la Biche	12.5%	12.5%	12.5%	0.0%	0.0%	37.5%	25.0%
Total	14.1%	27.6%	16.5%	10.4%	17.4%	12.3%	1.7%

5.2.2 Water quantity problems

About 10 percent of households that use water from municipal sources experience some sort of water quantity problem. This percentage is quite small for most of the regions (see Table 5-8). However, water quantity concerns are of greater concern in the Upper Peace region (17.4 percent of households) and the Wabasca region (27.5 percent). Three types of quantity problems occur. Summer water shortages are reported in 77 percent of the cases. This problem is associated with summer water-use restrictions and low water conditions in rivers. High water during spring run-off is a concern in 18 percent of the problem cases, and causes an increase in the colour of the water. Five percent of households are concerned about winter freeze-up of water lines. Low water during the summer periods is of concern to households in the Upper Peace and Wabasca regions.

5.2.3 Water quality problems

Water quality is of considerable concern to households that rely on municipal water systems. Over 31 percent have experienced some sort of water quality problem. The lowest incidence of concerns is in the Middle Athabasca region where very few households actually rely on municipal sources. On the other hand, more than half of households using municipal water in the Wabasca and Lac la Biche regions have water quality problems. Numerous types of water quality problems are noted. These are broken down into the seven categories shown in Table 5-9. In about 13 percent of cases, households did not specify the specific nature of the water quality.

An excessive chlorine taste is the most common water quality problems and is of concern to households in each of the 12 regions. On average, about 25 percent of households experiencing water quality problems are concerned about the amount of chlorine in municipal drinking water. This percentage is relatively consistent throughout the 12 regions.

Numerous households report problems with their municipal water smelling or tasting bad. Of those households that have water quality problems, 22 percent describe taste and odour problems in general, while another 20 percent mention taste and odour problems specifically during spring run-off. Taste and odour problems are most common in the Wabasca and Middle Peace regions where between 44 and 58 percent of households expressed this type of concern about their drinking water. Taste and odour problems during spring run-off are more common among households in the Lower Athabasca, Pembina/Macleod, Slave River/Delta and Lesser Slave regions.

About 12 percent of households with water quality concerns have problems with high levels of salts (like sodium) or iron in their water supply. These concerns occur in only five of the 12 regions and are highest for households in the Upper Athabasca and Lower Athabasca regions. Similarly, biotic problems, such as having an algae taste to the water or causing diarrhoea, are of minor concern in the basin as a whole. Less than five percent of households report these types of problems. However, biotic problems are of considerable concern in two regions, notably the Lesser Slave and Lac la Biche regions, where biotic factors account for at least 30 percent of water quality concerns.

About three percent of water quality problems involve sediments in municipal water sources. This concern comes from households in five of 12 regions. The greatest concentration of these problems is reported by households in the Slave River/Delta region where sediments account for 50 percent of all water quality problems.

5.2.4 Recent changes in water quality and quantity

About 22 percent of households depending on municipal water sources have seen changes in water quality or quantity over the past 10 years. This percentage is fairly consistent throughout the basin with the exception of the Wabasca and Lac la Biche regions where more than 40 percent have observed some sort of change.

Not all of the changes are bad. Households in nine of the 12 regions report an improvement in water quality. As shown in Table 5-10, water quality improvements are noted by 14 percent of households, with large numbers of households in the Upper Peace and Lesser Slave basins reporting an improvement in the quality of water from municipal water systems.

Most of the negative comments about municipal water supplies involve the taste or smell of the water. In total, 44 percent of comments suggest that the taste or smell of water has deteriorated. In about a third of these cases, this deterioration is tied to spring run-off. The other two-thirds of comments describe a general deterioration in water taste and smell. Another 17 percent of comments mention an increased chlorine taste in municipal water supplies. These concerns are particularly prevalent among households in the Upper Athabasca and Middle Peace regions. Although some households report that water shortages have become more common, these concerns account for only 12 percent of total comments and are more common in the Upper and Middle Athabasca regions. A small percentage of households report that the biological condition of the water, such as algae content and flavour, is also deteriorating. However, concerns about biotic factors account for 25 percent of comments made by households in the Lac la Biche region.

5.3 Municipal Water Supplies

Another source of information about domestic water use in the basin is the survey of local and municipal governments. Questionnaires were sent to the governments of each city, town village, summer village, municipal district, improvement district, county, Métis settlement and Indian Reserve in the basin. Completed questionnaires were received from 35 of 112 of these governments, for a response rate of 31 percent. These governments represent a total population of about 90,160 people which is equivalent to about 32 percent of the population.

A review of responses indicates that neither of the two cities, which account for 23 percent of the basin population, responded to the survey. This is considered to be a major deficiency of the survey of local and municipal government stakeholders. However, responses were received from

Table 5-11

Sources of Domestic Water Supplies, as Reported by Municipal and Local Governments

	Reported Population	Percent of Sample	Source of Water (Percent of Population)			
			Wells, Treated	Surface, Treated	Wells, Untreated	Surface, Untreated
Towns	54,108	60.0%	23.1%	74.2%	2.7%	0.0%
Villages, Indian Reserves	6,397	7.1%	6.1%	59.3%	20.6%	14.1%
MDs, IDs, Counties	29,655	32.9%	10.7%	9.1%	55.1%	28.4%
Total	90,160	100.0%	16.2%	52.3%	21.2%	10.3%

Table 5-12

Water Use Within Water Systems Operated by Municipal and Local Governments

	Operates Water Supply	Percent of Water Used				
		House-holds	Commercial	Industrial	Govern-ment	Leakage
Towns	93.3%	72.3%	15.7%	6.0%	3.9%	2.2%
Villages, Indian Reserves	90.9%	82.6%	7.2%	3.7%	4.9%	1.7%
MDs, IDs, Counties	77.8%	85.0%	10.8%	1.7%	1.7%	0.8%
Total	88.6%	78.3%	11.9%	4.3%	3.7%	1.7%

Table 5-13

Success of Water Treatment Facilities Meeting Water Quality Requirements

	Meets Requirements	Does Not Meet Requirements	Unknown
Towns	100.0%	0.0%	0.0%
Villages, Indian Reserves	80.0%	10.0%	10.0%
MDs, IDs, Counties	100.0%	0.0%	0.0%
Total	93.5%	3.2%	3.2%

15 of 25 towns (60 percent), seven of 23 villages (30 percent), nine of 24 municipal and improvement districts and counties (38 percent), and four of 38 Indian Reserves and Métis settlements (10 percent). Survey responses provide good coverage of local and municipal governments in the Lesser Slave, Middle Athabasca, Upper Peace and Upper Athabasca regions. Poor response rates came from the Lower Athabasca, Lac la Biche, Wabasca, and Pembina/Macleod regions.

In order to make best use of survey responses, data are grouped into three categories based on population size and the percent of urban residents. These three categories include: towns; villages, Indian Reserves and Métis settlements; and municipal districts (MDs), improvement districts (IDs) and counties. As shown in Table 5-11, the majority of basin residents represented by the survey responses from local and municipal governments live in towns (60 percent), with nearly one third living in rural areas (MDs, IDs and counties).

5.3.1 Water sources

Table 5-11 shows that the majority of the population in these areas (about 69 percent) receive their water from water treatment plants. Three-quarters of this water is from surface water sources, while the rest comes from groundwater. The percentage of the population using treated water is higher than estimated from the results of the household survey (see Section 5.1 and Table 5.1), probably due to differences in the representativeness of each sample.

As expected, only a very small portion of the population living in town is not served by water treatment plants. In comparison, 34 percent of the people living in villages, Indian Reserves and Métis settlements are not served by a water treatment plant, and neither are 83 percent of people living in MDs, IDs and counties.

Table 5-14

Factors Affecting Ability to Meet Drinking Water Standards

	Raw Water Supply	Plant Design/ Construction	Plant Operations/ Maintenance	Distribution System	Unknown/ Uncertain
Towns	50.0%	25.0%	0.0%	0.0%	25.0%
Villages, Indian Reserves	22.2%	33.3%	11.1%	11.1%	22.2%
MDs, IDs, Counties	28.6%	42.9%	0.0%	0.0%	28.6%
Total	35.7%	32.1%	3.6%	3.6%	25.0%

Table 5-15

Observed Historical Changes and Anticipated Future Changes in Municipal Water Treatment

	Change in Quality or Quantity of Raw Supply Last 10 Years	Plan to Upgrade or Construct Water Treatment Plants	Anticipate Future Changes in Water Quality or Quantity
Towns	35.7%	64.3%	42.9%
Villages, Indian Reserves	70.0%	40.0%	50.0%
MDs, IDs, Counties	57.1%	71.4%	28.6%
Total	51.6%	58.1%	41.9%

5.3.2 Operations of water systems

Nearly 89 percent of the local and municipal governments that responded to the survey are responsible for operating one or more water treatment facilities. This includes more than 93 percent of towns and 91 percent of villages.

There are five major categories of demand for treated water, and the relative importance these categories is summarized in Table 5-12. Household water use represents the largest demand for treatment plants operated by all three categories of municipal and local governments. The proportion of treated water used by households ranges from 72 to 85 percent of plant output. Commercial use accounts for 12 percent of water produced by treatment facilities, but is higher (16 percent) in towns. The proportion of water being used for industrial purposes is also much higher for towns than for other types of municipal and local governments. On the other hand, water consumption by government and institutional users accounts for a greater portion of the water drawn from treatment plants operated by villages, Indian Reserves and Métis settlements. Although the proportion of treated water being lost due to system leakage is quite small (less than three percent), larger systems (towns) report higher leakage than did the smaller systems operated by MDs, IDs and counties.

The survey provides some information about the operations of water treatment plants. The 29 treatment plants described in the survey range considerably in terms of age. About 15 percent of plants were constructed prior to 1965, and another 15 percent were built between 1965 and 1974. The greatest proportion of plants (39 percent) were built between 1975 and 1984. Another 30 percent of plants have been constructed since 1984, with half of these being built during the last five years. The size of these plants also varies considerably. Nearly half (48 percent) are small plants having a raw water capacity of less than 50,000 cubic metres (m^3) per year. Another 26 percent of plants treat between 50,000 and 250,000 m^3 of water per year. The remaining 26 percent of plants have capacities in excess of 250,000 m^3 per year and of these, two plants annually treat more than 750,000 m^3.

Table 5-16

Percent of Water Discharged Back to Surface Water Sources

	0% to 20%	21% to 40%	41% to 60%	61% to 80%	81% to 100 %
Towns	27.3%	9.1%	9.1%	9.1%	45.5%
Villages, Indian Reserves	44.4%	0.0%	22.2%	11.1%	22.2%
MDs, IDs, Counties	66.7%	0.0%	0.0%	16.7%	16.7%
Total	42.3%	3.8%	11.5%	11.5%	30.8%

Table 5-17

Treatment of Waste Water

	Treats Waste Water	Treatment Method	
		Primary	Secondary
Towns	100.0%	38.5%	61.5%
Villages, Indian Reserves	66.7%	50.0%	50.0%
MDs, IDs, Counties	57.1%	100.0%	0.0%
Total	80.0%	54.2%	45.8%

Nearly all of the water plant operators feel that their facilities are meeting the drinking water quality standards set out in their operating licences. As shown in Table 5-13, very few operators report that their facility is not meeting these standards or that they did not know whether standards were being met. These plants are being operated by villages, Indian Reserves or Métis settlements.

Table 5-14 lists the factors that most affect the abilities of water supply systems to meet drinking water standards. For towns, the quality of the raw-water supply is the factor of greatest concern, with plant design and operation being of secondary importance. While raw-water quality is of concern in plants being operated by MDs, IDs or counties, the design and construction of the water treatment facilities is of greater importance. Where water treatment facilities are being operated by villages, Indian Reserves or Métis Settlements, a variety of factors are listed but plant design and construction is listed as the most important factor. One-quarter of operators are unable to identify which of these factors most affect the operations of their water treatment facilities.

5.3.3 Changes in municipal water systems

Just over half of the municipal and local governments report that the quantity or quality of raw-water supplies has changed during the past 10 years. The highest incidence of historical changes in water supply is reported by villages, Indian Reserves and Métis settlements (70 percent) compared to only 35 percent of towns -- see Table 5-15.

More than half the changes (58 percent) are described as a decline in water quantities due to natural causes. Specific comments about problems include lack of run-off, lower water tables, lower spring floods, and lower lake levels. Another quantity issue (eight percent of responses) is that increased consumption by other users (notably farmers) has caused a reduction in water levels. The other 33 percent of comments relate to water-quality problems. These include increased siltation and turbidity, more methane in the water, and contamination from agricultural run-off.

The majority of local and municipal governments operating water treatment facilities have plans to upgrade these facilities or to build new ones. Such plans are reported by over 60 percent of MDs, IDs and counties, and 64 percent of towns - see Table 5-15. A wide range of changes are being considered. One-third of the proposed changes deal with improving the methods of treatment, either by adding chlorination or improving filtration systems. Forty percent of the proposed changes involve expanding the capacity of the treatment system, either by increasing water storage or by increasing the size of the plant.

Other changes being considered include finding an alternative water source, automating plants, expanding the water distribution system, and adding water meters throughout the system.

Less than half of the plant operators expect that the water quality or quantity requirements of their plants will change during the next 10 years. Most of these changes will be required to meet the needs of a growing population, especially where water distribution networks are expanding. In one case, rapidly increasing industrial demands will necessitate expansion of the water treatment facilities.

5.3.4 Sewage treatment

Table 5-16 shows the percentage of water that is used and then discharged back to lakes, rivers or other surface-water bodies. There are some important differences between urban and rural areas. Nearly half of all towns report returning more than 80 percent of their water, compared to only 22 percent of villages, and 17 percent of MDs, IDs and counties. On the other hand, two-thirds of MDs, IDs and counties return less than 20 percent of their water to surface sources. Part of the reason for these differences is that more towns and villages have sewage treatment facilities than do MDs, IDs and counties -- see Table 5-17. Larger centres tend to have sewage treatment facilities that operate and discharge treated sewage continuously, while smaller centres tend to treat sewage and hold it in lagoons which are emptied only once or twice a year.

Table 5-17 also shows that most towns use secondary sewage treatment systems, while MDs, IDs and counties only use primary treatment systems to remove solids. Half of the sewage treatment facilities operated by villages, Indian Reserves and Métis settlements use primary treatment while the other half use secondary treatment.

5.3.5 Other water issues

About one-third (36 percent) of municipal and local governments have other water management issues of importance to local residents. Seventy percent of their comments relate to general concerns about other water uses, notably agriculture and deep-well injection, impacting the quality or quantity of water in the community. Some other special issues are also mentioned. One community reports having mixed public opinion on the use of fluoride in the water supply. Another community is concerned about flooding. And, one community is concerned about maintaining the levels of a lake that supports tourism and a wildlife interpretive centre.

6.0 SUBSISTENCE USE OF RESOURCES

Very little is known about subsistence use of fish and wildlife resources in the northern river basins. Subsistence activities are defined as hunting, fishing and trapping for food. For most of the population, these activities are regulated through licences and are typically considered to be recreational activities. For Treaty Indians, subsistence activities are recognized to be a distinct form of resource use and must be examined and treated separately from recreational activities.

A series of questions about subsistence use of fish and wildlife resources was included in the survey. These questions were provided to all respondents. As expected, the survey produced some information about subsistence activities by Treaty Indians. These subsistence activities are described below. However, a large percentage of other respondents, including non-Treaty Indians and Métis, indicated that they also participated in subsistence activities. To make best use of the survey information, information related to hunting by people other than Treaty Indians is included as part of the analysis of recreational activities (Section 7.0). The corresponding information about trapping is summarized in Section 12.0.

6.1 Subsistence Activities By Treaty Indians

As noted in Section 4.2, household survey results estimate that 1.5 percent of households in the NRBS area are aboriginal. Further analysis shows that 45 percent of these are registered as Treaty Indians. The accuracy of these estimates is unknown due to the lack of census information on the ethnic background of northern residents.

Only 24 percent of the Treaty Indians who responded to the survey participate in subsistence activities. In total, this group is estimated to represent only 0.2 percent (± 0.3 percent) of basin households, or about 136 households. This number is quite small and has a very high error factor, because of the small number of responses from Treaty Indians. This small sample size (only four responses) cannot support detailed analysis and cannot provide an accurate assessment of subsistence activities in the NRBS area. As the purpose of this report is to summarize survey

results, a cursory analysis of the results is provided below, although the results must be interpreted with extreme caution. Although the survey collected information on subsistence activities from households in three regions (the Lower Peace, Slave River/Delta and Wabasca regions), these survey responses have been summarized as a single group.

6.2 Subsistence Fishing

Of the four Treaty Indian households that participate in subsistence activities, three are involved in subsistence fishing. Subsistence fishing occurs in the Peace River, Mamawi Lake and Peerless Lake, with reported harvests averaging 46 kilograms (kg) of fish per year. Preferred fish species include Northern Pike, Lake Whitefish, Walleye and Goldeye. Two of three subsistence fishermen fish in the river mainstems, including the lower reaches of the Peace River, the Quatre Fourches River and in Lake Athabasca at Fort Chipewyan. One fishermen eats all of his annual catch while another feeds 80 percent of the catch to his dogs. Two of the three subsistence fishermen have observed changes in the quantity or quality of fish caught over the last 10 years. One has noticed an increase in fish numbers while the other claims that fish flesh is softer and that they do not taste as good (more oily).

6.3 Subsistence Trapping

Two Treaty Indian households participate in subsistence trapping. Both have registered traplines, one of which is within 10 kilometres of the mainstems of the Peace River. Lynx is the preferred species for trapping and accounts for about 10 percent of the annual harvest. Other important species include marten (45 percent of harvest), beaver (25 percent) and muskrat (20 percent). Only one trapper eats furbearers, notably four beaver, nine muskrat and three lynx. Both trappers have noticed changes in the quality and quantity of furbearers during the past 10 years. Both claim that there are fewer animals, and one reports that the fur and meat are in poor condition.

6.4 Subsistence Hunting

All four households participate in subsistence hunting. They kill an average of two to three animals per year. Moose is the preferred species for three of four hunters and accounts for 90 percent of annual kills. Hunters also kill 50 ducks and one black bear per year. Between 70 and 90 percent of the meat is consumed by households, with most of the remainder being given to others. One hunter feeds 10 percent of the meat to his dogs. The amount of meat eaten per household ranges between 2.5 and 11 kg per week. Only one hunter reported that the quality or quantity of game in the region has changed in the past 10 years. He believes that game populations have decreased, animals are skinnier and smaller, and that more of them are sick and disfigured (skin growths).

6.5 Use of Water

One of four households that participate in subsistence activities consume river or lake water. This water is boiled before it is used.

Table 7-1

Household Participation Rates in Recreational Activities

Region	Outdoor Recreation	Water-Based Recreation
Upper Athabasca	82.0%	76.0%
Middle Athabasca	74.6%	69.5%
Lower Athabasca	88.9%	83.3%
Upper Peace	87.6%	58.9%
Middle Peace	91.7%	87.5%
Lower Peace	87.7%	65.4%
Slave River/Delta	83.0%	71.7%
Smoky/Wapiti	80.4%	65.2%
Lesser Slave	96.3%	92.6%
Pembina/Macleod	80.4%	70.1%
Wabasca	79.6%	66.7%
Lac la Biche	75.5%	69.4%
Total	82.3%	72.0%

7.0 RECREATION

A second common use of aquatic resources by residents of the NRBS area is recreation. Over 82 percent of households participate in outdoor recreation activities like camping, hunting, fishing, boating, canoeing, swimming and various other activities. As shown in Table 7-1, the percentage is relatively consistent among the 12 regions, with the highest household participation rates being reported by households in the Lesser Slave region.

Household participation in water-based recreation is slightly lower. About 72 percent of households indicate that they participate in one or more water-based recreational activities, including fishing, boating, canoeing and swimming. Table 7-1 shows that participation rates range from a low of 59 percent for the Upper Peace region to a high of 93 percent for the Lesser Slave Region. This variability is likely due to the availability of recreational facilities on rivers and lakes and the age composition of populations within each region.

Camping and fishing are the two most popular outdoor recreation activities in the NRBS area. About 55 percent of households participate in these two activities. In comparison, only 17 percent of households go canoeing, while 31 percent participate in hunting. Household participation rates for swimming and boating are 41 and 35 percent, respectively.

A brief overview of each of these activities is provided below and in tables 7-2 to 7-6 and 7-11. These tables include estimates of the total number of trips taken and the total number of user-days. These estimates must be interpreted with caution because they are calculated using four different factors taken from the survey results: household participation rates; average trips per household; average days per trip; and average party size. The resulting estimates for total activity within the basin have high variability for total trips (± 20 percent)[1] and user days (± 65 percent). Variability in estimates for individual regions is even higher.

[1] As noted in Section 3.1, a confidence interval of ± 20 percent means that the true value is likely to fall within 80 percent and 120 percent of the value of the estimate, 19 times out of 20.

Table 7-2

Camping Activity by Households in the Northern River Basins

	Percent of Households	Average Trips per Year	Estimated Total Trips	Average Days Per Trip	Average Party Size	Estimated Total User Days
Upper Athabasca	62.0%	8.0	38,800	3.2	3.1	387,100
Middle Athabasca	50.8%	5.6	15,100	5.1	3.2	250,000
Lower Athabasca	50.0%	3.7	19,000	3.6	3.6	244,800
Upper Peace	53.7%	5.1	19,200	3.1	3.3	200,300
Middle Peace	60.4%	6.7	17,200	3.3	3.1	173,700
Lower Peace	53.8%	5.1	7,500	2.7	3.7	74,300
Slave River/Delta	50.9%	7.7	4,000	4.4	2.7	47,600
Smoky/Wapiti	55.4%	9.1	111,300	2.7	3.2	951,000
Lesser Slave	51.8%	8.4	23,600	6.5	3.1	475,100
Pembina/Macleod	57.7%	7.7	84,300	5.1	3.1	1,313,800
Wabasca	59.2%	7.0	2,700	3.3	4.5	39,400
Lac la Biche	46.9%	6.3	11,400	3.6	3.0	121,500
Total	55.0%	7.2	354,000	3.8	3.2	4,278,500

7.1 Camping

Participation in camping is relatively consistent throughout the study area. Between 47 and 62 percent of households in the 12 regions go camping, although these differences are not statistically different. Table 7-2 shows that camping is most popular in the Middle Peace and the Upper Athabasca regions where more than 60 percent of households reported going camping.

Households in the northern basins take an average of 7.2 (±1.4) camping trips per year. This number is also relatively consistent from region to region, although households in the Lower Athabasca take only 3.7 trips per year. In total, it is estimated that households in the northern river basins take about 354,000 (±69,000) camping trips in an average year.

Total camping activity is estimated to be about 4.3 million (±1.2 million) user-days per year. This estimate is based on an average of 3.8 (±0.7) days per camping trip and an average party size of 3.2 (±0.2) people per trip. Trips length and party size are also quite consistent among regions. Camping trips are slightly longer than trips involving other recreational activities.

7.2 Swimming

About 41 percent of northern households take trips involving swimming. As shown in Table 7-3, this proportion is highly variable, ranging from 59 percent in the Lesser Slave region to 29 percent in the Upper Peace region. The high percentage in the Lesser Slave region is probably related to the availability of beaches and swimming opportunities at Lesser Slave Lake.

In total, households in the northern basins are estimated to take 336,700 (±54,700) swimming trips in an average year, based on an average of 8.9 (±1.4) trips per household. Within the 12 regions, the number of swimming trips per household varies from 5.9 to 18.1 per year, with households in the tributary basins taking more trips than households in regions along the Athabasca and Peace rivers.

Figure 7-2

Key Boating and Canoeing Sites Used by Basin Residents

Source: Household Survey Data

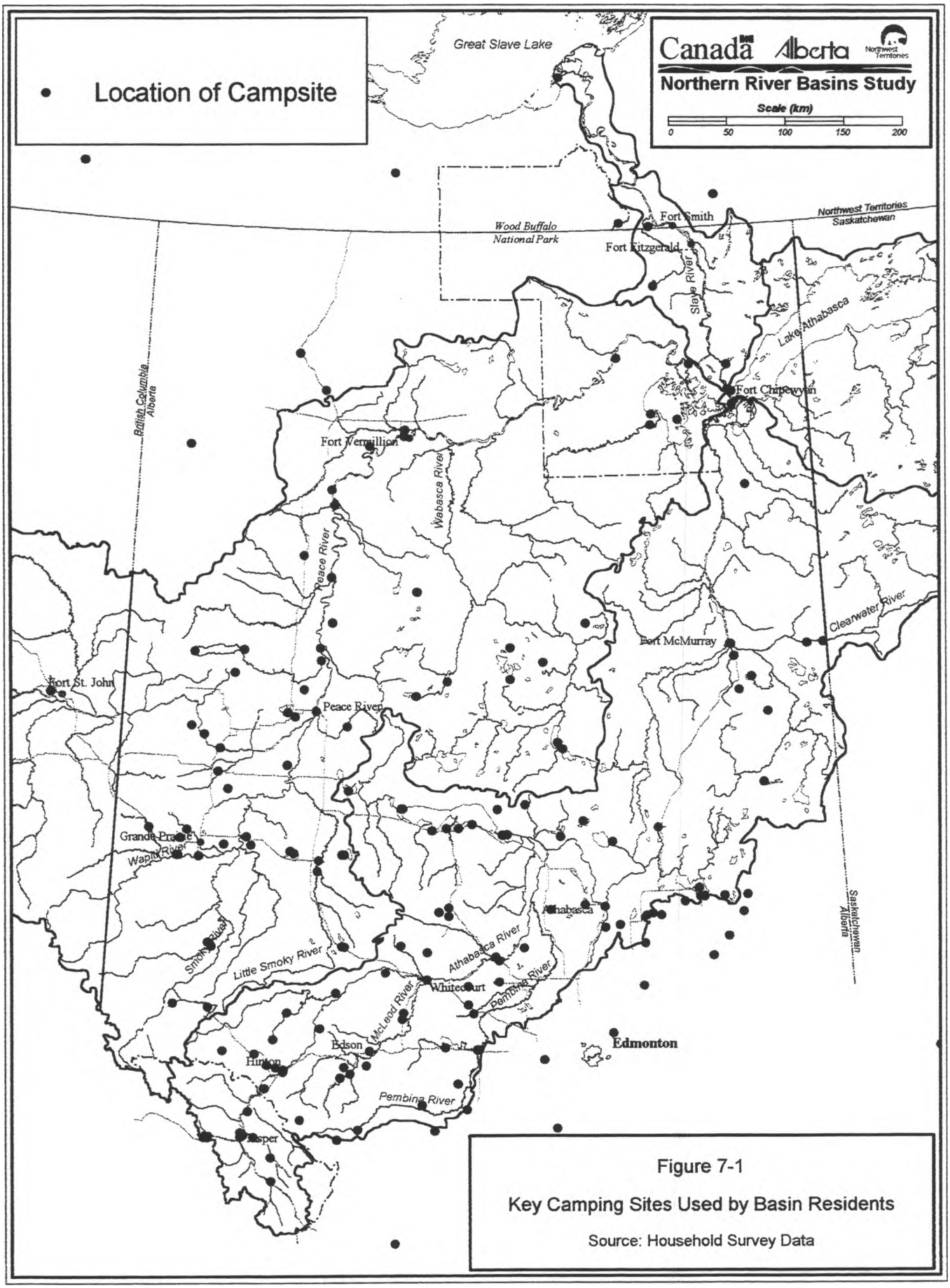


Figure 7-1

Key Camping Sites Used by Basin Residents

Source: Household Survey Data

Table 7-3

Swimming Activity by Households in the Northern River Basins

	Percent of Households	Average Trips per Year	Estimated Total Trips	Average Days Per Trip	Average Party Size	Estimated Total User Days
Upper Athabasca	44.0%	7.9	27,100	1.7	3.0	136,600
Middle Athabasca	35.5%	8.7	16,600	4.1	3.6	242,700
Lower Athabasca	48.1%	5.9	29,600	1.6	3.5	170,200
Upper Peace	28.5%	6.4	12,800	2.2	3.6	99,600
Middle Peace	43.7%	13.2	24,600	1.4	3.9	127,900
Lower Peace	30.7%	9.0	7,000	1.1	3.1	24,600
Slave River/Delta	32.0%	10.1	3,300	1.3	3.0	12,800
Smoky/Wapiti	39.1%	7.6	65,400	2.3	3.5	524,400
Lesser Slave	59.2%	17.4	56,000	4.0	3.5	787,800
Pembina/Macleod	37.1%	8.3	58,600	2.1	3.3	402,600
Wabasca	44.4%	18.1	5,200	1.8	4.4	40,500
Lac la Biche	48.9%	16.3	30,700	1.5	3.3	151,500
Total	40.7%	9.2	336,700	2.2	3.4	2,720,600

Table 7-4

Boating Activity by Households in the Northern River Basins

	Percent of Households	Average Trips per Year	Estimated Total Trips	Average Days Per Trip	Average Party Size	Estimated Total User Days
Upper Athabasca	30.0%	7.0	16,300	1.5	2.8	67,100
Middle Athabasca	35.6%	7.6	13,700	2.3	3.1	97,700
Lower Athabasca	38.9%	6.2	25,200	1.7	2.8	115,800
Upper Peace	25.0%	5.4	9,400	1.3	3.4	41,600
Middle Peace	56.2%	8.9	21,400	1.5	2.9	89,900
Lower Peace	34.6%	7.7	7,200	1.3	4.0	37,300
Slave River/Delta	50.9%	14.2	7,400	2.3	2.4	40,700
Smoky/Wapiti	33.7%	10.2	75,950	2.0	3.6	551,100
Lesser Slave	61.1%	16.2	53,500	3.3	2.9	505,400
Pembina/Macleod	23.7%	5.5	25,000	2.3	2.7	154,600
Wabasca	31.4%	15.6	3,200	1.5	3.2	15,000
Lac la Biche	42.8%	20.6	33,900	1.3	2.9	125,500
Total	34.6%	9.4	292,000	2.0	3.1	1,841,900

Trips involving swimming tend to be relatively short, lasting an average of 2.2 (± 0.5) days. These trips also involve most household members, with the average party size being 3.4 (± 0.4) people. Total swimming activity is estimated to be in the order of 2.7 million (± 1.0 million) days in an average year.

7.3 Boating

Boating trips are taken by about 35 percent of households in the northern river basins. This percentage is highest in the Lesser Slave (61 percent), Middle Peace (56 percent) and Slave River/Delta (51 percent) regions. Lesser Slave Lake is a major boating lake, and boating is an important means of transportation for households living in the Peace-Athabasca delta.

Households take an average of 9.4 (± 1.8) boating trips per year. This number ranges from 5.4 trips in the Upper Peace region to 20.6 trips in the Lac la Biche region which has the highest proportion of households living in cottages and rural subdivisions. Households in the Lesser Slave region also take a large number of boating trips (16.2) per year. In total, northern residents are estimated to take 292,000 (± 60,800) boating trips in an average year.

Compared to other activities, trips involving boating tend to be fairly short, averaging 2.0 (±0.4) days. The average party size is 3.1 (± 0.3) people. In an average year, total boating activity by northern residents is estimated to be about 1.8 million (±0.8 million) user-days.

7.4 Canoeing

Canoeing has the lowest participation rate of all six activities, with only about 17 percent of households participating on canoe trips. Very few households in the Upper Peace region (five percent) participate in canoeing compared to 36 percent of households in the Upper Athabasca region. The high participation rates in the Upper Athabasca may be due to this region having a large number of canoeing rivers on the east slopes of the Rocky Mountains. Above average

Table 7-5

Canoeing Activity by Households in the Northern River Basins

	Percent of Households	Average Trips per Year	Estimated Total Trips	Average Days Per Trip	Average Party Size	Estimated Total User Days
Upper Athabasca	36.0%	7.1	19,800	1.1	2.6	56,100
Middle Athabasca	16.9%	6.4	5,200	2.0	2.0	20,900
Lower Athabasca	27.7%	4.1	11,900	2.4	2.3	66,100
Upper Peace	5.3%	10.7	4,000	11.3	3.3	151,500
Middle Peace	25.0%	2.3	2,400	1.4	2.9	9,900
Lower Peace	15.3%	4.1	1,700	1.5	2.9	7,400
Slave River/Delta	22.6%	6.1	1,400	2.3	1.8	6,000
Smoky/Wapiti	11.9%	2.7	7,200	1.8	2.6	34,200
Lesser Slave	12.9%	2.9	2,000	1.5	1.9	5,600
Pembina/Macleod	14.4%	4.4	12,000	4.1	2.6	127,800
Wabasca	27.7%	8.5	1,500	1.3	2.3	4,700
Lac la Biche	12.2%	4.3	2,000	1.7	2.0	6,800
Total	17.2%	4.6	71,200	2.4	2.5	497,000

Table 7-6

Hunting Activity by Households in the Northern River Basins

	Percent of Households	Average Trips per Year	Estimated Total Trips	Average Days Per Trip	Average Party Size	Estimated Total User Days
Upper Athabasca	36.0%	13.3	37,400	2.0	1.3	99,600
Middle Athabasca	28.1%	6.5	9,500	2.3	2.0	43,400
Lower Athabasca	22.2%	6.5	15,000	4.9	1.3	93,700
Upper Peace	35.7%	9.0	22,400	3.3	1.4	104,000
Middle Peace	37.5%	6.3	10,100	2.5	1.5	37,500
Lower Peace	21.1%	7.2	3,800	3.4	1.6	20,700
Slave River/Delta	37.7%	7.2	2,800	3.3	1.6	14,400
Smoky/Wapiti	25.0%	9.3	51,400	2.2	1.5	174,600
Lesser Slave	38.8%	7.9	16,600	2.7	1.4	60,100
Pembina/Macleod	35.0%	14.8	99,100	5.9	1.4	784,600
Wabasca	33.3%	8.5	1,800	2.6	2.1	9,700
Lac la Biche	30.6%	9.0	10,600	3.1	1.7	54,100
Total	30.6%	10.3	280,300	3.5	1.5	1,496,600

numbers of households in the Lower Athabasca, Middle Peace and Wabasca regions also reported taking canoe trips.

Northern households take fewer trips per year for canoeing than for any other activity. They take only 4.6 (± 2.0) trips per year, although this number is highly variable among the regions, partially because of the small sample sizes. The lowest participation rate for canoeing occurs in the Upper Peace region but these households take over 10 trips per year. In contrast, households in the Middle Peace region take an average of only 2.3 trips per year. The total number of canoeing trips taken in a year is quite small: only about 71,200 (± 21,200) trips.

A typical canoe trip lasts 2.4 (± 1.7) days and involves 2.5 (± 0.4) household members. However, the average length of trip varies considerably. Total canoeing activity in an average year by northern residents is estimated to be in the range of 497,000 user-days, but there is considerable uncertainty in this estimate (± 243,000 user days).

7.5 Hunting

Just over 30 percent of northern households participate in hunting. This percentage is relatively consistent among regions, with participation rates ranging between 30 and 40 percent in eight of the 12 regions. On the other hand, only 19 percent of households in the Lower Peace region go hunting.

Hunters take numerous trips per year. The average is 10.3 (± 2.1) trips, but this number ranges from nearly 15 in the Pembina/Macleod region to 6.5 or less in the Middle Peace and Middle and Lower Athabasca regions. It is estimated that northern residents take about 280,300 (± 58,400) trips in an average year. These trips last an average of 3.5 (± 1.0) days with only 1.5 (± 0.1) household members participating. Total hunting activity is estimated to be about 1.5 million (± 0.7 million) hunter-days per year. Half of this activity is by hunters residing in the Pembina/Macleod basin.

Table 7-7

Overlap Between Recreational Hunting and Subsistence Hunting
(Percent of Households That Hunted)

	Recreational Hunting[1]	Subsistence Hunting[2]
Upper Athabasca	50.0%	50.0%
Middle Athabasca	31.3%	68.7%
Lower Athabasca	41.7%	58.3%
Upper Peace	25.0%	75.0%
Middle Peace	61.1%	38.9%
Lower Peace	40.0%	60.0%
Slave River/Delta	35.0%	65.0%
Smoky/Wapiti	30.4%	69.6%
Lesser Slave	33.3%	66.7%
Pembina/Macleod	44.1%	55.9%
Wabasca	38.9%	61.1%
Lac la Biche	40.0%	60.0%
Total	39.0%	61.0%

Table 7-8

Recreational Hunting and Hunting for Food:
Preferences for Big Game Species
(Percent of Households That Hunted)

Game Species	Recreational Hunting	Subsistence Hunting
Moose	34.7%	40.4%
Deer	42.2%	38.8%
Elk	23.1%	17.6%
Other Ungulates	0.0%	1.1%
Black Bear	0.0%	2.1%

1 These households completed the sections of the questionnaire related to recreational hunting and subsistence (food) hunting.
2 These households only completed the sections of the questionnaire related to subsistence (food) hunting.

7.5.1 Recreational and subsistence hunting

As noted in Section 6.0, a large number of households indicated that they hunted for food for subsistence purposes. However, because they are not Treaty Indians, this hunting is considered to be a recreational activity rather than subsistence hunting. The following profile of hunting represents a combination of responses from households that either reported hunting for recreation or for food (subsistence).

There is considerable overlap between households that participate in recreational hunting and households that hunt for food (subsistence). As shown in Table 7-7, 39 percent of households that hunt for recreation also completed the parts of the survey related to subsistence activities and recreational hunting. This percentage is relatively constant from region to region, with the exception of the Middle Peace region where 61 percentage completed both parts of the survey.

In terms of preferences for games species, amount of hunting activity, hunting success and consumption, there are no significant differences between recreational hunters and subsistence hunters. Table 7-8 shows that moose is the preferred species for both groups, followed by deer (both mule and white-tail), and elk. Recreational hunters take 9.0 (± 1.9) trips per year while food hunters take 10.0 (± 2.6) trips per year. The average number of animals killed is 4.0 (± 1.7) for food hunters and 2.8 (± 2.6) for recreational hunters. The average consumption of wild game is 1.7 (± 0.5) kg per week for food hunters compared to 1.1 (± 0.6) kg per week for recreational hunters. Thus, aside from differences in the motivation for hunting, these two classes of hunters are not statistically different and are treated as one group for the remainder of this analysis.

7.5.2 Annual harvests

Hunters kill an average of 1.0 big game animal per year. This ranges slightly from region to region -- see Table 7-9 -- with the highest hunter success reported in the Upper Athabasca, Middle Peace and Slave River/Delta regions. The lowest hunter success rates are in the Upper Peace and Middle Athabasca regions. Estimated total harvest is about 27,280 big game animals

Table 7-9

Estimated Composition of Annual Game Harvest, NRBS Area

Region	Kills per Hunter	Big Game					Game Birds	
		Moose	Deer	Elk	Bear	Other	Ducks	Grouse
Upper Athabasca	1.6	17.9%	67.9%	14.3%	0.0%	0.0%	28.6%	71.4%
Middle Athabasca	0.6	55.6%	33.3%	11.1%	0.0%	0.0%	0.0%	100.0%
Lower Athabasca	0.7	44.4%	55.5%	0.0%	0.0%	0.0%	0.0%	100.0%
Upper Peace	0.6	46.2%	46.2%	0.0%	7.7%	0.0%	0.0%	0.0%
Middle Peace	1.5	42.8%	50.0%	3.6%	3.6%	0.0%	100.0%	0.0%
Lower Peace	0.9	66.7%	22.2%	11.1%	0.0%	0.0%	100.0%	0.0%
Slave River/Delta	1.3	57.7%	0.0%	0.0%	7.7%	34.6%	76.9%	23.1%
Smoky/Wapiti	0.9	40.0%	40.0%	20.0%	0.0%	0.0%	0.0%	0.0%
Lesser Slave	0.7	33.3%	60.0%	6.7%	0.0%	0.0%	0.0%	100.0%
Pembina/Macleod	1.2	29.3%	51.2%	19.5%	0.0%	0.0%	0.0%	100.0%
Wabasca	0.7	75.0%	25.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Lac La Biche	0.7	45.5%	54.4%	0.0%	0.0%	0.0%	0.0%	100.0%
Total Basin	1.0	41.6%	43.4%	9.1%	1.8%	4.1%	49.0%	51.0%
Total Harvest	27,280	11,350	11,480	2,480	490	1,120		

Table 7-10

Use and Consumption of Meat From Big Game
(Percent of Households That Hunted)

Region	Use of Meat			Consumption (kg per week)
	Given Away	Fed to Animals	Consumed	
Upper Athabasca	4.7%	1.1%	94.2%	1.1 ± 0.4
Middle Athabasca	1.0%	2.0%	97.0%	1.4 ± 0.7
Lower Athabasca	12.5%	0.0%	87.5%	1.1 ± 0.3
Upper Peace	13.5%	0.0%	86.5%	1.2 ± 0.7
Middle Peace	5.0%	0.0%	95.0%	1.3 ± 0.5
Lower Peace	27.5%	0.0%	72.5%	0.5 ± 0.0
Slave River/Delta	22.5%	0.0%	77.5%	3.1 ± 2.0
Smoky/Wapiti	9.9%	8.3%	81.8%	0.8 ± 0.3
Lesser Slave	5.0%	0.0%	94.4%	1.0 ± 0.4
Pembina/Macleod	6.1%	0.0%	93.9%	1.5 ± 0.5
Wabasca	2.2%	1.4%	96.4%	4.5 ± 4.1
Lac La Biche	8.2%	0.1%	91.7%	1.4 ± 0.6
Total	8.7%	1.3%	90.0%	1.6 ± 0.4

per year. The composition of the average big game harvest is also shown in Table 7-9. Although hunters prefer moose, they kill more deer than moose. The only regions where hunters kill more moose than deer are the Wabasca, Lower Peace and Middle Athabasca regions. The Slave River/Delta region is unique because of the availability of different types of game. Hunters from this region kill about 1,120 caribou and bison.

7.5.3 Use of wild meat

The vast majority of killed game is eaten. As shown in Table 7-10, less than nine percent is given away and about one percent is fed to animals. The remaining 90 percent is consumed, and average household consumption is about 1.6 kilograms per week. These characteristics are fairly consistent among households in the various regions. Higher than average consumption is reported by households in the Wabasca and Slave River/Delta, but these differences are not statistically different. Households in the Slave River/Delta and Lower Peace regions also give away a much higher proportion (over 20 percent) of their game than elsewhere which suggests communal sharing of wildlife resources.

7.6 Fishing

Fishing is particularly popular in the Lesser Slave and the Middle Peace regions -- see Table 7-11. Participation rates in these regions are 72 percent and 67 percent of households, respectively. The high percentage in the Lesser Slave region is a result of the good fishing opportunities available in Lesser Slave Lake and Lesser Slave River. On the other hand, only 41 percent of households in the Wabasca region go fishing. These observed differences in participation rates among regions are statistically different.

Fishermen take an average of 10.8 (± 1.5) trips per year and this number is higher than for every other activity. This number is highly variable among regions, however, and this may be related to the availability of fishing opportunities in the region. The greatest number of trips are taken by households in the Lac la Biche region (21.6 trips per year), which has a large number of

Table 7-11

Fishing Activity by Households in the Northern River Basins

	Percent of Households	Average Trips per Year	Estimated Total Trips	Average Days Per Trip	Average Party Size	Estimated Total User Days
Upper Athabasca	66.0%	13.3	68,300	1.3	2.3	215,200
Middle Athabasca	55.9%	7.9	23,000	1.7	2.4	94,100
Lower Athabasca	51.9%	10.1	54,500	1.9	2.2	232,900
Upper Peace	46.4%	6.7	21,900	2.4	2.5	130,400
Middle Peace	66.7%	9.5	26,900	1.5	2.9	115,700
Lower Peace	51.9%	6.1	8,600	1.8	3.2	50,100
Slave River/Delta	49.1%	9.5	4,800	2.3	2.4	26,200
Smoky/Wapiti	47.8%	9.5	100,000	1.8	2.5	429,900
Lesser Slave	72.2%	17.9	70,000	1.8	2.5	312,300
Pembina/Macleod	53.6%	9.7	98,900	2.8	2.4	667,500
Wabasca	40.7%	13.0	3,400	1.4	2.7	13,000
Lac la Biche	55.1%	21.6	45,600	1.2	3.2	171,600
Total	54.2%	10.8	525,800	2.0	2.5	2,458,900

Table 7-12

Fish Catch and Consumption From the Peace, Athabasca and Slave Rivers and Major Tributaries

Region	Annual Catch (kg)	Eaten			Given Away	
		Percent of Anglers	Amount (kg)	Percent of Catch	Percent of Anglers	Percent of Catch
Upper Athabasca	30.0	45.5%	8.6	19.5%	6.1%	2.0%
Middle Athabasca	15.5	40.6%	11.1	59.4%	6.3%	1.3%
Lower Athabasca	52.1	42.8%	37.2	47.2%	32.1%	17.5%
Upper Peace	16.4	34.6%	13.1	47.0%	11.5%	21.3%
Middle Peace	22.8	37.5%	8.4	13.2%	12.5%	0.9%
Lower Peace	28.0	55.6%	14.9	32.9%	7.4%	0.0%
Slave River/Delta	44.8	69.2%	17.8	27.5%	34.6%	9.4%
Smoky/Wapiti	5.0	20.5%	4.1	48.0%	2.3%	0.0%
Lesser Slave	8.2	38.5%	20.1	57.3%	7.7%	2.4%
Pembina/Macleod	11.7	36.5%	7.0	46.2%	11.5%	6.8%
Wabasca	22.3	59.1%	15.6	64.1%	13.6%	2.2%
Lac la Biche	27.4	25.9%	12.0	54.0%	3.7%	16.4%
Total Basin	23.3	35.6%	13.6	37.7%	10.4%	9.0%
Estimated Harvest	354,000 kg		133,000 kg			31,900 kg

Figure 7-3

Key Fishing Sites Used by Basin Residents

Source: Household Survey Data

Figure 7-4

Key Recreational Sites Used by Basin Residents

Source: Household Survey Data

people living in cottage subdivisions, the Lesser Slave region (17.9 trips per year) which surrounds Lesser Slave Lake, and the Upper Athabasca region (13.3 trips) where residents have access to streams along the east slopes of the Rocky Mountains. It is estimated that northern residents take 525,800 (± 74,500) fishing trips in an average year.

These trips tend to be very short, lasting an average of 2.0 (±0.4) days, and involve 2.5 (±0.2) members of the household. Total angler effort per year is estimated to be in the range of 2.5 million (± 0.6 million) angler-days.

The questionnaire survey included numerous questions related to fishing, especially concerning the consumption of fish caught in the mainstems of the Athabasca, Peace and Slave rivers and their major tributaries. This additional information related to fishing is described below.

7.6.1 Fish harvest

Fishermen are estimated to catch an estimated 23.3 (±7.2) kilograms (kg) of fish per year from the mainstems of the Peace, Athabasca and Slave rivers and their major tributaries. As shown in Table 7-12, the highest catch is reported by households in the Slave River/Delta region (44.8 kg) and Lower Athabasca region (52.1 kg). In comparison, households in the Smoky/Wapiti only catch 5.0 kg of fish from the major rivers while households in the Lesser Slave region catch 8.2 kg of fish. These lower numbers are probably related to the difficulty in getting access to the upper reaches of the Peace River and the availability of Lesser Slave Lake as an alternative fishing site. The total sport fish harvest for the basin is estimated to be 354,000 kg (±110,500) per year.. This is equivalent to about 25 percent of the commercial fish harvest (see Chapter 11).

The composition of the fish catch from major rivers varies considerably from region to region. Northern pike and walleye are the two most important species (see Table 7-13). They account for 25.9 percent and 23.1 percent of the total catch, respectively, and comprise the majority of catch in most regions. However, various other species are of considerable importance in some regions.

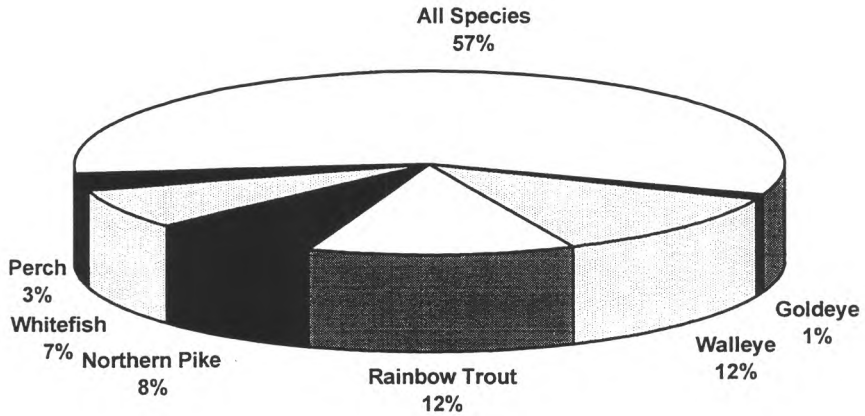
Table 7-13

Composition of Recreational Fish Catch

	Walleye	Northern Pike	Bull Trout	Lake Whitefish	Perch	Rainbow Trout	Mountain Whitefish	Goldeye	Arctic Grayling	Burbot	Other Trout
Upper Athabasca	3.8%	16.7%	6.6%	20.7%	0.4%	27.8%	4.6%	0.1%	15.5%	0.0%	3.8%
Middle Athabasca	36.3%	34.7%	8.0%	8.0%	8.0%	1.6%	0.0%	3.4%	0.0%	0.0%	0.0%
Lower Athabasca	32.1%	24.9%	16.4%	16.4%	1.8%	1.7%	0.0%	5.8%	0.9%	0.0%	0.0%
Upper Peace	19.9%	31.3%	16.0%	9.2%	7.7%	9.2%	0.0%	0.0%	0.0%	6.7%	0.0%
Middle Peace	24.3%	14.7%	12.3%	7.7%	3.8%	15.2%	2.3%	1.2%	0.8%	17.8%	0.0%
Lower Peace	16.1%	46.5%	0.0%	12.6%	0.0%	0.0%	6.2%	18.7%	0.0%	0.0%	0.0%
Slave River/Delta	49.0%	38.8%	0.0%	7.4%	0.0%	4.8%	0.0%	0.0%	0.0%	0.0%	0.0%
Smoky Wapiti	32.6%	5.6%	9.0%	3.4%	6.7%	22.5%	16.9%	0.0%	3.4%	0.0%	0.0%
Lesser Slave	22.1%	13.8%	20.7%	21.4%	2.1%	6.9%	4.1%	2.1%	6.9%	0.0%	0.0%
Pembina/Macleod	18.3%	40.4%	0.0%	8.3%	24.9%	3.3%	0.0%	3.0%	1.7%	0.0%	0.0%
Wabasca	29.4%	48.6%	0.0%	9.0%	8.4%	0.0%	0.0%	0.0%	0.0%	4.5%	0.0%
Lac La Biche	6.6%	78.5%	1.7%	0.0%	8.3%	1.7%	3.3%	0.0%	0.0%	0.0%	0.0%
Total	23.1%	25.9%	8.5%	10.2%	8.8%	11.0%	4.9%	2.3%	3.4%	1.5%	0.4%

Figure 7-5

Species of Fish Eaten by Fishermen



For example, households in the Upper Athabasca region catch the most diverse mix of fish species. Rainbow trout, lake whitefish and Arctic grayling account for about two-thirds of the catch. Households in this region also catch bull trout, mountain whitefish, brook trout and cutthroat trout. These species account for about 15 percent of their total catch.

Rainbow trout also account for a significant portion of fish catches by households in the Middle Peace and Smoky/Wapiti regions. Mountain whitefish comprise a greater portion of the catch reported by households in the Smoky/Wapiti region than in any other region. Other regional differences include a high portion of perch caught by households in the Pembina/Macleod region, large amounts of bull trout and lake whitefish in the Lesser Slave region, goldeye in the Lower Peace region and burbot in the Lower Peace region.

7.6.2 Fish consumption

Only about 36 percent of households that participate in fishing eat part of their catch -- see Table 7-12. This percentage is highest in the Slave River/Delta region, where 69 percent of angling households eat part of their catch, and is also very high in the Wabasca and Lower Peace regions. In contrast, less than 25 percent of angling households in the Smoky/Wapiti and Lac la Biche regions eat part of their catch.

Households that participate in fishing eat an average of 13.6 (± 6.6) kilograms of fish, although there is considerable variation among regions. The highest consumption is reported by households in the Lower Athabasca region (37.2 kg) while only 4.1 kg of fish is eaten by households in the Smoky/Wapiti region. Above average consumption rates are reported by households in the Lesser Slave, Slave River/Delta and Wabasca and Lower Peace regions. In total, it is estimated that about 38 percent of the fish caught by recreational fishermen (133,000 kg per year) are eaten.

Although most fishermen (57.0 percent) eat all the species of fish that they catch, the remainder show preferences for selected fish species. About 12.3 percent of anglers eat walleye, 11.8

Figure 7-6

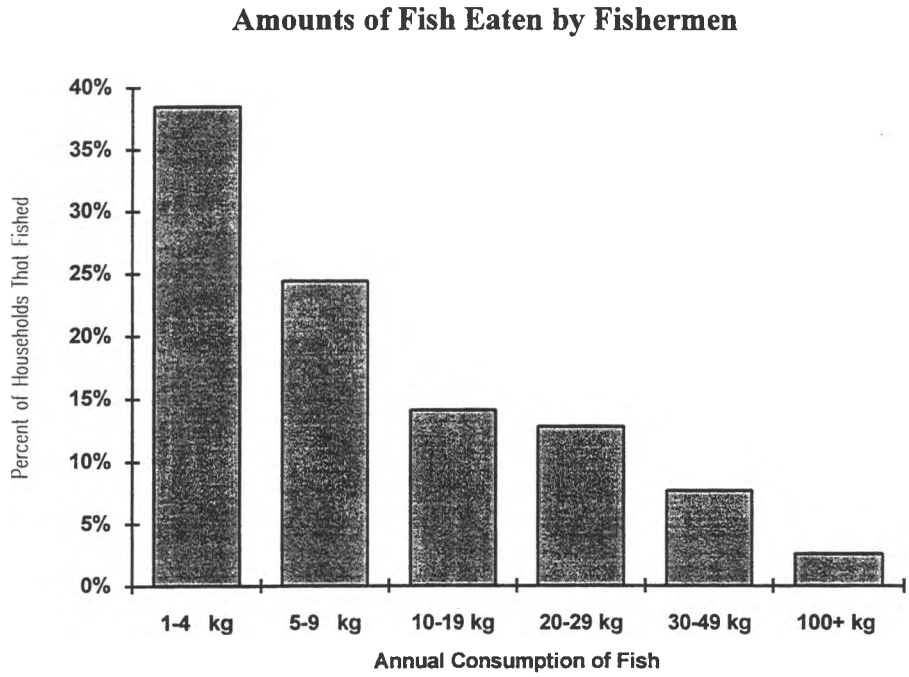


Table 7-14

Summary of Recreational Activity by Households in the Northern River Basins

	Percent of Households	Average Trips per Year	Estimated Total Trips	Percent of Trips	Average Days Per Trip	Average Party Size	Estimated Total User Days	Percent of Total
Camping	55.0%	7.2	334,000	18.2%	3.8	3.2	4,278,500	32.2%
Swimming	40.7%	9.2	336,700	18.3%	2.2	3.4	2,720,600	20.5%
Boating	34.6%	9.4	292,000	15.9%	2.0	3.1	1,841,900	13.9%
Canoeing	17.2%	4.6	71,200	3.9%	2.4	2.5	497,000	3.7%
Hunting	30.6%	10.3	280,300	15.2%	3.5	1.5	1,496,600	11.3%
Fishing	54.2%	10.8	525,800	28.6%	2.0	2.5	2,458,900	18.5%
Total	82.3%	26.7	1,840,000	100%			13,293,500	100%

percent eat rainbow trout, 8.2 percent eat northern pike, 7.1 percent eat whitefish, 3.0 percent eat perch and 0.6 percent eat goldeye. Consumption of perch is reported by households in the Middle Athabasca and Smoky/Wapiti regions, while goldeye are eaten by households in the Middle Peace region. Whitefish are eaten by households in the Upper Athabasca, Upper Peace and Pembina/Macleod regions. Walleye are eaten by households in all regions except for the Upper Athabasca.

The amounts of fish eaten by households varies considerably. The majority of these households (63 percent), eat less than 10 kg of fish per year. Another 27 percent eat between 10 and 29 kilograms of fish. The remaining 10 percent of households eat more that 30 kg of fish and, of these, one-quarter reported eating in excess of 100 kilograms of fish per year.

The balance of the catch is released back into the rivers, although small amounts of fish are given away. About 10 percent of angling households give away part of their catch. On average, they give away about 9.3 (±4.1) kilograms of fish and this represents only about nine percent of their total catch.

7.7 Summary of Activities

In total, it is estimated that over 82 percent of households in the northern basins participate in one or more outdoor recreational activities. They take an average of 26.7 (± 3.3) trips per year. As shown in Table 7-14, fishing trips account for nearly 29 percent of these trips, while camping and swimming each account for 18 percent of the trips taken in an average year. Camping and hunting trips tend to last longer than trips involving the other activities. While camping, swimming and boating trips involve most household members, very few household members go on hunting trips. Total recreational activity by northern households amounts to 1.8 million (± 0.2 million) trips per year and involves 13.3 million (± 3.2 million) user-days of activity. Camping trips account for nearly one third of total user days while 20 percent of user-days are on swimming trips. Boating, fishing and canoeing account for about 36 percent of total user-days.

Table 7-15

Number and Location of Recreational Trips Taken by Northern Households

Region	Average Trips	Trips to Three Most Used Sites	Percent of Trips	Households Using Mainstems	Trips on Mainstems	Percent of Trips
Upper Athabasca	35.0	18.4	52.5%	46.0%	12.8	20.4%
Middle Athabasca	22.8	13.7	60.1%	30.5%	6.9	12.3%
Lower Athabasca	20.2	13.8	68.3%	42.6%	9.0	21.3%
Upper Peace	16.6	9.7	58.4%	46.4%	7.4	26.2%
Middle Peace	26.2	14.9	56.9%	58.3%	14.3	34.7%
Lower Peace	17.9	10.7	59.8%	36.5%	10.9	28.1%
Slave River/Delta	30.0	16.2	54.0%	56.6%	15.8	35.9%
Smoky/Wapiti	24.3	14.1	58.0%	23.9%	6.2	7.6%
Lesser Slave	42.7	17.3	40.5%	29.6%	7.5	5.4%
Pembina/Macleod	26.1	10.9	41.8%	29.9%	8.4	12.0%
Wabasca	35.0	15.6	44.6%	20.4%	10.0	7.3%
Lac la Biche	48.1	35.9	74.6%	12.2%	8.5	2.9%
Total	26.7	14.5	54.3%	33.6%	9.1	13.9%

Table 7-16

Location of Recreational Trips Taken to Three Sites Used Most by Northern Households

Sites	Trips	Percent of Total
Lakes	448,170	48.7%
Rivers and Creeks	278,930	30.3%
Other Sites	112,360	12.2%
Sites Outside Basin	81,250	8.8%
Total	920,700	100.0%

7.8 Location of Activities

Households were asked to list the three sites that they use most often for recreational purposes; estimate the number of trips made in an average year; and list the usual recreational activities during a visit to this site. By the completion of the survey, households had identified over 400 different sites. As shown in Table 7-15, these sites account for between 40 and 75 percent of all trips taken by households in the various regions. Overall, trips to the three most-used sites account for just over half (54 percent) of all trips taken by northern households.

Some of the most-used sites are locations outside the NRBS study area. Visits to such sites amount to about 81,000 trips, and this represents about 8.8 percent of trips to most-used sites.

Lakes within the study area account for nearly half (48.7 percent) of all trips taken to the most heavily-used sites. It is estimated that over 448,000 trips are made to lakes. Some of the most important recreational lakes are Gregoire Lake (5.0 percent of total trips), Lesser Slave Lake (4.0 percent), Pierre Grey Lakes (2.6 percent), Sturgeon Lake (2.2 percent), Saskatoon Lake (1.9 percent), Beaver Lake (1.8 percent), Smoke Lake (1.4 percent), Carson Lake (1.2 percent), Long Lake (1.2 percent), Fork Lake (1.1 percent), Chip Lake (1.1 percent) and Grande Cache Lake (1.0 percent). All other lakes capture less than one percent of total trips to the three most-used sites.

Rivers and creeks account for another 30.3 percent of trips to sites most used by northern households. Key rivers for recreation include the Athabasca River (36 percent of total trips), the Lesser Slave River (2.8 percent), the Peace River (2.2 percent), the Clearwater River (1.8 percent), the Wapiti River (1.8 percent), the Smoky River (1.7 percent), the Macleod River (1.6 percent), the Little Smoky River (1.6 percent) and the Pembina River (1.5 percent).

Northern households also take about 112,000 trips to other sites that are in the basin but are not on lakes and rivers. These sites include a variety of communities, parks and recreation areas. The most important of these is Jasper National Park, with 3.1 percent of total trips.

Table 7-17

Consumption and Treatment of Water by Households Taking Recreational Trips

Region	Consume Water on Trips	Treat Water
Upper Athabasca	23.1%	44.4%
Middle Athabasca	15.2%	28.6%
Lower Athabasca	27.4%	80.0%
Upper Peace	23.8%	40.0%
Middle Peace	30.2%	38.5%
Lower Peace	34.1%	85.7%
Slave River/Delta	46.8%	63.6%
Smoky/Wapiti	25.3%	65.0%
Lesser Slave	22.4%	45.5%
Pembina/Macleod	13.9%	54.5%
Wabasca	47.6%	57.9%
Lac la Biche	23.1%	28.6%
Total	22.4%	56.3%

Table 7-18

Observed Changes in Water, Fish, Animals or Plants Along River Mainstems in Past 10 Years

Region	Changes Observed	Types of Changes			
		Water	Fish	Animals	Plants
Upper Athabasca	34.2%	53.9%	76.9%	15.4%	23.1%
Middle Athabasca	33.3%	71.4%	85.7%	21.4%	21.4%
Lower Athabasca	40.4%	68.4%	52.6%	15.8%	21.1%
Upper Peace	38.6%	76.5%	17.7%	11.8%	17.7%
Middle Peace	67.5%	70.4%	59.3%	18.5%	7.4%
Lower Peace	35.0%	92.9%	64.3%	28.6%	28.6%
Slave River/Delta	31.9%	73.3%	66.7%	40.0%	26.7%
Smoky/Wapiti	37.8%	60.7%	50.0%	35.7%	32.1%
Lesser Slave	51.1%	79.2%	58.3%	37.5%	50.0%
Pembina/Macleod	43.2%	62.5%	62.5%	21.9%	21.9%
Wabasca	34.2%	100.0%	84.6%	69.2%	46.2%
Lac la Biche	39.5%	80.0%	53.3%	6.7%	33.3%
Total	41.2%	64.9%	56.6%	24.1%	25.8%

Mainstems of the Athabasca, Peace and Slave rivers are also important recreational sites. Just over one-third of northern households (33.6 percent) use sites along the mainstems of these three rivers. This percentage varies considerably from region to region, likely due to the travel distances to reach sites along the mainstems. As shown in Table 7-15, households living in tributary regions are less likely to use sites along the river mainstems than are households in regions containing the Athabasca, Peace or Slave rivers. The highest use of river mainstem is reported by households in the Middle Peace region (58.3 percent) and Slave River/Delta region (56.6 percent).

The number of recreational trips to sites along the river mainstems also varies considerably from region to region. Overall, households make an average of 9.1 (±1.7) trips to sites on the river mainstems and these account for 13.9 percent of total recreational trips made by northern residents. Much higher numbers of trips are reported by households in the Slave River/Delta region (15.8 trips) and sites on the mainstem account for more than one third (35.9 percent) of all trips taken by residents of this region.

Sites on river mainstems account for at least 20 percent of trips taken by households living in regions along the Peace and Athabasca rivers, with the exception of households in the Middle Athabasca region. Mainstem sites account for less than 10 percent of trips for households living in all of the tributary basins with the exception of the Pembina/Macleod region.

7.9 Consumption of Water During Recreational Activities

Few households consume river or lake water while on recreational trips. Water consumption is reported by about 22 percent of households that participate in outdoor recreation but this varies significantly among regions -- see Table 7-17. In the Wabasca and Slave River/Delta regions, about 47 percent of households consume water while on recreational trips, while less than 15 percent of households from the Middle Athabasca and Pembina/Macleod regions consume water on their recreational trips.

Table 7-19

Observed Changes in Water Along River Mainstems in Past 10 Years

Region	Higher Water Levels	Lower Water Levels	Dirtier	Foam on Water	Smell	More Algae, Plants	Pollution
Upper Athabasca	0.0%	12.5%	62.5%	12.5%	12.5%	0.0%	0.0%
Middle Athabasca	20.0%	20.0%	40.0%	20.0%	0.0%	0.0%	0.0%
Lower Athabasca	15.4%	0.0%	38.5%	30.8%	0.0%	0.0%	15.4%
Upper Peace	0.0%	21.4%	21.4%	28.6%	14.3%	7.1%	7.1%
Middle Peace	0.0%	0.0%	26.3%	31.6%	15.8%	10.5%	15.8%
Lower Peace	0.0%	14.3%	42.9%	14.3%	7.1%	0.0%	21.4%
Slave River/Delta	0.0%	53.9%	7.7%	0.0%	7.7%	0.0%	30.8%
Smoky/Wapiti	4.8%	0.0%	47.6%	9.5%	23.8%	4.8%	9.5%
Lesser Slave	10.0%	15.0%	45.0%	0.0%	15.0%	15.0%	0.0%
Pembina/Macleod	0.0%	42.9%	28.6%	0.0%	9.5%	4.8%	14.3%
Wabasca	0.0%	35.7%	21.4%	0.0%	7.1%	7.1%	28.6%
Lac la Biche	0.0%	33.3%	16.7%	0.0%	0.0%	25.0%	25.0%
Total	4.8%	16.4%	36.7%	13.0%	11.9%	6.2%	11.1%

More than half the households that use water while on recreational trips reported treating this water first. Boiling is the most common form of treatment, being reported by 93 percent of households. Filtration (4.5 percent) and the addition of iodine (1.4 percent) or bleach (1.0 percent) are other methods used to treat river or lake water before drinking it. Water treatment practices are most common in the Lower Athabasca and Lower Peace regions where over 80 percent of households on recreational trips use some form of treatment.

7.10 Observed Changes in River Mainstems

Households that participate in recreational activities were asked whether they had noticed any changes to the water, fish, animals and plants along the mainstems of the Athabasca, Peace and Slave rivers in the past five years. As shown in Table 7-18, 41 percent of the respondents have observed some sort of change. This percentage is relatively constant among regions, with the exception of the Middle Peace region where 68 percent have seen changes.

Table 7-18 also summarizes the general types of changes that have been observed. Of households that noted changes, nearly 65 percent have seen a change in water resources, 57 percent reported changes in fish, 26 percent noted changes in plants, and 24 percent indicated having seen changes in animals along the river mainstems. In nearly all regions, changes in water resources are the most common change reported by households. However, households in the Upper and Middle Athabasca regions reported more changes in fish populations than for water.

7.10.1 Water

Households have observed changes in both the quality and quantity of water in the river mainstems. Just over 21 percent of comments are about water quantity. As shown in Table 7-19, about five percent of households say that water levels have increased while 16 percent claim that water levels have declined during the past 10 years. In the Slave River/Delta region, which has been affected by the operation of dams on the Peace River, nearly 54 percent of comments report

Table 7-20

Observed Changes in Fish Along River Mainstems in Past 10 Years

Region	More Fish	Fewer Fish	Dead Fish	Smaller Fish	Bad Taste	Contam -inated	Dis- figured	Softer Flesh
Upper Athabasca	0.0%	44.4%	0.0%	33.3%	0.0%	11.1%	11.1%	0.0%
Middle Athabasca	0.0%	40.9%	0.0%	22.7%	13.6%	0.0%	13.6%	9.1%
Lower Athabasca	5.9%	35.3%	0.0%	11.8%	11.8%	0.0%	29.4%	5.9%
Upper Peace	0.0%	40.0%	0.0%	40.0%	0.0%	20.0%	0.0%	0.0%
Middle Peace	0.0%	26.1%	0.0%	21.7%	30.4%	13.0%	4.3%	4.3%
Lower Peace	6.9%	40.0%	0.0%	26.7%	13.3%	0.0%	6.7%	6.7%
Slave River/Delta	0.0%	42.1%	0.0%	15.8%	5.3%	0.0%	15.8%	21.1%
Smoky/Wapiti	0.0%	41.7%	4.2%	33.3%	8.3%	4.2%	8.3%	0.0%
Lesser Slave	4.5%	36.4%	4.5%	27.3%	13.6%	0.0%	4.5%	9.1%
Pembina/Macleod	0.0%	40.0%	2.9%	28.6%	11.4%	2.9%	11.4%	2.9%
Wabasca	0.0%	47.4%	0.0%	36.8%	5.3%	0.0%	10.5%	0.0%
Lac la Biche	0.0%	46.7%	0.0%	46.7%	0.0%	0.0%	0.0%	6.7%
Total	1.3%	39.0%	1.9%	27.7%	11.1%	4.2%	10.9%	3.8%

reduced water levels. A large portion of comments (43 percent) from households in the Pembina/Macleod region also report that water levels have dropped. Reports of increased water levels come mainly from households in the Upper and Middle Athabasca regions.

About 79 percent of comments mention changes in water quality. Households describe five different types of changes. Nearly 37 percent of comments are that the rivers are dirtier now, with more mud and debris ("junk, sawdust") in them. Comments about rivers being dirtier are made by households throughout the basin, especially by households in regions containing the Athabasca River.

A second change in water quality is that there is now a foamy scum along the edge of rivers. Reports of foam come from 13 percent of households in the basin, almost exclusively from households living in regions along the Athabasca and Peace rivers.

About 12 percent of households believe that the river mainstems smell more than they did 10 years ago. Such comments come primarily from households in the Smoky/Wapiti region and along the Peace River.

The fourth change is that there is now more algae (green slime) than there used to be. These observations are made by households in the Lac la Biche and Lesser Slave regions, each of which contains large lakes. The remaining 11 percent of comments are that levels of pollution in mainstem rivers have increased. Respondents note that rivers look more polluted and, because of this, they not longer drink river water. Such comments come from households along the Peace River, plus households in the Wabasca, Lac la Biche and Pembina/Macleod regions.

7.10.2 Fish

Households have seen changes in both the numbers and quality of fish in the river mainstems -- see Table 7-20. While a small proportion of households (1.3 percent) report increasing fish populations, especially in the Lesser Slave, Lower Athabasca and Lower Peace regions, 39

Table 7-21

Observed Changes in Animals Along River Mainstems in Past 10 Years, as Reported by Subsistence (Food) Hunters

Region	Percent of Hunters	Types of Changes			
		More Animals	Less Animals	Decreased Quality	Decreased Health
Upper Athabasca	55.6%	40.0%	60.0%	20.0%	20.0%
Middle Athabasca	20.0%	0.0%	100.0%	100.0%	0.0%
Lower Athabasca	0.0%	0.0%	0.0%	0.0%	0.0%
Upper Peace	71.4%	66.7%	33.3%	20.0%	20.0%
Middle Peace	54.5%	0.0%	0.0%	0.0%	0.0%
Lower Peace	0.0%	0.0%	0.0%	0.0%	0.0%
Slave River/Delta	50.0%	25.0%	50.0%	25.0%	25.0%
Smoky/Wapiti	80.0%	0.0%	75.0%	25.0%	12.5%
Lesser Slave	50.0%	0.0%	100.0%	0.0%	0.0%
Pembina/Macleod	47.1%	0.0%	100.0%	25.0%	12.5%
Wabasca	37.5%	50.0%	50.0%	0.0%	66.7%
Lac la Biche	50.0%	0.0%	100.0%	0.0%	33.3%
Total	52.5%	15.1%	79.2%	21.6%	13.4%

percent of households indicated that fish populations have declined. This proportion is consistent among the regions, with the exception of the Middle Peace region where only 26 percent of households report declining fish populations. Households in only three regions report seeing an increase in the number of dead fish.

More than 25 percent of comments are that fish in the mainstem rivers are smaller than they used to be. This comment come from between 12 and 47 percent of households in the various regions and is made quite frequently by households living in upper regions of both the Athabasca and Peace rivers.

Just over 11 percent of households report that the taste of fish has deteriorated in the last 10 years. These types of observations come from people living in the middle and lower reaches of the Athabasca and Peace rivers, as well as the Lesser Slave region. Another 11 percent of households note that the number of disfigured fish has increased. Examples include discolouration, growths, sores and blisters. The percentage of comments related to disfigurement is higher in the lower reaches of both the Athabasca and Peace rivers than in the upper reaches, and is also high in the Slave River/Delta region.

Other observations about fish in the river mainstems are that they are now more contaminated (four percent of comments) and that fish flesh is softer (four percent). Comments about contamination are most commonly from households in the Upper and Middle Peace regions, some of whom noted that they were warned by Fish and Wildlife not to eat fish. The most frequent comments about softer fish flesh come from households in the Slave River/Delta region.

7.10.3 Animals

Very few comments about the quality and quantity of animals are provided by households that use the basin for recreational purposes. Due to the low numbers of comments about changes in animals living along the river mainstems, a detailed regional analysis of these survey results is not presented. In aggregate, nearly two-thirds of comments are that the number of animals has

decreased in the last 10 years. Respondents make specific references to reduced numbers of moose, deer, bear, ducks and rabbits. These comments come from the majority of households in each region. A small number of households (15 percent) now see more animals than before. These households are located in the Lower Athabasca, Lower Peace, Lesser Slave and Pembina/Macleod basins. These households indicate seeing increased numbers of bears, beavers, deer, mice and coyotes.

Small numbers of households report seeing increases in the number of sick animals (five percent), dead animals (four percent) and smaller animals (three percent). Such comments come from households in the Middle Peace, Slave River/Delta, Smoky/Wapiti and Wabasca regions. Another seven percent of comments, primarily from households in the Upper Athabasca and Middle Peace regions, are that animals are no longer drinking water from river mainstems.

Households that hunt for food (subsistence) provide a much more comprehensive description of changes in the quality and quantity of animals in the basins during the past 10 years. As shown in Table 7-21, more than half of these hunters have observed some sort of change, with the highest percentages being reported by hunters in the Upper Peace and Smoky/Wapiti regions. No changes are noted by households in the Lower Athabasca and Lower Peace regions.

The most common observation is that the number of animals in the regions has changed. Of the hunters making these comments, over 79 percent indicate that the number of animals has declined. Although this is a general comment in most cases, two-thirds of these people report lower moose populations while the remainder now see fewer deer. A reduction in game numbers is a common observation by households residing in most of the tributary basins, as well as the Middle Athabasca and Middle Peace regions. In contrast, 15 percent of hunters report seeing more game, especially grouse in the Upper Athabasca and moose in the Upper Peace and Wabasca regions.

Of hunters commenting on changes in animals, nearly 22 percent report that the quality of animals has declined. The most common concern is that there are no old bull moose. This is of

concern to hunters in the Upper and Middle Athabasca regions, the Smoky/Wapiti and Pembina/Macleod regions. Other hunters note that animals are smaller than they used to be and that the quality of the meat has declined.

A decline in animal health is mentioned by 13 percent of hunters who describe changes in animal populations in the basin. Many of these comments come from hunters in the Wabasca region, although hunters in the Upper Athabasca, Upper Peace, Slave River/Delta and Lac la Biche regions also report seeing an increase in the number of sick or diseased animals. Reported symptoms include underweight animals, fleas, worms and bald patches.

7.10.4 Plants

Respondents have few comments describing changes to plants along river mainstems. The most common comments are that there are now fewer trees or less vegetation (31 percent of comments), and logging is often cited as the cause. Another 29 percent of comments are that more trees seemed to be diseased or dying. These comments come from households in nine of the 12 regions.

Other concerns are that there are now more weeds than before. While this observation accounts for about 21 percent of comments on changes in vegetation, only households in tributary basins and the Slave River/Delta region report seeing this type of change. Some households (eight percent of comments) report seeing more growth, while three percent of comments indicate there are now fewer berries growing in the basin.

7.11 Recreational Activities by Stakeholder Groups

Additional information on recreational activities in the NRBS area can be found in the survey of environmental and recreational groups. While the household survey provides data on recreational activity in the basin by residents of the basin, the survey of environmental and recreational groups was specifically designed to collect some information about use of the basin

Table 7-22

Participation Rates for Selected Recreational Activities by Members of Recreational and Environmental Groups
(Percent of Groups Whose Members Participate in Each Activity)

Group	Location	Fishing	Boating	Canoeing	Camping	Hunting	Swimming
Recreational Groups	Inside the Basin	87%	83%	65%	87%	87%	43%
	Outside the Basin	17%		67%	17%	17%	
Environmental Groups	Inside the Basin	33%	33%	33%	33%	33%	33%
	Outside the Basin	25%		25%	25%	25%	

Table 7-23

Participation Rates and Number of Recreational Trips by Members of Recreational and Environmental Groups

Activity	Percent of Groups	Trips Taken	Percent of Total Trips
Fishing	55.0%	1417	28.4%
Boating	52.5%	988	19.8%
Hunting	55.0%	784	15.7%
Canoeing	55.0%	521	10.4%
Camping	57.5%	548	10.4%
Snowmobiling	35.0%	274	5.5%
Skiing (water or snow)	42.5%	144	2.9%
Swimming (lakes/rivers)	30.0%	124	2.5%
Kayaking	15.0%	113	2.3%
Rafting	17.5%	61	1.2%
Horseback Riding	22.5%	45	0.9%
Total		4989	100.0%

by people living outside the NRBS area. The surveys were sent to key contacts within the groups and they were asked to speak on behalf of members of their organizations.

Surveys were sent to 160 environmental groups, recreational groups, professional associations and Native friendship centres and 43 responses were received, for a response rates of 27 percent. Of the completed responses, 67 percent were from recreational associations, 23 were from environmental groups and the remainder (10 percent) were from other organizations.

For purposes of describing recreational use of the region, responses are grouped into four categories based on the nature of the group (recreational versus environmental) and the location of the vast majority of group members (this was selected as 85 percent of membership). This stratification of the responses means that 59 percent of responses (23 responses) are from recreational groups with members in the basin, 15 percent (six responses) are from recreational groups outside the basin, 11 percent (four responses) are from environmental groups inside the basin and 15 percent are from environmental groups outside the basin. Although the sample sizes are quite small for some groups, there are some important differences in their recreational use of the basin.

7.11.1 Participation in recreational activities

Table 7-22 summarizes recreation participation rates for each of the four categories of environmental and recreational groups. The table shows a number of important trends. First, groups having the majority of members living in the basin participate in all six categories of recreational activities. In contrast, members of groups located outside the basin participate in only four of the six activities and do not travel to the region for boating or swimming.

Second, even though members of environmental groups do not view themselves as "users" of the resource base, some of them do participate in some recreational activities.

Table 7-23

Recreational Sites in the Northern River Basins Used by Members of Recreational and Environmental Groups
(Percent of Trips)

Activity	Sites on River Mainstems	Sites on Other Rivers	Sites on Lakes
Fishing	0.1%	40.8%	59.1%
Boating	0.0%	70.2%	29.8%
Canoeing	9.4%	13.6%	77.0%
Kayaking	54.5%	45.5%	0.0%
Camping	0.0%	42.6%	57.4%

Third, members of recreational groups located in the basin show high participation in most of the six recreational activities. On the other hand, members of recreational groups from outside the region show high participation rates in only one activity. This difference may be an artifact of the sample, in that most of the responses from recreational groups from outside the basin came from canoe clubs while the majority of responses from groups inside the basin came from fish and game associations. However, it is also likely that people who travel to the region do so for a particular activity, such as canoeing, fishing or hunting.

7.11.2 Amount of recreational activity

The 40 environmental and recreation groups that responded to the survey reported that their members take a total of about 5,000 trips per year to locations in the northern river basins groups. This represents an average of 125 trips per group. As shown in Table 7-23, fishing was the most common activity. Sixty percent of stakeholder and environmental groups fish in the region and such trips account for 28 percent of trips to the basin by group members. Other important activities include boating, hunting canoeing and camping.

7.11.3 Location

Eighty percent of environmental and recreational groups reported using the mainstems of the Peace, Athabasca or Slave rivers and their major tributaries for recreational purposes. Preferred recreational sites vary according to activity and, as shown in Table 7-24, members of environmental and recreation groups only use the mainstems of the Peace, Athabasca or Slave rivers for canoeing and kayaking. Favourite sites include the upper Athabasca River for canoeing and the Slave River for kayaking. Kayaking also occurs on the Pembina River. Most boating activities (70 percent) occur on rivers other than the Peace Athabasca or Slave. The Little Smoky River was mentioned most frequently. About 42 percent of fishing trips were to other rivers in the basin, and the Little Smoky and Pembina were mentioned most often. The majority of camping, fishing and canoeing occurs on lakes in the basin. Important lakes include Lesser Slave Lake and Smoke Lake for fishing and camping, and Crooked Lake for canoeing.

Table 8-1

Number and Distribution of Farming Operations in the Northern River Basins

Region	Percent of Households	Estimated Number of Farms	95% Confidence Interval[1]	Percent of Total
Upper Athabasca	0.0%	0	± 0	0.0%
Middle Athabasca	55.9%	2,990	± 380	13.9%
Lower Athabasca	0.0%	0	± 0	0.0%
Upper Peace	37.5%	2,630	± 335	12.2%
Middle Peace	29.2%	1,240	± 160	5.8%
Lower Peace	38.5%	1,045	± 140	4.8%
Slave River/Delta	1.9%	20	± 1	0.1%
Smoky/Wapiti	21.7%	4,805	± 405	22.3%
Lesser Slave	22.2%	1,205	± 135	5.6%
Pembina/Macleod	35.1%	6,685	± 635	31.0%
Wabasca	0.0%	0	± 0	0.0%
Lac La Biche	24.5%	940	110	4.4%
Total	24.1%	21,560	720	100.0%

[1] An explanation of 95 percent confidence intervals is provided in Section 3.1.

8.0 AGRICULTURE

There is very little existing information that describes use of water for agricultural purposes in the NRBS area. While there is some data on agricultural water licences, most farms do not have licences. The purpose of this section is to summarize use of water resources by farmers in the basin and to describe the types of land use activities that can have potential effect on water quality and quantity.

8.1 Number of Farming Operations

Survey results suggest that 24 percent of households in the basin participate in farming. This represents about 21,560 (± 720) households. However, other survey information (Table 4-1) shows that 30 percent of households live on farms, and the difference occurs because not all households that live on farms are actually engaged in farming and there may be several households on the same farm. The employment data from the survey, as described in Table 4-8, suggests that someone in only 20 percent of households is actually employed in agriculture.

A more definitive estimate of the number of farms in the basin can be drawn from the 1991 Alberta Census of Agriculture. Census data for the basin, when adjusted to reflect river basin boundaries, suggest there are actually only about 13,870 farms in the basin. The data also show that the total area farmed is estimated to be 10.6 million acres, of which 6.4 million acres are used for crops. The average farm size, based on land area used for crops, is 465 acres. The Census information clearly shows that survey data exaggerate the number of farms in the basin. This has likely occurred because a disproportionate number of farm households responded to the survey. Although this inconsistency will affect the accuracy of any estimates of total farming activity in the basin, other comparisons with the Census of Agriculture show that survey results provide a fairly accurate representation of the characteristics of typical (average) farms in the basin.

Table 8-2

Types of Farming Operations

Region	Grains/ Oilseeds	Mixed farming	Specialty Crops	Livestock Only
Upper Athabasca	0.0%	0.0%	100.0%	0.0%
Middle Athabasca	12.2%	51.5%	6.1%	30.3%
Lower Athabasca	0.0%	50.0%	0.0%	50.0%
Upper Peace	46.2%	38.5%	0.0%	15.4%
Middle Peace	53.3%	33.3%	0.0%	13.3%
Lower Peace	41.7%	45.8%	0.0%	12.5%
Slave River/Delta	50.0%	0.0%	50.0%	0.0%
Smoky/Wapiti	47.6%	19.0%	9.5%	23.8%
Lesser Slave	35.7%	35.7%	0.0%	28.6%
Pembina/Macleod	11.1%	55.6%	0.0%	33.3%
Wabasca	0.0%	100.0%	0.0%	0.0%
Lac La Biche/Other	15.4%	46.2%	0.0%	38.5%
Total	29.4%	40.9%	3.6%	26.1%

Table 8-3

Average Farm Size
(Area of Crops)

Region	Size (Acres)	95 % CI
Middle Athabasca	379	± 171
Upper Peace	637	± 226
Middle Peace	547	± 260
Lower Peace	762	± 282
Smoky/Wapiti	315	± 143
Lesser Slave	475	± 403
Pembina/Macleod	285	± 107
Lac la Biche	403	± 250
Average	462	± 81

8.2 Type and Location of Farming Operations

Table 8-1 shows that the majority of farms are concentrated in four regions: the Middle Athabasca region (13.9 percent of farms), the Upper Peace region (12.2 percent), the Smoky/Wapiti region (22.3 percent), and the Pembina/Macleod region (31.0 percent). Although there are some farm operations in the other regions, the number of these farms is quite small. Farms in the Upper and Lower Athabasca, the Slave River/Delta and the Wabasca regions account for less than one percent of total farming operations in the basin.

Four types of farming are found in the basin. Mixed farms, where both crops and livestock are raised, are most common and account for nearly 41 percent of farming operations (Table 8-2). Mixed farming occurs more frequently in the Middle and Lower Athabasca regions and in the Pembina/Macleod and Lac la Biche regions than in the Upper and Middle Peace regions. Farms raising grains and oilseeds are most common in regions along the Peace River and in the Smoky/Wapiti region, and account for about 29 percent of farming operations in the basin. Another 26 percent of farms are livestock operations. Most of these operations are located in the Middle Athabasca, Smoky/Wapiti, Lesser Slave, Pembina/Macleod, and Lac la Biche regions. The remaining four percent of farms raise specialty crops. These farms are located in the Upper and Middle Athabasca regions, the Slave River/Delta region and the Smoky/Wapiti region. Specialty crops include honey (bee keeping), greenhouses, market gardens, and Saskatoon berries.

8.3 Size of Farming Operations

Survey data indicated that the average size of farms in the basin, based on the area of crops being harvested, is 462 acres (± 80 acres). This is nearly identical to the Census of Agriculture estimate of 465 acres. Farms in the regions adjacent to the Peace River are larger than elsewhere in the basin. As shown in Table 8-3, the average size of farms in the Peace River area ranges from 547 acres in the Middle Peace region to 762 acres in the Lower Peace region.

Figure 8-1

Distribution of Farms by Size (Acres)

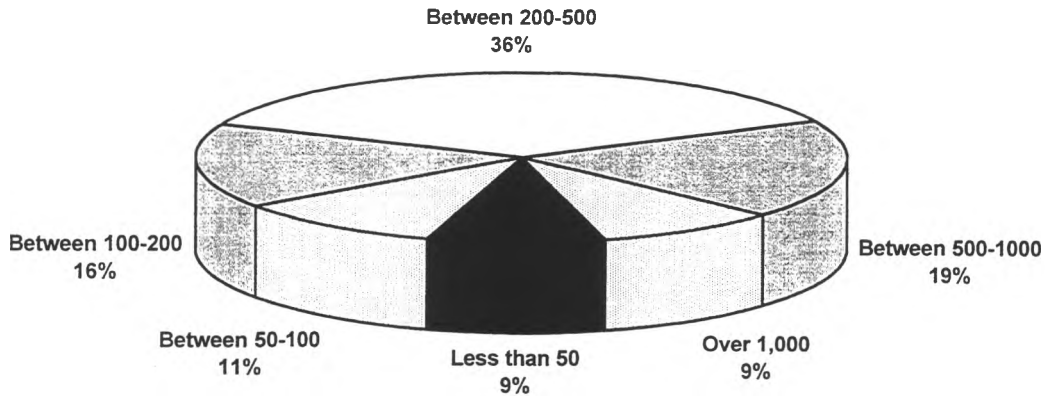


Table 8-4

Common Crops in the Northern River Basins, by Farm Type
(Percent of Farms Growing Crop)

Farm Type	Wheat	Canola	Barley	Oats	Hay	Legumes	Alfalfa	Grasses
Grains/Oilseeds	75.0%	75.0%	66.1%	37.5%	7.1%	21.4%	10.7%	28.6%
Mixed Farms	43.8%	48.8%	53.8%	70.0%	40.0%	17.5%	15.0%	16.3%
Livestock Only	0.0%	0.0%	0.0%	2.2%	13.0%	0.0%	2.2%	0.0%
Specialty Crops	0.0%	0.0%	0.0%	0.0%	16.7%	50.0%	0.0%	0.0%

Part of the reason for the difference in farm size is related to the type of farm operation. Grain/oilseed farms, with an average size of 535 acres, are larger that other types of farming operations. Mixed farms are slightly smaller, averaging 429 acres in size. Farms growing specialty crops are only about 168 acres in size. Survey data show the average size of livestock operations to be about 200 acres, but this number reflects the number of acres harvested or planted and may understate the actual size of these operations.

Figure 8-1 describes farms in the basin according to the number of acres planted or harvested per year. Nearly 20 percent of farms are quite small (less than 100 acres) and there are relatively few (nine percent) really large farms (in excess of 1,000 acres). Just over one-third (36 percent) of farms plant between 200 and 500 acres per year.

Using these numbers, it is estimated that the total area of land planted or harvested in the northern basins is about 8.7 million acres (± 1.3 million). This estimate is considerably higher than reported by the Census of Agriculture statistics for the region and, as noted earlier, the difference is due to the over-representation of farm households in the overall survey. Other information from Alberta Agriculture, Food and Rural Development shows that, between 1988 and 1993, an average of about six million acres of wheat, oats, barley, canola and hay have been planted each year in northern Alberta (see Figure 8-2).

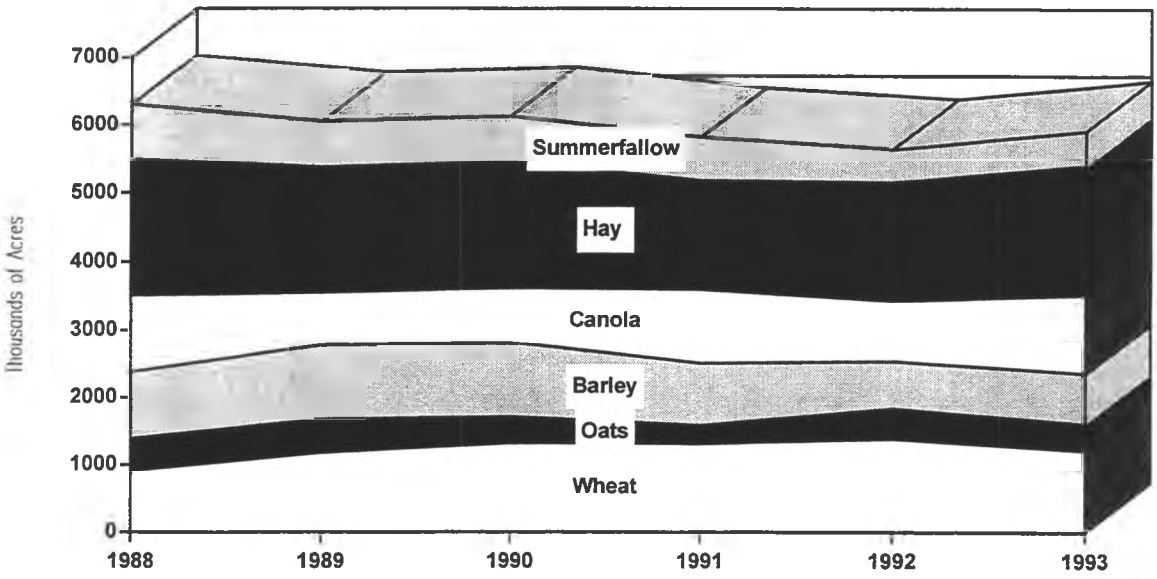
8.4 Types of Crops

Survey results show that farmers raise at least 20 different types of crops. These include the major cereal crops (wheat, oats, barley and rye), canola, animal feed (hay and alfalfa), various types of grasses (such as fescue and timothy), legumes (including peas and beans), and various specialty crops such as clover, Saskatoon berries, beans, potatoes, soft fruits, and honey.

The mix of crops grown in each region is slightly different. This is a reflection of the different soil and weather conditions in parts of the basin. As shown in Table 8-4, wheat and canola are the most important crops grown in the Upper, Middle and Lower Peace regions. These crops are

Figure 8-2

Crop Production by Land Area in the NRBS Region, 1988 to 1993



Source: 1993 Alberta Agricultural Statistics Yearbook

Table 8-5

Common Crops in the Northern River Basins
(Percent of Farms Growing Crop)

Region	Wheat	Canola	Barley	Oats	Hay	Legumes	Alfalfa	Grasses
Middle Athabasca	27.3%	18.2%	33.3%	54.5%	36.4%	15.2%	9.1%	12.1%
Upper Peace	73.1%	73.1%	53.8%	34.6%	3.8%	23.1%	15.4%	38.5%
Middle Peace	60.0%	73.3%	73.3%	46.7%	0.0%	13.3%	13.3%	6.7%
Lower Peace	70.8%	75.0%	50.0%	33.3%	16.7%	8.3%	12.5%	0.0%
Smoky/Wapiti	47.6%	42.9%	33.3%	33.3%	14.3%	23.8%	9.5%	28.6%
Lesser Slave	42.9%	57.1%	35.7%	64.3%	28.6%	28.6%	0.0%	28.6%
Pembina/Macleod	16.7%	22.2%	47.2%	38.9%	30.6%	2.8%	5.6%	5.6%
Lac la Biche	15.4%	15.4%	23.1%	46.2%	38.5%	15.4%	15.4%	15.4%

typical of the grain/oilseed operations found in those regions. Barley is also an important crop in the Middle Peace region. More than 55 percent of farms in the Lower Athabasca and Lesser Slave regions raise oats. Table 8-5 shows that about 70 percent of mixed farms grow oats, often for animal feed, and the percentage of farms raising livestock is quite high in these two regions. Hay is also raised as part of many (40 percent) mixed farming operations and is grown by at least 30 percent of farms in the Middle Athabasca, Lac la Biche and Pembina/Macleod regions.

Legumes are raised on small numbers of farms throughout most of the regions. Although some legumes are grown by grain/oilseed and mixed farming operations, they are becoming an important specialty crop. Production of grasses is more associated with grain/oilseed operations than farms with livestock. As a result, the highest proportion of farms raising grasses is in the Middle Peace region.

8.5 Livestock Production

About two-thirds of farms in the basin raise livestock, either as a mixed farming operation or focusing on livestock production alone. Cattle are the most important types of livestock. Survey results indicate that cattle are raised on 55 percent of farms in the basin. Census of Agriculture statistics for Alberta show that, in 1991, cattle were raised on about 6,880 farms in the basin and this represents about 50 percent of the total number of farms in the NRBS area.

Livestock production in the basin varies from region to region. The survey data summarized in Table 8-6 show that cattle are found on more than 64 percent of farms in the Middle Athabasca, Pembina/Macleod and Lac la Biche regions. Fifty percent or less of farms in the other regions raise cattle, and the number of cattle on these farms is lower than in the three main cattle-producing regions. Table 8-7 shows that the number of cattle on mixed farming operations tends to be twice as high as the number of cattle on farms that raise only livestock. A small number of specialty and grain/oilseeds farms also raise a few cattle.

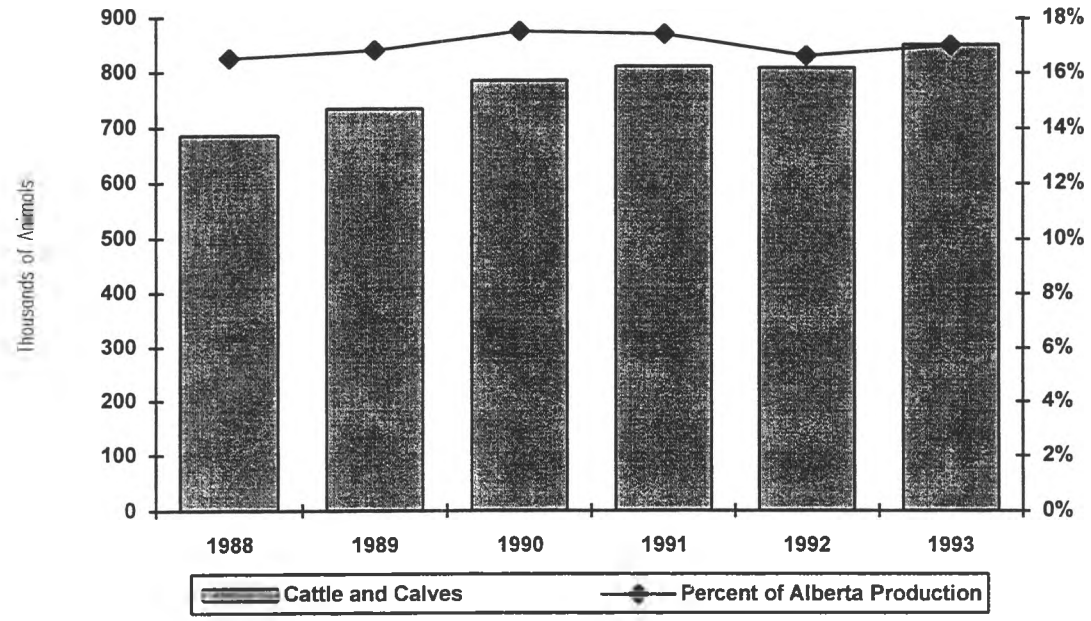
Table 8-6

Livestock Production in the Northern River Basins
(Percent of Farms)

Region	Cattle		Horses		Swine		Sheep		Poultry	
	Percent of Farms	Average Number	Percent of Farms	Average Number	Percent of Farms	Average Number	Percent of Farms	Average Number	Percent of Farms	Average Number
Middle Athabasca	70.6%	91.8	29.4%	3.9	2.9%	4.0	5.9%	82.5	14.7%	66.8
Upper Peace	50.0%	82.5	7.7%	14.5	7.7%	75.0	3.8%	105.0	3.8%	50.0
Middle Peace	40.0%	53.3	26.7%	3.5	6.7%	200.0	6.7%	2.0	6.7%	40.0
Lower Peace	50.0%	27.2	20.8%	3.4	29.2%	48.6	4.2%	10.0	20.8%	113.4
Smoky/ Wapiti	28.6%	78.2	19.0%	3.0	4.8%	20.0	4.8%	9.0	9.5%	35.0
Lesser Slave	50.0%	350.7	35.7%	6.2	7.1%	4.0	0.0%	0	7.1%	200.0
Pembina/ Macleod	69.4%	65.8	25.0%	8.4	13.9%	68.0	5.5%	21.5	16.7%	28.8
Lac la Biche	64.3%	93.9	9.5%	1.7	0.0%	0	7.1%	160.0	7.1%	50.0

Figure 8-3

Production of Cattle and Calves in the NRBS Region, 1988 to 1993



Source: 1993 Agricultural Statistics Yearbook

Extrapolation of survey results suggests that there are about 1.0 million (± 0.4 million) cattle in the NRBS area. This number is much higher than agricultural statistics which show an average of about 851,000 cows and calves on census farms in 1993. As shown in Figure 8-3, the number of cattle and calves on basin farms have been increasing since 1988 and cattle numbers have likely risen since 1993, due to stronger beef prices. However, the difference between the Census of Agriculture data and survey results is again due to the over-estimation of the number of farms in the basin because of higher survey response rates from farm households.

Although about 24 percent of farms in most regions reported raising horses, the number of horses is quite small, averaging four horses or less. About 95 percent of farms report having less than 10 horses. Operations in the Upper Peace region raise much higher numbers of horses than average, but this may be due to the small number of farms in this region. Nearly 49 percent of livestock operations raise horses, compared to only 14 percent of mixed farms. However, the number of horses on each type of farm is nearly the same.

Swine are raised on 16 percent of both mixed farms and livestock farms, and are most frequently found on farms in the Lower Peace region. The number of swine per farm ranges from an average of 40 on livestock farms to just over 60 on mixed farms. Overall, survey results indicate that swine are raised on 11 percent of farms in the basin. This percentage is identical to information from the 1991 Census of Agriculture.

Both survey results and data from the Census of Agriculture show that sheep are raised on five percent of farms in the basin. These farms are distributed fairly evenly throughout the basin. Sheep are raised almost exclusively on livestock operations. Less than two percent of mixed or grain/oilseed farms raise sheep and then only in small numbers. Livestock farms have an average of nearly 48 sheep per operation.

Poultry are raised on about 17 percent of farms in the basin. Chickens, ducks and turkeys are found on 29 percent of mixed farms, with an average of 53 birds per farm. While only 19 percent of livestock farms raise poultry, the number of birds per operation is much higher -- an

Table 8-7

Livestock Production in the Northern River Basins, by Farm Type
(Percent of Farms)

Farm Types	Cattle		Horses		Swine		Sheep		Poultry	
	Percent of Farms	Average Number	Percent of Farms	Average Number	Percent of Farms	Average Number	Percent of Farms	Average Number	Percent of Farms	Average Number
Grains/ Oilseeds	3.6%	6.5	3.6%	4.0	0.0%	0	1.8%	9.0	0.0%	0
Mixed Farms	83.8%	108.9	23.8%	6.7	16.3%	61.5	1.3%	150.0	28.8%	52.5
Livestock Only	86.0%	40.0	48.8%	4.0	16.3%	40.4	16.3%	47.9	18.6%	93.8
Specialty Crops	16.7%	56.7	16.7%	5.4	0.0%	0	0.0%	0	16.7%	50.0

average of 94 birds per operation. Poultry are also grown on some (17 percent) specialty farms. Above average numbers of poultry are raised on farms in the Lower Peace, Pembina/Macleod, and Middle Athabasca regions.

Only farms in the Pembina/Macleod and the Lower Peace regions raise all five types of livestock. The Middle Athabasca region has the largest cattle operations while the largest horse farm is located in the Lower Athabasca. The Middle Peace region has the largest swine operation, and the Lac La Biche region has the largest sheep operation. The largest poultry operations are found in the Lesser Slave and Lower Peace regions.

8.6 Use of Water

Water use varies considerably according to the types of farming activities in the study area. Very small amounts of water are used on grain and oilseed farms, usually for mixing with chemicals for spraying. Mixed and livestock farms require water for watering animals. Specialty farms may require water for irrigating special crops.

Current policy in Alberta is that farm operations using more than five acre-feet[1] of water per year from creek or river diversions or from dug-outs are required to get a water licence. Water licences are also required for any diversion of water that involves constructing a dam or other works in a water body or for diversion of water for irrigation.

Five acre-feet of water would meet the needs of about 200 head of cattle or allow irrigation of five acres of land with a foot of water. Based on reported numbers of cattle per operation, this would suggest that at least five percent of farms in the basin would require water licences. Any specialty farms using irrigation would also require a water licence.

[1] This is equivalent to 6.2 cubic decametres of water or 6.2 million litres.

Table 8-8

Use of Herbicides, Other Pesticides and Fertilizers by Type of Farming Operations

Farm Type	Herbicides	Other Pesticides	Fertilizers
Mixed Farming	60.3%	7.7%	66.2%
Grains/Oilseeds	84.6%	7.8%	84.6%
Livestock Only	11.0%	0.0%	11.1%
Specialty Crops	0.0%	0.0%	40.0%
Total	54.9%	5.4%	56.3%

Table 8-9

Use of Herbicides, Other Pesticides and Fertilizers by Farms in the Basin

Region	Herbicides	Other Pesticides	Fertilizers
Upper Athabasca	0.0%	0.0%	0.0%
Middle Athabasca	28.0%	4.8%	52.0%
Lower Athabasca	0.0%	0.0%	0.0%
Upper Peace	95.0%	5.0%	90.0%
Middle Peace	100.0%	7.7%	84.5%
Lower Peace	79.0%	15.8%	89.5%
Slave River/Delta	100.0%	0.0%	100.0%
Smoky/Wapiti	70.5%	17.6%	69.0%
Lesser Slave	54.5%	0.0%	64.0%
Pembina/Macleod	58.0%	4.0%	68.0%
Wabasca	0.0%	0.0%	0.0%
Lac la Biche	45.5%	0.0%	36.0%
Total	52.4%	5.4%	56.3%

Survey results indicate that less than two percent of the farms have water licences. The actual number of respondents having water licences (four) is too small to prepare any meaningful analysis of licenced water use. However, three-quarters of these licences are for irrigation. Most licences are for groundwater.

Only four farm households reported irrigating their crops: two in the Middle Athabasca region, one in the Slave River/Delta region, and one in the Smoky/Wapiti region. Again, this number is insufficient to provide a detailed assessment of irrigation practices in the NRBS area. Farms that use irrigation grow hay, canola, potatoes, beans, peas, legumes and soft fruits. One respondent uses water to irrigate a nursery. Three of the four farms irrigate two or less acres of land.

8.7 Farm Chemicals

Part of the survey asked farmers to describe their use of pesticides, herbicides and fertilizers. Analysis of survey results proved difficult, however, because some respondents included herbicides as a type of pesticide and others did not. To resolve this confusion, the Fairview District Offices of Alberta Agriculture, Food and Rural Development (AAFRD) was asked to review the survey results. Their suggestions clarified a number of problems[1].

In this analysis, pesticides are defined to be any chemical used to eradicate a pest and they include herbicides, insecticides, fungicides and rodenticides. Analysis of the survey results shows that 52 percent of farms use herbicides but only five percent use other types of pesticides. Most farms that use other pesticides also use herbicides.

[1] This review was provided by Richard Lussier, Soil Management Specialist, Alberta Agriculture, Food and Rural Development, Spirit River, January 2, 1996.

Table 8-10

Common Herbicides Used by Farms in the Northern River Basins
(Percent of Farms Using Herbicides)

Herbicide	Mixed Farming	Grains/Oilseeds
Round-Up	44.7%	40.9%
MCPA Amine	31.9%	36.4%
Lontrel	17.0%	15.9%
Poast	14.9%	29.5%
2,4-D	14.9%	11.4%
Treflan	14.9%	6.8%
Triumph	14.9%	6.8%
Avenge	14.9%	4.5%
Edge	10.6%	9.1%
Assert	8.5%	18.2%

Table 8-11

Regional Use of Six Common Types of Herbicides in the Northern River Basins

Region	Round-Up	MCPA Amine	Lontrel	Poast	2,4-D	Treflan
Middle Athabasca	42.9%	14.2%	0.0%	0.0%	14.2%	0.0%
Upper Peace	68.4%	36.8%	21.0%	26.3%	5.3%	10.5%
Middle Peace	15.4%	23.1%	30.8%	46.2%	15.4%	0.0%
Lower Peace	40.0%	33.3%	33.3%	33.3%	6.7%	26.7%
Smoky/Wapiti	50.0%	25.0%	16.7%	8.3%	8.3%	8.3%
Lesser Slave	66.7%	66.7%	16.7%	16.7%	0.0%	16.7%
Pembina/Macleod	21.4%	42.9%	14.3%	0.0%	14.3%	7.1%
Lac la Biche	20.0%	60.0%	20.0%	0.0%	20.0%	20.0%

Table 8-12

Common Fertilizers Used by Farms in the Northern River Basins
(Percent of Farms Using Fertilizers)

Fertilizer	Mixed Farming	Grains/Oilseeds
Nitrogen (blend unspecified)	48.9%	47.7%
27-14-0-0	36.2%	31.8%
11-52-0-0	18.2%	8.5%
Anhydrous Ammonia	11.4%	14.9%

More than half of the farms in the northern river basins use herbicides and fertilizers. The use of farm chemicals is highly variable throughout the basin. Table 8-8 shows that grain/oilseed farmers are extremely reliant on fertilizers and herbicides for weed control. Nearly 85 percent of grain/oilseed farms use fertilizers and/or herbicides. Thus, the highest incidence of using fertilizers and herbicides is in those regions with a high proportion of grain/oilseed farms, notably the Upper, Middle and Lower Peace regions -- see Table 8-9.

Less than two-thirds of mixed farms use herbicides and fertilizers. As mixed farms are most common in the Middle Athabasca and tributary regions, fewer farms in these regions report using herbicides and fertilizers. About 70 percent of farms in the Smoky/Wapiti region use both herbicides and fertilizers. In the Lower Athabasca region, the proportion of farms using fertilizers is lower (52 percent) and herbicide use is much less common (28 percent of farms). In the Lac la Biche region, more farms use herbicides than use fertilizers.

8.7.1 Herbicides

Farmers who were surveyed use about 30 different types of herbicides. Ten of these are used by at least 10 percent of farms that use herbicides. Respondents sometimes listed these herbicides by trade names and other times by active ingredient. Herbicides include: Round-Up, MCPA Amine, Poast, Lontrel, 2,4-D, Treflan, Edge, Triumph, Avenge and Assert. Table 8-10 summarizes the proportion of farms that use these chemicals.

Table 8-11 shows the percentage of farms in the major agricultural regions that use six of the most common types of herbicides. The table shows that Round-Up is the herbicide of choice in five of the eight regions while MCPA Amine is most used in three regions. All six types of herbicides are used in the Upper Peace and Lower Peace regions. Five of the six most common brands of herbicides are used in five of the six regions.

Farmers were also asked to describe typical herbicide application rates for these herbicides but survey results were rather confusing when compared to the recommended application rates based

on the amount of active ingredient applied per acre. The application rates reported by farmers and the rates recommended by AAFRD are listed below:

Herbicide	Average Reported Rate	Typical Reported Range	Recommended Range
Round-Up	57 litres per acre	40 to 100 litres per acre	0.45 to 2.00 litres per acre
MCPA Amine	73 litres per acre	40 to 50 litres per acre	0.28 to 1.70 litres per acre
Lontrel	21 litres per acre	5 to 12 litres per acre	0.17 to 0.34 litres per acre
Poast	102 litres per acre	100 to 200 litres per acre	0.32 to 1.09 litres per acre
2,4-D	98 litres per acre	50 to 200 litres per acre	0.20 to 1.70 litres per acre
Treflan	133 litres per acre	100 to 200 litres per acre	0.61 to 1.20 litres per acre

This comparison indicates that farmers reported application rates that are approximately 100 times the recommended rate. Part of the difference relates to how this information was reported. These herbicides are sold as concentrates that are mixed with water before application, so farmers may have reported the total volumes being applied rather than the amount of active ingredient. Even so, typical dilution rates are about 40 parts water to one part herbicide so this only explains part of the difference. AAFRD also indicated that, farmers often apply herbicides at rates below the recommended rate, due to cost.

8.7.2 Other pesticides

Only five percent of farm operations use other types of pesticides. These include less than eight percent of both mixed and grain/oilseed farms. The highest incidence of use of other pesticides is reported by farms in the Lower Peace and Smoky/Wapiti regions.

Farmers who responded to the survey mentioned six different pesticide brands. Each brand was identified by one respondent. These other pesticides include: nequvon, diagnon, malathion, vitavax, lysoff, and rotomo.

8.7.3 Fertilizers

The majority (56 percent) of farms in the basins use fertilizers. Table 8-9 shows that use of fertilizers is highest in the regions along the Peace River while Table 8-8 indicates that grain/oilseed farms are most likely to use fertilizers.

Farmers were asked to identify the types of fertilizers used and typical application rates. Interpretation of survey responses was complicated by the fact that some respondents identified specific types of fertilizer mixes, while others mentioned only one nutrient in fertilizer (nitrogen, for example). Fertilizers are sold as various blends of four nutrients: nitrogen (N), Phosphorous (P_2O_5), potassium (K), and sulphur (S). Fertilizer blends are described in terms of the percentage, by weight, in the following order: N- P_2O_5-K-S.

The majority of farmers who use fertilizers simply reported that they use a nitrogen fertilizer, with no details on the other nutrients. Nearly 49 percent of mixed farms and 28 percent of grain/oilseeds farms that use fertilizers gave this response.

Other farmers who use fertilizer mentioned 26 different blends of fertilizers. Three of these blends are used by at least 10 percent of farm operations that use fertilizers. These blends include: 27-14-0-0, 11-52-0-0, and anhydrous ammonia (82-0-0-0). The proportion of farms using these three types of fertilizers is summarized in Table 8-12.

Table 8-13 shows which of these three fertilizer blends are used in the major farming regions in the study area. The 27-14-0-0 blend is used most extensively by farms in the Lesser Slave, Upper Peace and Lower Peace regions. Farms in the Middle Peace and Lac la Biche regions prefer to use a 11-52-0 blend. The highest use of anhydrous ammonia occurs in the Upper and Lower Peace regions. In contrast, farms in the Upper Athabasca, Lower Athabasca, Slave River/Delta, Wabasca and Lac la Biche regions reported no use of fertilizers.

Table 8-13

Regional Distribution of Common Types of Fertilizers in the Northern River Basins
(Percent of Farms Using Fertilizers)

Region	27-14-0-0	11-52-0-0	Anhydrous Ammonia
Middle Athabasca	8.3%	8.3%	8.3%
Upper Peace	44.4%	11.1%	27.2%
Middle Peace	18.2%	27.3%	9.1%
Lower Peace	41.2%	0.0%	17.6%
Smoky/Wapiti	27.3%	9.1%	9.1%
Lesser Slave	100.0%	28.6%	0.0%
Pembina/Macleod	17.6%	11.8%	11.8%
Lac la Biche	0.0%	25.0%	0.0%

Table 8-14

Common Manure Disposal Practices by Farms in the Northern River Basins
(Percent of Farms With Manure)

Farm Type	Spread	Compost	Sell
Grains/Oilseeds	20.0%	80.0%	0.0%
Mixed Farms	83.6%	13.7%	2.7%
Livestock	85.0%	12.5%	2.5%
Specialty	100.0%	0.0%	0.0%

Table 8-15

Regional Manure Disposal Practices in the Northern River Basins
(Percent of Farms With Manure)

Region	Spread	Compost	Sell
Middle Athabasca	100.0%	0.0%	0.0%
Upper Peace	57.1%	28.5%	14.3%
Middle Peace	60.0%	40.0%	0.0%
Lower Peace	85.7%	14.3%	0.0%
Smoky/Wapiti	66.7%	22.2%	11.0%
Lesser Slave	87.5%	12.5%	0.0%
Pembina/Macleod	89.7%	10.3%	0.0%
Lac la Biche	81.8%	18.2%	0.0%

Fertilizer application rates are relatively consistent among two of the three most commonly used blends of fertilizers. As shown below, typical application rates reported by farmers ranged between 22 and 29 kilograms per acre, with the exception of 11-52-0 which is typically applied at rates of 50 to 100 kilograms per acre.

Fertilizer	Average Rate	Typical Range
27-14	23 kilograms per acre	15 to 25 kilograms per acre
11-52-0	75 kilograms per acre	50 to 100 kilograms per acre
Anhydrous Ammonia	29 kilograms per acre	18 to 27 kilograms per acre

These application rates describe the total weight of fertilizers being applied rather than the weight of the specific nutrients in the fertilizer blend.

8.8 Manure Disposal

Farmer who raise livestock identified three common methods for disposing of manure. The most common method of disposal is to spread the manure onto fields. Spreading manure is the disposal method of choice on about 85 percent of mixed and livestock farms -- see Table 8-14. Table 8-15 shows that this practice is common throughout the basin, especially in the tributary regions. Composting of manure is the most popular manure disposal practice on grain/oilseed farms, but is relatively unusual on other types of farm operations. The highest incidence of composting is reported by farms in the Middle Peace region. The third method for disposing of manure is to sell it. Only two or three percent of mixed and livestock farms sell manure.

Table 9-1

Summary of Licenced Industrial Water Use, 1995
(Amounts in Acre-Feet)

Water Source		Athabasca Basin	Peace Basin	Slave Basin	Total	Percent
Surface Water	Licences	178	77	6	261	29.1%
	Amount	287,017	109,214	2,020	398,251	92.5%
Ground Water	Licences	416	277	19	635	70.9%
	Amount	17,827	13,016	1,524	32,367	7.5%
Total Water	Licences	594	277	25	896	100.0%
	Amount	304,844	122,230	3,544	430,618	100.0%
Percent of Total	Licences	66.3%	30.9%	2.8%	100.0%	
	Amount	70.8%	28.4%	0.8%	100.0%	

Table 9-2

Allocation of Licenced Industrial Water Use According to Major Purpose, 1995

Purpose	Athabasca Basin	Peace Basin	Slave Basin	Total
Processing	61.7%	67.6%	20.2%	62.8%
Cooling	18.2%	10.9%	1.6%	16.2%
Injection	14.7%	10.8%	60.5%	14.1%
Washing	0.5%	1.5%	0.0%	0.7%
Steam	0.5%	0.4%	0.0%	0.5%
Other	4.4%	8.8%	17.7%	5.7%
Total	100.0%	100.0%	100.0%	100.0%

9.0 INDUSTRIAL WATER USE

A significant portion of consumptive water use in the northern river basins is for industrial purposes. Many of these industrial operations have their own water licences. A few, small industrial water users obtain their water from municipal water systems. In order to learn about industrial water use, a survey of companies holding water licences was undertaken. These companies range from large oil and gas producers to small sand and gravel enterprises. Operations that use groundwater or surface water were included in the survey.

9.1 Status of Industrial Water Use

A review of the water licence files maintained by Alberta Environmental Protection indicates that 95 companies were holding 896 water licences that allow them to use water in the northern river basins in Alberta for various industrial purposes. The water allocated under these licences amounts to 430,618 acre-feet (531,167 cubic decametres) per year. As shown in Table 9-1, 71 percent of the licenced allocation of water is from sources in the Athabasca River basin while 28 percent comes from sources in the Peace River basin. The vast majority of this water (92 percent) comes from surface water sources with the balance (eight percent) coming from groundwater. Water licences issued for the Slave River basin account for less than one percent of industrial water allocations in the northern river basins.

Industrial water licences are issued for a variety of purposes. The amounts of water allocated to six of the major classifications are summarized in Table 9-2. The data show that water used for industrial processing, including pulp mills and gas plants, accounts for 62 percent of allocations in the Athabasca basin and 68 percent of allocations in the Peace basin. The second most-important water use is for cooling purposes, including the oil sands plants and thermal power production. This use accounts for 18 percent of allocations in the Athabasca basin and 11 percent in the Peace basin. Some water is injected into the ground to help recover oil. Such uses account for 14 percent of allocations in the basin, and represent the most important industrial use

Table 9-3

Summary of Licenced Industrial Water Use by Water Source, 1995

Purpose	Surface Water	Ground-water	Total
Processing	67.7%	5.7%	62.8%
Cooling	17.2%	4.1%	16.2%
Injection	14.5%	9.2%	14.1%
Washing	0.1%	7.8%	0.7%
Steam	0.0%	6.3%	0.5%
Other	0.4%	66.9%	5.7%
Total	100.0%	100.0%	100.0%

Table 9-4

Summary of Licenced Industrial Water Use From Mainstem Sources, 1995
(Amounts in Acre-Feet)

Water Source:		Athabasca	Peace	Slave	Total
River Mainstems	Licences	17	10	0	27
	Amount	223,560	33,850	0	257,410
Total Water in Basin	Licences	594	277	25	896
	Amount	304,844	122,230	3,544	430,618
Importance of River Mainstems	Licences	2.9%	3.6%	0.0%	3.0%
	Amount	73.3%	27.7%	0.0%	59.8%

of water in the Slave River basin. Water used for gravel washing, steam processing for oil and gas operations, and various other uses are of minor importance in the basin.

The source of water being used for the six classes of industrial purposes is summarized in Table 9-3. This table shows that surface water is used almost exclusively for processing, cooling and injection purposes. These three uses of surface water account for 91.5 percent of all industrial water allocations in the basins. Groundwater is used for all six types of industrial use and is the dominant water source for washing, steam and other purposes.

The mainstems of the Athabasca and Peace rivers provide much of the water used for industrial purposes. Although only 27 water licences have been issued to companies that draw water directly from these rivers, these licences are for 257,410 acre-feet of water. This represents almost 60 percent of all licenced water use in the basin. There are no allocations of water for industrial purposes from the mainstem of the Slave River.

As shown in Table 9-4, some 223,560 acre-feet of water from the mainstem of the Athabasca River have been allocated for industrial purposes. The 17 licences represent 73 percent of all industrial water allocations in the Athabasca basin. The other key river for industrial water allocations in the Athabasca basin is the Lesser Slave River. Twelve licences for 13,748 acre-feet of water from the Lesser Slave River have been issued.

Water allocations from the Peace River are relatively small when compared to the Athabasca River. Allocations from the Peace River amount to only 33,850 acre-feet or 28 percent of the basin total. Some of the largest industrial water users in the Peace basin are located on the major tributaries to the Peace River. These include the Smoky River (three licences for 10,200 acre-feet) and the Wapiti River (seven licences for 33,502 acre-feet).

Table 9-5

Comparison of Sample Data With Total Industrial Water Use
(Amounts in Acre-Feet)

Basin	Source		Sample	Total	Percent
Athabasca	Surface Water	Licences	20	178	11.2%
		Amount	129,324	287,017	45.1%
	Ground-water	Licences	126	416	30.3%
		Amount	3,953	17,827	50.5%
Peace	Surface Water	Licences	25	77	32.5%
		Amount	99,267	109,214	22.2%
	Ground-water	Licences	109	200	54.5%
		Amount	8,472	13,016	65.1%
Slave	Surface Water	Licences	3	6	50.0%
		Amount	120	2,020	5.9%
	Ground-water	Licences	2	19	10.5%
		Amount	75	1,524	4.9%
Total	Surface Water	Licences	48	261	18.4%
		Amount	228,711	398,251	57.4%
	Ground-water	Licences	237	635	37.3%
		Amount	12,500	32,367	38.6%

9.2 Industrial Water Use Survey

Forty-four of 95 companies responded to the Industrial Water Use Survey undertaken for the Northern River Basins Study. While this represents a 46 percent response rate to the survey, each company may have several water licences from one or more sources in the basin. This means that sample results may not be representative of all licenced industrial water users in the basin.

As shown in Table 9-5, the companies that responded to the survey hold a total of 285 water licences (32 percent of total licences) having a total allocation of 241,211 acre-feet. This represents 56 percent of the total industrial allocation in the basin.

Table 9-5 suggests that the sample contains information from some of the larger operations that use surface water, and that companies holding small surface water licences, especially in the Athabasca basin, are under-represented in the survey. Industrial operations that use groundwater and responded to the survey also use slightly more water than the overall average for the region. In addition, the overall sample contains more examples of surface-water users than actually occurs in the basin. Thus, the survey results reflect information from the larger, surface-water users rather than being a representative sample of all industrial operations in the northern basins.

9.2.1 Type and location of industries

Survey responses came from companies operating in five major industrial sectors. These are as follows:

1. Oil and gas - These are companies that extract and process oil and natural gas, including condensates, from conventional reserves, sometimes producing sulphur as a by-product. The survey includes 18 companies in this sector.
2. Oilfield injection - Twelve companies use water for injection down wells to recover oil and gas that cannot be extracted using conventional methods.

Table 9-6

Location of Industrial Activity by Basin as Reported by Survey Respondents
(Percent of Companies From Each Sector)

Sector	Athabasca Basin	Peace Basin	Slave Basin
Oil and Gas	52.9%	35.3%	11.8%
Oilfield Injection	58.3%	43.7%	0.0%
Forest Industries	66.7%	33.3%	0.0%
Mineral Extraction	50.0%	50.0%	0.0%
Power Production	0.0%	100.0%	0.0%
Total	58.6%	36.6%	4.9%

Table 9-7

Duration of Operations for Companies in Major Industrial Sectors
(Percent of Companies From Each Sector)

Sector	1 to 5 Years	5 to 10 Years	10 to 15 Years	15 to 20 Years	Over 20 Years
Oil and Gas	11.1%	16.7%	33.3%	11.1%	27.8%
Oilfield Injection	33.3%	41.7%	0.0%	8.3%	16.7%
Forest Industries	0.0%	33.3%	0.0%	0.0%	66.7%
Mineral Extraction	11.1%	11.1%	22.2%	11.1%	44.4%
Power Production	0.0%	0.0%	0.0%	0.0%	100.0%
Total	16.3%	23.3%	18.6%	9.3%	32.6%

Table 9-8

Size of Companies in Major Industrial Sectors
(Percent of Companies From Each Sector)

Sector	Less Than 10 Employees	10 to 25 Employees	26 to 50 Employees	51 to 100 Employees	101 to 200 Employees	Over 200 Employees
Oil and Gas	22.2%	22.2%	22.2%	11.1%	0.0%	22.2%
Oilfield Injection	66.7%	16.7%	0.0%	8.3%	8.3%	0.0%
Forest Industries	0.0%	0.0%	0.0%	0.0%	33.3%	66.7%
Mineral Extraction	37.5%	37.5%	0.0%	0.0%	12.5%	12.5%
Power Production	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%
Total	35.7%	23.3%	9.5%	9.5%	7.1%	16.7%

3. Forest industries - This sector includes three companies that produce pulp and paper, lumber and/or oriented strand board (OSB).
4. Mineral extraction - Nine companies that responded to the survey are involved in mineral extraction. These include coal mines and the oil sands plants, as well as operations that produce sand, aggregates and concrete.
5. Power Production - This sector includes the only thermal electric power plant in the basin.

The geographical distribution of the companies in each sector is presented in Table 9-6. The majority of companies are located in the Athabasca basin. Between one-third and one-half of companies are located in the Peace basin, which also contains the only thermal power plant in the basin. The only reported industrial activity licenced to use water in the Slave basin is oil and gas development.

Licenced industrial water users are located in nine of the 12 regions used for the household survey. Industrial water users are found in all regions of the NRBS except the Lower Peace, Slave River/Delta and Lac la Biche regions. Fifty-seven percent of all industrial users are located in the Smoky/Wapiti, Pembina/Macleod and the Upper Athabasca regions. Only one company is located in the Wabasca region.

The Upper Athabasca region contains the greatest range of industrial activities, followed by the Smoky/Wapiti region. While oil and gas companies are operating in all regions, mining extraction activities are present in the Upper and Middle Athabasca, Upper Peace, Smoky/Wapiti and the Pembina/Macleod regions. Forestry activities are located in the Upper Athabasca (pulp, paper and logging) and the Smoky/Wapiti (pulp, paper, logging, and lumber) regions. The thermal power plant is located in the Smoky/Wapiti region.

Table 9-9

Use of Water Allocations by Companies in Major Industrial Sectors
(Percent of Companies From Each Sector)

Sector	Water Source:	Under 20%	21% to 40%	41% to 60%	61% to 80%	80% to 100%
Oil and Gas	Surface	37.5%	0.0%	12.5%	25.0%	25.0%
	Ground	18.2%	18.2%	18.2%	27.3%	18.2%
Oilfield Injection	Surface	50.0%	0.0%	0.0%	25.0%	25.0%
	Ground	30.0%	10.0%	10.0%	20.0%	30.0%
Forest Industries	Surface	0.0%	0.0%	33.3%	66.7%	0.0%
	Ground	100.0%	0.0%	0.0%	0.0%	0.0%
Mineral Extraction	Surface	0.0%	25.0%	0.0%	25.0%	50.0%
	Ground	16.7%	0.0%	16.7%	16.7%	50.0%
Power Production	Surface	0.0%	100.0%	0.0%	0.0%	0.0%
Total		25.0%	10.4%	12.5%	29.2%	22.9%

Table 9-10

Use of Water by Companies in Major Industrial Sectors
(Percent of Water Used)

Sector	Processing	Cooling	Sanitation	Other
Oil and Gas	65.3%	12.8%	15.6%	6.3%
Oilfield Injection	0.0%	0.0%	0.4%	99.6%
Forest Industries	58.7%	34.7%	6.7%	0.0%
Mineral Extraction	76.1%	0.0%	12.8%	11.1%
Power Production	30.0%	70.0%	0.0%	0.0%
Total	46.3%	9.1%	9.2%	35.4%

9.2.2 Years of operation and company size

Almost one-third of industrial operators have been active in the NRBS area for over 20 years -- see Table 9-7. This includes the majority of the forest industry operations plus the thermal power plant. The most important new industrial use of water is oilfield injection, with 75 percent of companies in this sector operating in the basin for 10 years or less.

The companies that responded to the survey are either very big (24 percent have more than 100 employees) or very small (36 percent have less than 10 employees). The very large companies are in the forest industry or are involved in mineral extraction, especially the coal mines and oil sands plant. In comparison, the oilfield injection companies are quite small, with 83 percent having less than 25 employees. Only the thermal power plant has a medium-sized workforce.

9.2.3 Use of water

Not all of the water allocated under a water licence is actually used. Table 9-9 shows the extent to which companies in the different sectors actually use their licenced allocations of water. Only about 23 percent of operators use anywhere near the full amount of their licences, and these are primarily industries involved in mineral extraction. The majority of companies in the forest industries use between 61 and 80 percent of their surface water licences. Companies involved in oil and gas development, including oilfield injection, show considerable variability in terms of the amount of licenced water actually used. A large proportion of these operations use less than 20 percent of licenced amounts, while about half of them use 61 percent or more of licenced water from both surface and groundwater sources.

9.2.4 Water use characteristics

Nearly half (46 percent) of the water used by companies that responded to the survey is used for processing purposes. As shown in Table 9-10, the proportion of water used for processing is very high for the oil and gas sector (processing plants) and the forest industry (pulp mills).

Table 9-11

Proportion of Water Recycled by Companies in Major Industrial Sectors
(Percent of Companies From Each Sector)

Sector	Under 20%	21% to 40%	41% to 60%	61% to 80%	80% to 100%
Oil and Gas	58.3%	8.3%	0.0%	0.0%	33.3%
Oilfield Injection	66.7%	0.0%	0.0%	0.0%	33.3%
Forest Industries	0.0%	0.0%	33.3%	33.3%	33.3%
Mineral Extraction	22.2%	0.0%	11.1%	0.0%	66.7%
Power Production	0.0%	0.0%	0.0%	0.0%	100.0%
Total	41.9%	3.2%	6.5%	3.2%	45.2%

Table 9-12

Proportion of Water Returned to Water Bodies by Companies in Major Industrial Sectors
(Percent of Companies From Each Sector)

Sector	Under 20%	21% to 40%	41% to 61%	61% to 80%	80% to 100%
Oil and Gas	93.3%	0.0%	0.0%	6.7%	0.0%
Oilfield Injection	100.0%	0.0%	0.0%	0.0%	0.0%
Forest Industries	0.0%	0.0%	0.0%	33.3%	66.7%
Mineral Extraction	44.4%	0.0%	0.0%	11.1%	44.4%
Power Production	100.0%	0.0%	0.0%	0.0%	0.0%
Total	73.5%	0.0%	0.0%	8.8%	45.2%

Table 9-13

Treatment of Water Returned to Water Bodies by Companies in Major Industrial Sectors
(Percent of Companies From Each Sector)

Sector	Water Treated Before Returned	Primary Treatment	Secondary Treatment
Oil and Gas	50.0%	83.3%	16.7%
Oilfield Injection	20.0%	100.0%	0.0%
Forest Industries	100.0%	100.0%	0.0%
Mineral Extraction	37.5%	100.0%	0.0%
Power Production	100.0%	100.0%	0.0%
Total	48.3%	93.3%	6.7%

Relatively small amounts of water are used for cooling or for sanitation purposes. The proportion of water used for cooling is highly significant for thermal-power production, and of lesser importance for the forest industry. Table 9-10 also shows that almost 100 percent of water being used by companies involved in oilfield injection is for other purposes. These other purposes include oilfield injection and maintaining pressure in oil formations.

Most companies reported that they recycle either almost all of their water or very little of their water. Low recycle rates are reported by more that half of companies in the oil and gas, and oilfield injection sectors. On the other hand, more than two-thirds of companies involved in mineral extraction and power production recycle more than 80 percent of their water. Forest industries show the highest variability in recycling rates. Table 9-11 shows that recycle rates for the forest industry range between 60 percent and 100 percent.

9.2.5 Water discharge and treatment

Companies in the five sectors are significantly different in terms of the amount of water discharged back to surface-water bodies. Companies in the forest industries and mineral extraction sectors discharge more than 60 percent of the water they use -- see Table 9-12. In contrast, between 90 and 100 percent of oil and gas, and oilfield-injection companies return less than 20 percent of their water back to surface-water bodies. Very low return flow is also reported by the thermal power plant plus 44 percent of companies involved in mineral extraction.

Nearly half of companies that return water back to surface sources treat it first. As shown in Table 9-13, this ranges from 100 percent of forest industries and the thermal power plant to only 20 percent of companies using water for oilfield injection. In nearly all cases, water treatment is limited to primary or mechanical treatment to remove solids. A few companies in the oil and gas sector (17 percent) use secondary treatment, which involves biological treatment of wastes.

Table 9-14

Changes in Water Use by Companies in Major Industrial Sectors
(Percent of Companies From Each Sector)

Sector	Changes Observed in Past 10 Years	Changes Expected in Next 10 Years
Oil and Gas	5.6%	38.9%
Oilfield Injection	0.0%	16.7%
Forest Industries	66.7%	66.7%
Mineral Extraction	0.0%	0.0%
Power Production	0.0%	0.0%
Total	7.0%	25.6%

9.2.6 Changes in water use

Only seven percent of companies have observed any changes in the quality or quantity of their raw-water supply during the past 10 years. These include one company in the oil and gas sector and two forest industry companies -- see Table 9-14. The majority of these companies are operating in the Peace River basin. However, the nature of the observed changes in water quality or quantity was not specified.

Very few changes in future industrial water demands are anticipated. About 25 percent of operations expect that their water quality or quantity requirements will change in the next 10 years. The majority of these companies are in the oil and gas sector. Two of three forest industry companies also indicated that their water-use requirements might change. About half of the companies anticipating changes in their water requirements are located in the Athabasca Basin. The majority of companies (60 percent), mainly in the oil and gas sector, are expecting a decline in water use. The remainder, especially those in the forest industry, expect to increase their demands for water.

9.2.7 Summary

The survey results for industrial water use by companies in each of the five sectors can be summarized as follows:

1. Oil and gas - These companies are located mainly in the Athabasca basin, with the majority operating for more than 10 years and employing fewer than 50 people. Between 45 to 50 percent of these companies use 60 percent or more of their water allocation, with 65 percent of this water being used for processing. Two-thirds of these companies recycle less than 40 percent of their water, and less than 20 percent is returned to surface-water bodies, with about half of this water being treated first.

2. Oilfield injection - The majority of these operations are located in the Athabasca basin, and 75 percent have been operating for less than 10 years. These companies tend to be quite small with two-thirds having less than 10 employees. Half of the companies use more than 60 percent of their allocation while 30 to 50 percent use less than 20 percent of their licences. Almost all water is injected for oil recovery with less than 20 percent of water being recycled in most cases. Less than 20 percent of water is returned to surface-water sources and only 20 percent is treated.

3. Forest industries - These are large companies with more than 100 employees and are located mainly in the Athabasca basin. Two-thirds of companies have been operating for more than 20 years. These companies use between 40 and 80 percent of their surface-water allocations, mainly for processing and partly for cooling. In excess of 40 percent of water is recycled, and more than 60 percent is returned after being treated.

4. Mineral extraction - These companies are split between the Peace and Athabasca basins. Three-quarters of the operations have less than 25 employees while the remainder have in excess of 100 employees. Half of the companies have operated in the area for more than 20 years. These companies use about two-thirds of their water allocations, with about 75 percent being used for processing. Two-thirds of these operations recycle more than 80 percent of their water. Less than 20 percent of water is returned by almost half the companies while the remainder return at least 60 percent. Only 38 percent of return flow is treated first.

5. Power Production - One plant is located in the Peace basin and has been operating for more than 20 years. This plant uses between 21 and 40 percent of its allocation, mostly (70 percent) for cooling. Between 80 and 100 percent of water is recycled, but less than 20 percent is returned after being treated.

9.3 Other information sources

The survey information is consistent with another assessment of industrial water use that was conducted by Alberta Environmental Protection. This other study was conducted in collaboration with Environment Canada as part of a national initiative to quantify industrial water use during 1991. A total of 359 companies in Alberta were asked to complete surveys and the results for companies operating in the Athabasca and Peace (including the Slave) basins are summarized in Table 9-15.

Water use by industries in the basin was estimated to be 115,502 acre-feet in 1991. This represents only 28 percent of the water allocated through industrial licences. This partly demonstrates that industries only use a portion of their licences but also reflects that not all the industries operating in the basin responded to the survey. Based on this estimate of water use, companies in the Peace and Athabasca basins account for about 18 percent of all industrial water use in Alberta.

Table 9-15 shows that the vast majority of industrial water use comes from surface-water sources. It also shows that much of this water is recycled several times before being discharged. Gross water use is nearly four times greater than water withdrawals. The table also shows that 72 percent of water is discharged after use. Net industrial water consumption is estimated to be about 32,600 acre-feet or 28 percent of water withdrawals.

Table 9-15

Industrial Water Use Statistics, 1991

	Source	Athabasca Basin		Peace Basin		Total Area	
		Amount	Percent of Intake	Amount	Percent of Intake	Amount	Percent of Intake
Intake	Surface	50,909	90.6%	56,248	89.8%	104,157	90.2%
	Ground	4,555	8.1%	4,594	7.7%	9,149	7.9%
	Other	753	1.3%	1,442	2.4%	2,195	1.9%
	Total	56,217	100.0%	59,285	100.0%	115,502	100.0%
Recirculation		233,296	415%	94,289	159%	327,585	284%
Gross Usage		289,513	515%	153,574	259%	443,087	384%
Discharge	Surface	41,051		39,575		80,626	
	Ground	392		1,878		2,270	
	Other	4		5		9	
	Total	41,447	73.7%	41,458	69.9%	82,905	71.8%
Consumption		14,770	26.3%	17,827	30.1%	32,597	28.2%

Source: Alberta Environmental Protection, 1994. Alberta Industrial Water Use Survey 1991

10.0 COMMERCIAL RECREATION

Another group of people that use and rely on the aquatic resources of the northern river basins are commercial recreation companies. These companies provide various services to tourists and recreationists, and their livelihood can be directly affected by changes in how the water resources of the basin are managed. This group includes companies that run fish camps, offer guiding services, or conduct tours.

A list of commercial recreation companies operating in the basin was developed as part of earlier studies undertaken for the NRB Study. The list was compiled from various data sources, including trade magazines and Alberta Economic Development and Tourism. A total of 51 commercial recreation companies were found to operate in the basin, and these companies were surveyed to provide information about their use of the aquatic resources of the basin and the water-management issues of greatest concern.

Responses were received from 16 of these companies. This represents a response rate of 31 percent. Although the number of responses is small, the accuracy of the data is reasonably high because responses were received from about one of every three known commercial recreation companies in the basin.

10.1 Business Profile

The commercial recreation companies that responded to the survey are located in six of the 12 regions used for the household survey. As shown in Figure 10-1, these regions include the Middle Peace region (25 percent of companies), the Lower Athabasca (19 percent), the Upper Athabasca (19 percent), the Upper Peace (19 percent), the Slave River/Delta (12 percent) and the Smoky/Wapiti (six percent).

Figure 10-1

Location of Commercial Recreation Companies

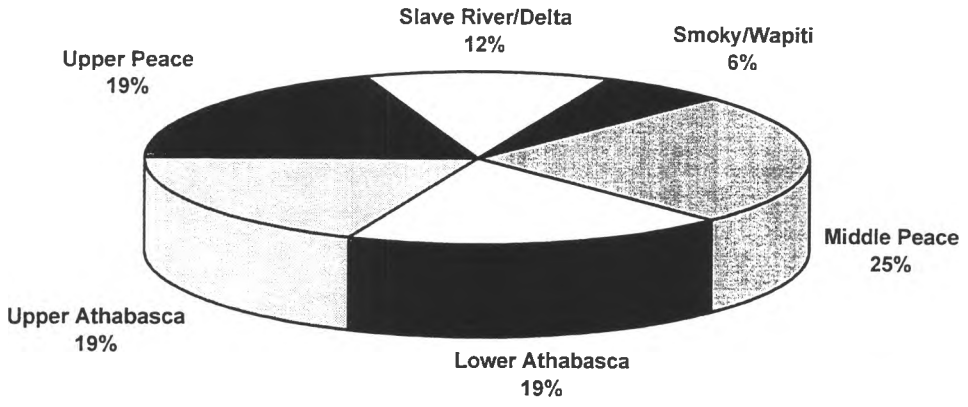


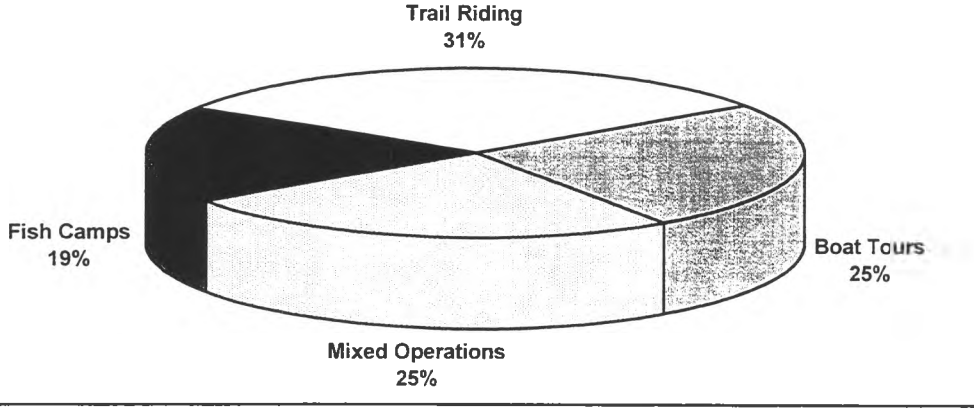
Table 10-1

Recreational Activities Provided by Commercial Recreation Companies
(Percent of Companies)

	Fishing	Boating	Horse Riding	Canoeing	Hunting	Accom-modation
Fish Camps	100.0%	33.3%	0.0%	0.0%	33.3%	0.0%
Boat Tours	0.0%	100.0%	0.0%	33.3%	0.0%	0.0%
Trail Riding	0.0%	0.0%	100.0%	40.0%	20.0%	0.0%
Mixed Operations	25.0%	50.0%	50.0%	0.0%	25.0%	50.0%

Figure 10-2

Types of Commercial Recreation Companies



Analysis of the types of recreation and tourism services provided by these companies suggests four different types of operations. These include:

1. fish camps, where fishing accounts for at least 50 percent of the company's business. Other activities include boating and hunting;
2. river tours and boat trips, where companies offer jet boat trips or organized canoe trips;
3. trail riding, where companies provide guided trips by horseback, sometimes for hunting. Some of these companies also offer canoe tours; and,
4. mixed operations that offer accommodation as well as a variety of summer and winter recreational activities, including fishing, boating, hunting, cross-country skiing, and eco-tourism.

Table 10-1 shows the types of recreational activities and facilities offered by companies in each of these categories. Although there are some overlaps in terms of the range of activities provided, the majority of business for specialty companies comes from one major activity.

Based on these classifications, Figure 10-2 shows that 31 percent of companies that responded to survey are trail-riding operations. Another 25 percent provide river tours and boat trips. About 19 percent are fish camps. The remaining 25 percent of businesses are mixed operations. The location of these operations within the study area is summarized in Table 10-2. The majority of the companies offering boat tours are located in Peace River. Two of the trail-riding operations are located in Brule. Two companies operate out of Fort Smith and include a fish camp and one mixed operation.

Most commercial recreation companies are quite small. The majority of businesses (87 percent) have less than 10 employees during the peak season of operation -- see Figure 10-3. Only one operator has more than 20 employees. The majority of fish camps and river-tour operations have less than five employees. Companies that provide a mixed of recreation facilities typically have more employees than most other operations.

Table 10-2

Geographical Distribution of Commercial Recreation Companies
(Percent of Companies)

	Fish Camps	Boat Tours	Trail Riding	Mixed Operations
Upper Athabasca	0.0%	0.0%	40.0%	25.0%
Lower Athabasca	66.7%	25.0%	0.0%	0.0%
Upper Peace	0.0%	0.0%	40.0%	25.0%
Middle Peace	0.0%	75.0%	0.0%	25.0%
Slave River Delta	33.3%	0.0%	0.0%	25.0%
Smoky/Wapiti	0.0%	0.0%	20.0%	0.0%

Figure 10-3

Size of Commercial Recreation Companies, Based on Number of Employees

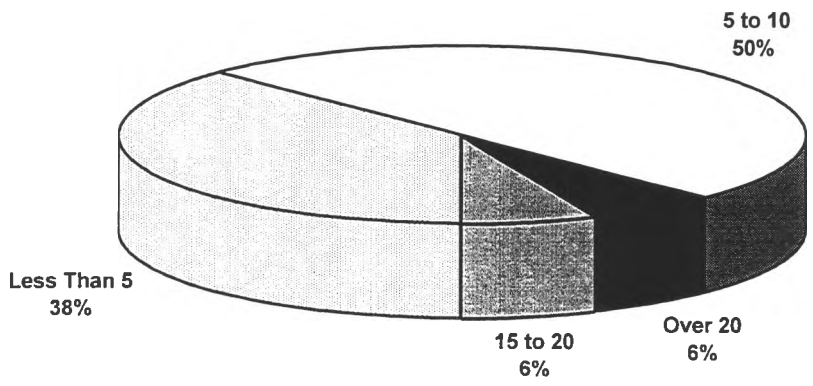
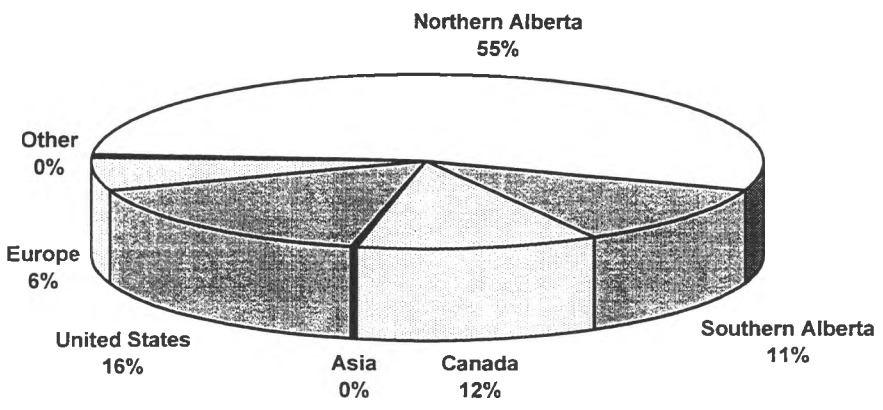


Figure 10-4

Origin of People Using Commercial Recreation Companies



The majority of commercial recreation companies (56 percent) have been operating for more than 10 years. These long-term operators include all of the fish camps and all of the companies that offer trail riding. In comparison, all of the companies offering river-touring services have been operating for less than 10 years. While most mixed operations have been operating for less than five years, one company has been in operation for more than 15 years.

10.2 Annual Use and Visitation

The number of people using commercial recreation services and facilities varies among operations. Nearly half of all operations (46 percent) have less than 200 visitors per year. A similar percentage or companies have between 200 and 800 visitors. One operator reports having 12,000 visitors per year.

For all but the largest operator, average visitation amounts to about 255 (±55) visitors per year. On the assumption that most (over 90 percent) of the 51 commercial recreation companies in the northern river basin are small, it is estimated that about 50,000 people use the services or facilities provided by these operations.

Commercial recreation companies draw visitors from all over the world. Figure 10-4 shows that the bulk of visitors (54 percent) are residents of northern Alberta and southern NWT. Another 11 percent come from the rest of Alberta. People from other parts of Canada account for about 12 percent of the customers of these operations, while people from the United States account for 16 percent. Less than seven percent of visitors come from outside North America. Most of these are from Europe (six percent of total visitors) with a few people coming from Asia and other parts of the world.

There are some slight differences in the origin of people using the different type of operations. Fish camps attract people from North America, with only 24 percent coming from southern Alberta and 22 percent coming from the United States. Companies doing river tours have very few users from outside the province. Nearly 72 percent of their customers are from northern

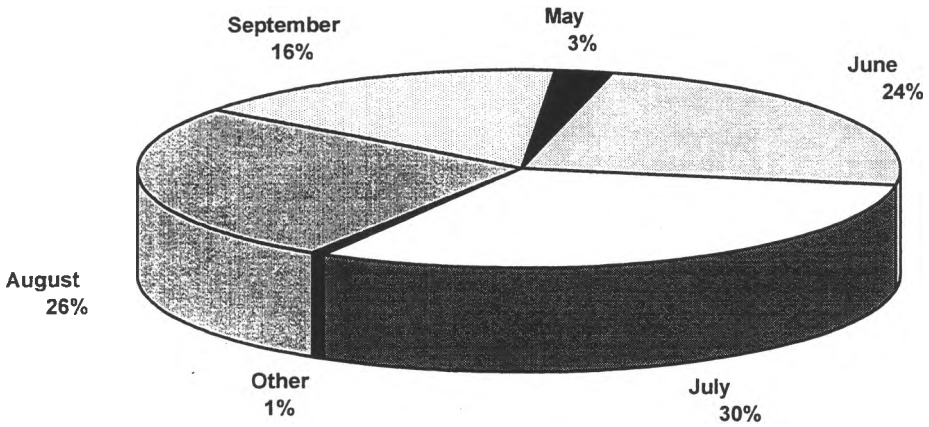
Table 10-3

Seasonal Use of Commercial Recreation Operations
(Percent of Annual Use)

Month	Fish Camps	River Tours	Trail Riding	Mixed Operations	Total
January to April	0.0%	0.0%	1.0%	6.4%	0.3%
May	6.7%	1.8%	1.0%	4.4%	2.7%
June	51.3%	17.5%	14.4%	20.9%	23.8%
July	21.7%	31.6%	35.6%	26.9%	30.9%
August	4.3%	28.1%	33.7%	26.9%	26.0%
September	16.0%	21.1%	14.4%	7.1%	16.0%
October to December	0.0%	0.0%	0.0%	7.4%	0.3%

Figure 10-5

Seasonal Use of Commercial Recreation Operations
(Percent of Annual Use)



Alberta and 15 percent are from southern Alberta. Companies offering trail riding attract numerous customers from other parts of Canada; these people account for 23 percent of their customers.

July is the peak month for commercial recreation companies. About 31 percent of visitors use the facilities during this month. June and August are also important, with 24 percent and 26 percent of customers, respectively. Table 10-3 shows that seasonal-use patterns vary according to the type of operation. Fish camps reported that the majority of their customers use their facilities in June, and use tapers off during the summer and rebounds in September. Mixed operations are often open year-round and provide accommodation and winter sports. Thus, the summer peaks are not as significant and 25 percent of visitation occurs between October and April.

More than 83 percent of companies reported an increase in business activities during the last 10 years. Only 40 percent of companies that offer trail riding reported a decline. The increases in business are due to promotion of their businesses (63 percent of responses), increased numbers of tourists passing through the region (25 percent) and more demands for wilderness-based experiences (12 percent). Two of the businesses are in their first years of operations.

Most operators are expecting an increase in business activity over the next 10 years. About 80 percent of companies, including all companies offering river tours, predict an increase in the number of people using their services. The reasons for this include more promotion, increasing demands for their products, and implementation of a training program to improve services. A small number of operators (13 percent) expect their businesses to stay the same. They expressed an interest in maintaining quality and are content with current levels of use.

10.3 Major Recreation Sites

Several key recreational areas are used by commercial recreation operations. While fish camps are located on individual lakes within the study area, companies operating boat tours use two key

rivers. Much of the boat tour business, involving trips lasting one day or less, occurs on the Peace River, near the Town of Peace River. The Clearwater River is also important both for river tours, especially canoe trips lasting four to seven days.

The majority of trail-riding companies are located in the upper reaches of the Athabasca and Peace rivers and offer trips throughout each region. Key areas for trail riding include Willmore Wilderness Park, the Kakwa River, and Jasper National Park. Trips in these regions are either relatively short, lasting from four to seven days, or are for extended periods, sometimes in excess of two weeks. Other areas used for trial riding include the Smoky and Wapiti river valleys.

Mixed operations offer a range of activities at locations relatively close to their base of operations. These activities are located in the Upper Athabasca region, the Peace River valley, and the Slave River basin.

10.4 Importance of Water Resources

Nearly all commercial operators (94 percent) indicated that water resources are very important to the experience and products offered to their clients. This includes all fish camps and companies offering boat tours. These operators note that without sufficient water for boating and good quality water for fishing, drinking and swimming, they would "have no business".

All mixed operations consider water resources to be very important to their businesses. Some of them reported building their businesses around water-based recreation, and clear water "makes for better pictures" and better scenery. For companies that offer trail riding, water resources are of less importance to their operations, although some of them rely on lakes and springs for drinking water. In addition, part of the wilderness products they promote emphasizes the lack of pollution in the area.

The majority (69 percent) of operators allow clients to consume river or lake water. These include half of the companies operating boat trips, 80 percent of trail-riding companies, half of

mixed operations and all fish camps. Of these, only 27 percent of operations, including all mixed operation and one boat-tour operator, treat this water before drinking it. Boiling is the standard means of treating water, although some also filter their water while others allow sediments to settle in pots overnight. These results mean that 80 percent of trail-riding companies and all the fish camps are allowing clients to drink untreated water from surface sources.

The mainstems and tributaries of the Peace, Athabasca and Slave rivers are also very important to the majority (94 percent) of operations. Even though fish camps are not located on the river mainstems, they noted that fishing is their business and that they can be affected by conditions in the Athabasca, Peace and Slave rivers. Most boating operations use the river mainstems, especially the Peace River, and are concerned about water quality and quantity. Trail-riding companies reported that visits to lakes and rivers, including mainstems, are an important part of their business. One operator remarked that they used to drink the water from the Smoky River 25 years ago but "now the lower section stinks". Mixed operations noted that they have built their product "around a clear pristine and wilderness setting" that could be compromised by changes in the nearby rivers.

10.5 Observed Changes in Aquatic Resources

Nearly 70 percent of commercial recreation operators reported that they or their clients have seen changes in the aquatic resources of the mainstems of the Peace, Athabasca or Slave rivers or their major tributaries during the last 10 years. This includes the majority of companies in each type of operation except boat tours. Of these, over 80 percent have seen changes in the water, more than 70 percent described changes in fish resources, nearly 20 percent observed changes in wildlife, and about 10 percent mentioned other types of changes -- see Table 10-4.

Table 10-4

Observed Changes in Aquatic Resources by Commercial Recreation Operations
(Percent of Annual Use)

	Changes Noticed	Types of Changes			
		Water	Fish	Wildlife	Other
Fish Camps	75.0%	100.0%	66.7%	0.0%	33.3%
Boat Tours	33.3%	100.0%	0.0%	0.0%	0.0%
Trail Riding	75.0%	66.7%	66.7%	0.9%	0.0%
Mixed Operations	80.0%	75.0%	100.0%	50.0%	0.0%
Total	68.8%	81.2%	72.7%	18.2%	9.1%

The key change in water resources is that river levels are now lower. This change accounts for 55 percent of comments. Other operators reported that river water is now dirtier (33 percent) while others complained that river water can no longer be consumed (11 percent). Changes to the fish resources of the region vary considerably. The greatest concern (50 percent of comments) is that, because of contamination, fish can no longer be eaten or eaten in the same amounts. Others changes are an increase in the number of dead fish, more deformed fish, fewer fish, or no fish at all. In regard to wildlife, one operator reported that wildlife are leaving traditional areas while another operator noted that there seems to be fewer species of wildlife. A general concern was that rivers seem to be more polluted.

11.0 COMMERCIAL FISHING

Commercial fishing is an important activity in some parts of the northern river basins. A full assessment of commercial fishing operations was recently prepared (Krips, 1995) for the Northern River Basins Study. This assessment showed that 66 percent of the annual provincial catch during the past five years comes from lakes in the Peace and Athabasca river basins. A summary of the status of commercial fishing in the basin is provided below.

11.1 Status of Commercial Fishing

The Peace, Athabasca and Slave river basins fall within Alberta Commercial Fishing Zones C to H. It is estimated that there are currently about 400 commercial fishermen operating in the NRBS area. This number has fallen from about 600 fishermen in 1990/91.

Commercial fishermen caught an average of 1.37 million kilograms (kg) of fish per year from lakes in the NRBS area between 1990/91 and 1994/95. This harvest represents two-thirds of the total Alberta commercial fish harvest. Total catch per year in the NRBS area has remained fairly consistent during this five-year period.

Lake whitefish accounts for about 70 percent of the average total catch in the region -- see Table 11-1. Annual harvests of lake whitefish averaged 966,200 kg between 1990/91 and 1994/95. Northern pike accounts for another 17 percent of the commercial harvest in the region, with annual harvests of about 237,200 kg. Much of the balance of the commercial catch (11 percent) consists of walleye and tullibee. The commercial catch for these two species averaged about 150,000 kg per year.

Table 11-1 also shows the provincial significance of the commercial fishery in the northern river basins. Lakes in the NRBS area account for more than 80 percent of the provincial harvest of walleye, tullibee and perch, and 62 percent of the provincial catch of lake whitefish.

Table 11-1

Average Commercial Fish Catch by Species, 1990/91 to 1994/95

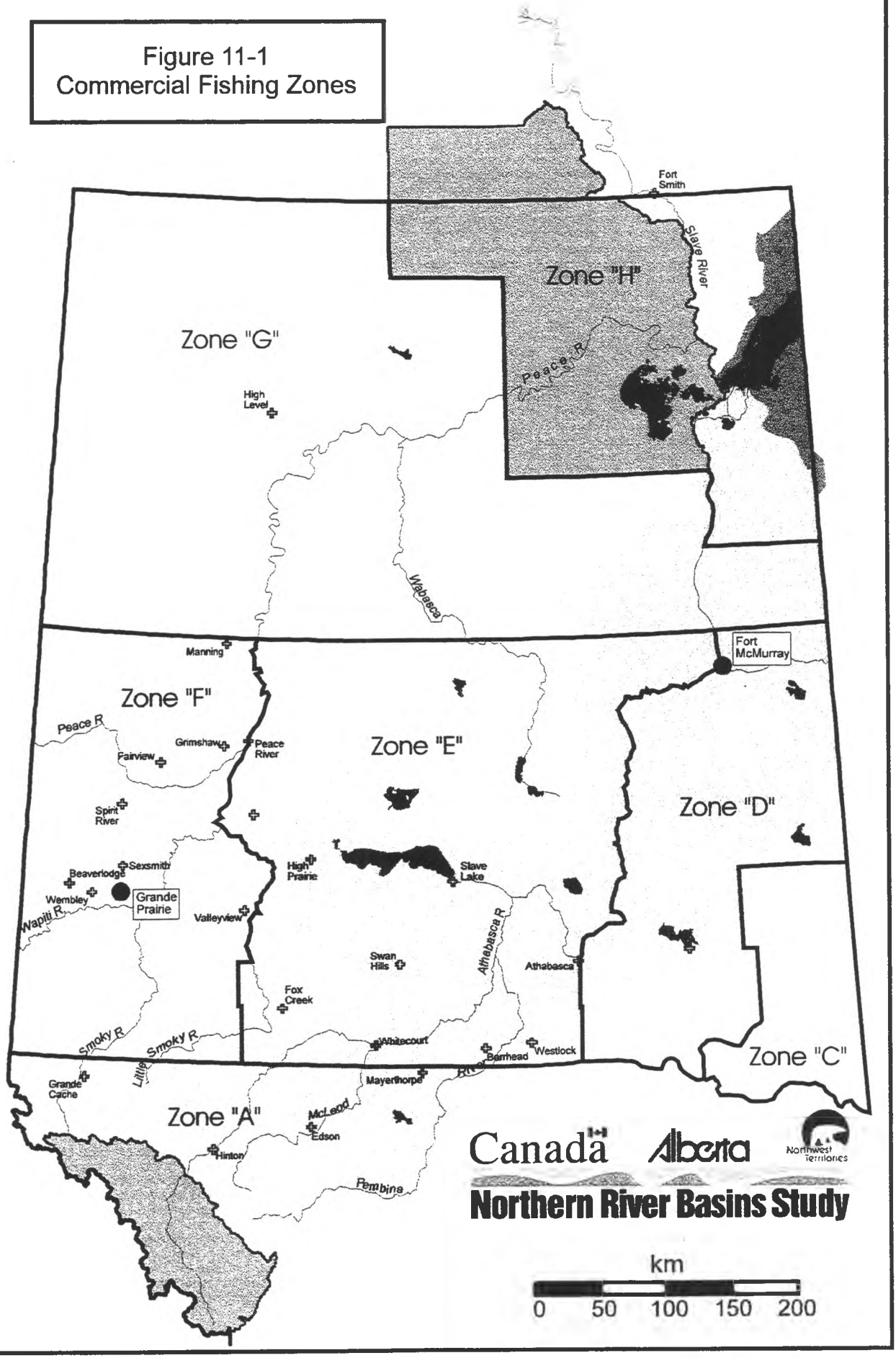
Species	Average Catch Per Year (kilograms)	Proportion of Total Catch in NRBS Area	Proportion of Provincial Catch
Lake Whitefish	966,200	70.4%	61.7%
Northern Pike	237,200	17.3%	77.3%
Walleye	83,400	6.1%	80.8%
Tullibee	66,700	4.9%	88.8%
Suckers	6,700	0.5%	33.4%
Burbot	5,400	0.4%	33.7%
Perch	2,500	0.2%	87.5%
Roe	1,500	0.1%	49.3%
Trout	1,100	0.1%	47.1%
Total	1,370,700	100.0%	66.0%

Table 11-2

Average Commercial Fish Catch by Location, 1990/91 to 1994/95

Location	Average Catch per Year (kilograms)	Proportion of Total Catch in NRBS Area	Proportion of Provincial Catch
Lesser Slave Lake	610,000	44.6%	29.4%
Lac la Biche	154,900	11.1%	7.3%
Snipe Lake	128,800	9.3%	6.1%
Lake Athabasca	90,800	6.7%	4.5%
Utikima Lake	77,400	5.7%	3.8%
Winagami Lake	55,200	4.0%	2.7%
Sturgeon Lake	42,800	3.1%	2.0%
Peerless Lake	39,500	2.9%	1.9%
N Wabasca Lake	27,300	2.0%	1.3%
Nipisi Lake	21,100	1.5%	1.0%
Total	1,247,800	90.9%	60.0%

Figure 11-1
Commercial Fishing Zones



More than 25 lakes in the NRBS area are used for commercial fishing. The majority of this fishing occurs in 10 lakes which include: Lesser Slave Lake, Lac la Biche, Snipe Lake, Lake Athabasca, Utikima Lake, Winagami Lake, Sturgeon Lake, Peerless Lake, North Wabasca Lake, and Nipisi Lake. During the past five years, these ten lakes yielded an average of 1.25 million kg of fish per year. They account for about 91 percent of the annual regional catch.

About 35 percent of the total annual harvest in the NRBS area comes from Lesser Slave Lake. As shown in Table 11-2, Lesser Slave Lake produces annual harvests averaging 610,000 kg per year. Lac la Biche, Snipe Lake, Lake Athabasca, and Utikima Lake are the next most important lakes in the region and contribute another 33 percent of the total commercial catch.

About 70 percent of the commercial fish harvest in Alberta is sold through the Freshwater Fish Marketing Corporation. The remaining estimated 30 percent of the annual catch is either consumed or sold locally by the commercial fishermen.

11.2 Survey of Commercial Fishermen

A sample of commercial fishermen operating in the NRBS area was surveyed to obtain information about their fishing activities and the water-management issues and concerns of greatest importance to their industry. A total of 47 fishermen were selected for the survey, based on advice from the Fish and Wildlife Division of Alberta Environmental Protection and the Government of the Northwest Territories. Only 13 questionnaires were completed, for a response rate of 28 percent. Because of the small sample size, the survey results must be used with caution. Estimates of percentages are only accurate to within ± 10 percent.

11.2.1 Location of commercial fishermen

The majority (64 percent) of surveys were completed by fishermen from Zone E which has more fishermen than any other zone and also generates the bulk of the commercial fish harvest. The balance of responses (29 percent) came from fishermen in Zone F which has the second largest

Table 11-3

Estimated Number of Commercial Fishermen in Zones E and F

	1-10	11-30	31-50	51 to 70	70 to 100	More Than 100
Zone E	0.0%	14.3%	14.3%	14.3%	28.6%	28.6%
Zone F	33.3%	33.3%	0.0%	0.0%	33.3%	0.0%

Table 11-4

Estimated Commercial Fish Harvest and Major Species in Zones E and F
(Weights in Kilograms)

		Lake Whitefish	Northern Pike	Walleye	Tullibee	Perch
Zone E	Average	491,900	53,700	33,400	12,200	3,100
	Mode	907,200	68,000	13,600		4,500
	Low	36,300	6,800	2,300	1,800	900
	High	1,134,000	90,700	113,400	22,600	4,500
Zone F	Average	21,800	500			500
	Mode					
	Low	500				
	High	35,000				

Table 11-5

Key Commercial Fishing Lakes in Zone E

	Percent of Fishermen	Percent of Harvest			
		Average	Mode	Low	High
Lesser Slave Lake	100%	48%	50%	25%	70%
Snipe Lake	100%	15%	15%	5%	20%
Winagami Lake	78%	12%	10%	10%	20%
Utikima Lake	44%	12%	10%	10%	15%

number of commercial fishermen. One response was received from a fisherman from Zone G, but his fishing activities are outside the basin. Fishermen in the NWT did not complete the survey, probably because their fishing occurs outside the NRBS area. Thus the survey results apply only to commercial fishermen from two major fishing zones in the region.

11.2.2 Commercial harvesting activities

More than half of the fishermen from Zone E estimate that more than 70 people in their area are catching fish commercially. Part of the variability in responses -- see Table 11-3 -- may have resulted because respondents come from four different communities. Fishermen in Zone F show no consensus regarding the number of active commercial fishermen in their area. Estimates range from less than 10 to more than 70.

Although estimates of the size of the harvest varies widely among respondents (see Table 11-4), there is complete agreement as to the relative importance of the various fish species. Lake whitefish is the most important commercial fish species in both zones, with estimates of the annual harvest in Zone E being close to 0.5 million kg. Northern pike is rated second, with an estimated average harvest of 53,700 kg, followed by walleye (33,400 kg), tullibee (12,200 kg) and perch (3,100 kg). In Zone F, annual harvests of lake whitefish are estimated to be on the order of 21,800 kg.

The key commercial fishing lake in Zone F is Sturgeon Lake. This is the only commercial fishing lake in the region, and all respondents reported that 100 percent of the commercial harvests in the zone came from Sturgeon Lake. Table 5-11 shows the relative importance of various lakes in Zone E. Lesser Slave Lake is recognized as the most important lake, accounting for nearly half of the commercial fish catch by fishermen in Zone E. Other key lakes include Snipe Lake (15 percent of Zone E harvest), Winagami Lake (12 percent), and Utikima Lake (12 percent).

Table 11-6

Fish Species Eaten by Commercial Fishermen in Zones E and F
(Percent of Fishermen Eating Species)

	Lake Whitefish	Northern Pike	Walleye	Perch
Zone E	88.9%	66.7%	100.0%	22.2%
Zone F	100.0%	0.0%	0.0%	0.0%

Table 11-7

Observed Changes in Fish Caught by Commercial Fishermen in Zones E and F in Last 10 Years
(Percent of Fishermen)

	Observed Changes in Fish	Type of Change		
		Increased Numbers	Decreased Size	Decreased Health
Zone E	66.7%	66.7%	16.7%	16.7%
Zone F	33.3%		100.0%	

Although the estimates of commercial catch do not exactly match harvest records, the survey results accurately portray the most important fish species and key fishing lakes in each region.

11.2.3 Use of river mainstems

None of the commercial fishermen fish in the mainstems of the Peace or Athabasca rivers. This is consistent with the commercial harvest statistics. Thus, commercial fishing in the study area would not be directly affected by management of the river mainstems.

11.2.4 Fish consumption

All commercial fishermen report eating part of their catch. Table 11-6 shows that lake whitefish is the preferred species and is eaten by 89 percent of fishermen in Zone E and 100 percent of fishermen in Zone F. All Zone E fishermen also eat walleye, and two-thirds eat northern pike. Perch is eaten by about 22 percent of fishermen in Zone E.

Most fish are eaten as fillets, with less than 15 percent of fishermen indicating that they eat livers or fish cheeks. Fishermen eat about 48 kg of fish per year, although this ranges from 2.5 kg to 2300 kg. Half of the fish eaten are lake whitefish.

11.2.5 Consumption of water

Survey results show that most commercial fishermen consume lake or river water while engaged in fishing. This includes all fishermen in Zone E but none from Zone F. Few fishermen (22 percent) treat the water in some way before drinking it. The most common form of treatment is boiling. The remainder (78 percent) consume water directly from lakes.

11.2.6 Recent changes in aquatic resources

Two-thirds of commercial fishermen in Zone E and one-third of commercial fishermen in Zone F indicated that the number, health or quantity of fish caught over the last 10 years has changed - see Table 11-7. Two-thirds of comments from fishermen in Zone E are that the number of fish has increased over the last 10 years while 17 percent reported catching smaller fish and 17 percent noted increased disfigurement of fish (lumps on whitefish). The only change noted by fishermen in Zone F is that fish are skinnier than they were 10 years ago.

12.0 TRAPPING

Trappers are another group of stakeholders whose livelihood is dependent on the aquatic resources of the Peace, Athabasca and Slave river basins. Beaver, muskrat and otter are key fur resources in the basin, and the populations of these animals can be affected by changes in water quality or quantity.

According to records and information from the Wildlife Management Division of Alberta Environmental Protection, there are about 3,470 licenced trappers in the Alberta portion of the study area, and about two-thirds of these have registered traplines. In order to obtain information about trapping and the water management issues and concerns of greatest importance to the trapping industry, a sample of trappers operating in the basin was surveyed. Selection of this sample was based on advice from the Alberta Trappers Association and the Department of Renewable Resources of the Government of the Northwest Territories. Twenty-four questionnaires were sent out to selected trappers who were asked to describe the activities of all trappers operating in their part of the study area. Only nine questionnaires were completed, for a response rate of 37 percent. Because of the small sample size, these survey results must be used with caution.

A second source of information on trapping was the household survey. Analysis of responses showed that 29 of 718 households participate in trapping. Ten of the 29 have registered traplines. Extrapolation of survey results suggests that 3.0 (±1.4) percent of basin households are involved in trapping. This translates into about 2,680 (± 1,250) households. Given the actual number of registered traplines in the basin (about 2,155), the information from the household provides a reasonable assessment of trapping in the basins.

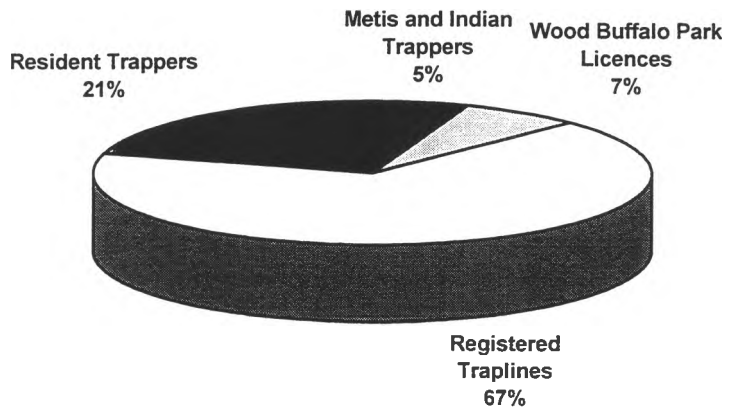
Table 12-1

Number of Trappers' Licences Issued in Alberta, 1994/95

	Provincial Total	Trappers in Study Area	
		Percent	Estimate
Registered Traplines	2,694	80%	2,155
Resident Trappers	1,297	66%	856
Métis and Indian Licences	231	80%	185
Wood Buffalo Park Licences	275	100%	275
Total	4,497	77.2%	3,471

Figure 12-1

Licenced Trappers Within the Alberta Portion of the Northern River Basins



12.1 Number of Trappers

It is not possible to prepare a completely accurate assessment of the amount of trapping that occurs in the study area. Although the number of registered traplines within the basins can be determined, only 60 percent of licenced trappers have registered traplines. The remainder trap on private lands, within Wood Buffalo National Park, or on Indian reserves, so the number of these trappers in the basin must be estimated.

For 1994/95, the Wildlife Management Division issued a total of 4,497 trapping licences in Alberta. As shown in Table 12-1, the majority of these were for registered traplines but a considerable number were issued to allow people to trap on private lands (resident trappers). Regional harvest records from the Wildlife Management Division indicate that about 80 percent of all active registered traplines in Alberta were located in the Athabasca, Peace and Slave river basins. This suggests that there were about 2,155 registered traplines in the basin in 1994/95. The records also show that 275 licences were issued for trapping inside Wood Buffalo National Park. In addition, it is assumed that about 80 percent of licences for Indian and Métis trappers and 67 percent of resident trapping licences were issued to residents of the Athabasca, Peace and Slave basins. Using these assumptions, it is estimated that there were about 3,470 trappers in the Alberta portion of the study area in 1994/95. This means that about two-thirds of trappers had registered traplines -- see Figure 12-1.

Not all trappers are active. Authorizations for registered traplines are issued for five-year terms, as long as trappers renew their licences every year. This means that licences may be acquired to maintain the right to the registered trapline, even though no trapping actually occurs. Wildlife Management Division data for 1993/94 indicate that 49.9 percent of registered trappers in the study area actually harvested animals. Based on this information it is estimated that about 2,390 trappers are currently active in the Alberta portion of the basin. Survey data also indicates that there are about 10 active trappers in the Fort Smith area in the NWT. Thus, there are about 2,400 active trappers in the basin. This is quite close to the 2,680 trappers estimated by the results of the household survey.

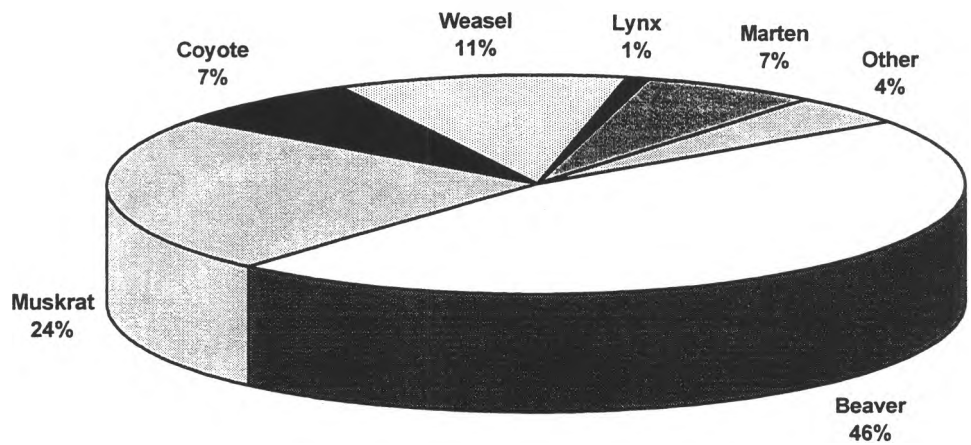
Table 12-2

Estimated Number of Active Registered Traplines and Total Trappers in the Alberta Portion of the Northern River Basins Study Area

Region	Registered Traplines[1]		Estimated Trappers[2]	
	Number	Percent	Number	Percent
Upper Athabasca	38	2.8%	156	5.8%
Middle Athabasca	87	6.4%	181	6.8%
Lower Athabasca	108	8.0%	0	0.0%
Upper Peace	36	2.7%	0	0.0%
Middle Peace	82	6.1%	89	3.3%
Lower Peace	67	5.0%	105	3.9%
Slave River/Delta[3]	291	21.6%	77	2.9%
Smoky/Wapiti	152	11.3%	961	35.9%
Lesser Slave	222	16.4%	201	7.5%
Macleod/Pembina	81	6.0%	590	22.0%
Wabasca	86	6.4%	83	3.1%
Lac la Biche	110	8.1%	235	8.8%
Total	1350	100.0%	2677	100.0%

Figure 12-2

Composition of Fur Harvest by Registered Alberta Trappers in the Northern River Basins Study Area, 1994-95



1 Based on data from Wildlife Management Division, Alberta Environmental Protection.
2 Based on extrapolation of survey data.
3 Includes 275 licences for Wood Buffalo Nation Park and 10 active trappers in Fort Smith area.

12.2 Location of Trapping

Trapping activities are concentrated in specific portions of the basin. As shown in Table 12-2, the majority of registered traplines are located in the Slave River/Delta, Lesser Slave, Smoky/Wapiti, Lac la Biche and Lower Athabasca regions. These five regions account for two-thirds of all registered traplines in the basin.

These results do not match survey estimates of the regional distribution of trappers. Survey results indicate much higher numbers of trappers in the Smoky/Wapiti, Pembina/Macleod, Lac la Biche, Upper Athabasca, Middle Athabasca and Lower Peace regions. While part of this difference is related to the small sample size, it is likely that more resident trappers' licences are issued to residents of these regions, which have a higher proportion of private land holdings than do the other regions. Without additional details on the residency of people holding resident, and Indian and Métis trappers' licences, it is not possible to get a more accurate assessment of the regional distribution of trapping activity in the basin.

12.3 Annual Harvests

Figure 12-2 shows the composition of the fur harvest from registered traplines in the Alberta portion of the study area for 1994/95. Beaver is the most important species in terms of numbers, with a reported harvest of 16,322 animals. This represents 46 percent of the overall harvest of major furbearer species from registered traplines in the region, and over 80 percent of beaver trapped on all registered traplines in Alberta -- see Table 12-3. Other important species in the basin include muskrat (8,335 harvested), weasel (3,722), coyote (2,579) and marten (2,350). These species are harvested in large numbers due to their relative abundance and/or the value of their fur. Although the number of pelts taken from mink, fisher and otter is relatively small by comparison (less than 1,000 each), more than 84 percent of the harvest of these species from registered traplines in Alberta comes from the Peace, Athabasca and Slave basins. The value of these furs from registered traplines was $749,000 in 1994/95.

Table 12-3

Fur Harvest From Registered Traplines in the Alberta Portion of the Northern River Basins Study Area, 1994/95

Species	Harvest	Proportion of Harvest from Registered Traplines in NRBS	Proportion of Harvest from All Registered Traplines
Beaver	16,322	46.4%	80.8%
Muskrat	8,335	23.7%	74.8%
Weasel	3,772	10.7%	86.7%
Coyote	2,579	7.3%	72.1%
Marten	2,350	6.7%	71.8%
Fisher	885	2.5%	93.9%
Mink	351	1.0%	84.2%
Otter	267	0.8%	86.1%
Lynx	281	0.8%	64.2%

Table 12-4

Estimated Total Fur Harvest From Trapping in the Northern River Basins Study Area, 1993/94

Species	Registered Traplines	Resident Trappers[1]	Indian and Métis Trappers[2]	Fort Smith Area[3]	Total[4]	Percent of Alberta
Beaver	16,050	8,200	1,210	133	25,600	73.8%
Muskrat	5,830	3,380	425	779	10,414	67.3%
Weasel	2,320	560	50	6	2,940	86.9%
Coyote	2,640	8,620	30	1	11,290	52.9%
Marten	2,650	70	10	352	3,080	69.2%
Fisher	790	5	15	16	830	89.3%
Mink	300	120	15	208	640	70.3%
Otter	265	5	5	1	275	83.9%
Lynx	340	5	10	3	360	58.9%
Total	31,185 56.3%	20,965 37.8%	1,770 3.2%	1,500 2.7%	55,420 100.0%	

1 Estimated to be 67 percent of provincial harvest by resident trappers.
2 Estimated to be 80 percent of provincial harvest by Indian and Metis trappers.
3 Includes licences for Wood Buffalo National Park and survey data for Fort Smith.
4 Excludes harvest from trappers in the NWT.

Table 12-4 provides an estimate of the fur harvest for the entire northern river basins area in 1993/94. The estimates include harvests for resident trappers, Indian and Métis trappers, trappers in Wood Buffalo Park plus survey estimates for trappers in the Fort Smith portion of the NWT. The table shows that only about 56 percent of the total fur harvest for the region came from registered traplines. Another 38 percent came from trappers who were licenced to trap on their own land or on other private land.

Individuals with Métis and Indian trappers' licences accounted for only three percent of the total, while trappers in the Fort Smith area and in Wood Buffalo National Park accounted for another three percent of fur production in the basins.

Table 12-4 also shows that traplines in the northern basins generate the majority of fur pelts produced in Alberta. With the exception of coyote and lynx, the NRBS area accounts for at least two-thirds of the harvest for all major fur species. In total, some 55,420 fur pelts are produced from the region. The total value of this harvest in 1994/95 was $1.3 million. Thus, trapping also represents a major source of income for residents of the study.

Figure 12-3 describes both the total harvest of these key species plus the resulting total revenues. Beaver is again the key species in terms of both numbers harvested and total revenues. While muskrats account for a large portion (19 percent) of the total harvest, the resulting revenues are actually quite small because of the low prices paid for muskrat pelts. Higher prices are paid for marten, fisher, lynx, and otter. Thus, these species are more important because of their contributions toward total trapping revenues than is indicated by the number harvested.

The importance of key furbearer species varies within the basin. Table 12-5 shows that nearly 25 percent of beaver from registered traplines are taken from the Lesser Slave region, with 15 percent coming from the Smoky/Wapiti region. Muskrats are also important in the Lesser Slave region which accounts for 33 percent of production. The Wabasca region accounts for another 13 percent of the muskrat harvest. The highest numbers of coyote are taken in the Middle Athabasca (20 percent), Lac la Biche (18 percent) and Lesser Slave (17 percent) regions.

Figure 12-3

Fur Harvest and Value of Production by Species, NRBS Area

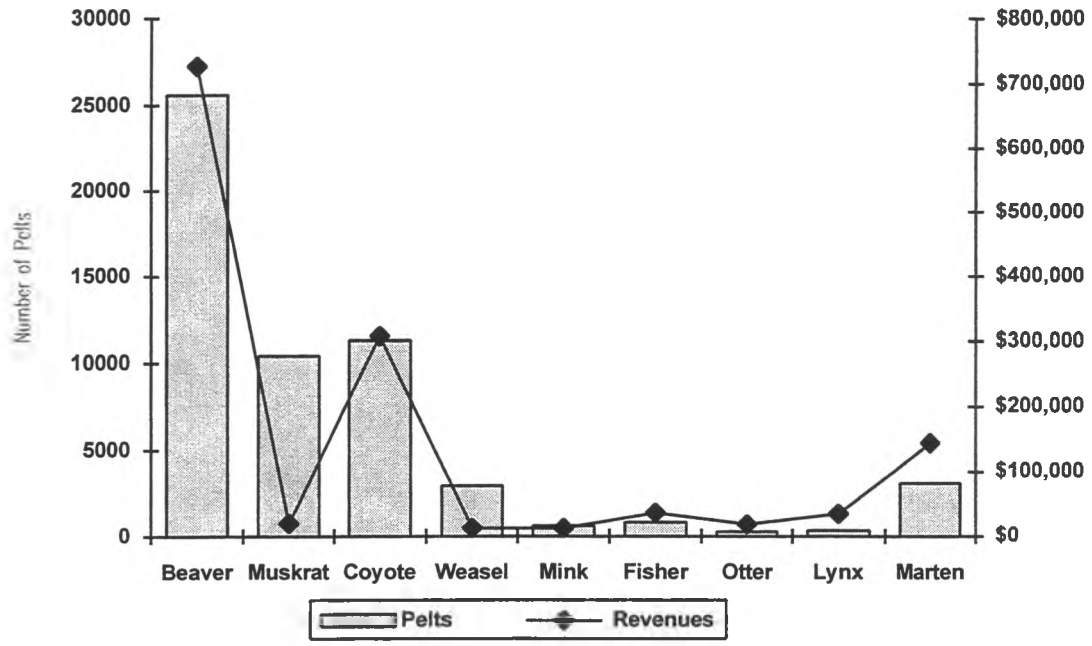


Table 12-5

Regional Composition of Fur Harvests by Registered Trappers

Region	Beaver	Muskrat	Coyote	Weasel	Mink	Fisher	Otter	Lynx	Marten
Upper Athabasca	5.6%	0.5%	6.0%	2.6%	2.0%	1.0%	1.9%	2.6%	10.0%
Middle Athabasca	9.6%	10.7%	20.1%	9.7%	9.9%	6.5%	8.6%	5.5%	0.6%
Lower Athabasca	6.6%	8.1%	4.9%	10.3%	12.2%	22.9%	30.5%	15.9%	6.6%
Upper Peace	5.7%	1.6%	2.5%	6.6%	1.7%	5.8%	1.5%	5.9%	3.8%
Middle Peace	9.7%	5.1%	5.6%	10.2%	9.0%	13.2%	0.8%	16.2%	9.5%
Lower Peace	2.0%	1.9%	1.0%	2.3%	9.3%	3.8%	3.0%	8.9%	15.2%
Slave River/Delta	0.3%	8.4%	0.0%	1.5%	6.7%	0.8%	0.4%	4.8%	4.8%
Smoky/Wapiti	15.1%	4.7%	12.6%	10.6%	5.8%	3.7%	3.8%	7.7%	22.5%
Lesser Slave	24.5%	33.0%	16.7%	23.7%	9.6%	16.1%	14.7%	10.7%	14.5%
Pembina/Macleod	6.0%	1.9%	11.6%	4.3%	8.5%	0.1%	0.4%	3.7%	10.8%
Wabasca	4.4%	13.3%	0.8%	4.7%	17.5%	8.9%	5.6%	5.2%	1.2%
Lac la Biche	10.5%	11.1%	18.1%	13.4%	7.6%	17.2%	28.9%	12.9%	0.6%

The most important region for mink is the Lesser Slave which accounts for 24 percent of the harvest from registered traplines in the basin. Other key regions for mink are the Wabasca (17 percent) and Lower Athabasca (12 percent). A considerable portion (23 percent) of fisher also come from the Lower Athabasca region, with other key regions being the Lac la Biche (17 percent) and Lesser Slave (16 percent) regions. A similar harvest pattern is reported for otter, with 30 percent coming from the Lower Athabasca region and 29 percent from the Lac la Biche region. The largest number of lynx are taken in the Middle Peace region (16 percent) and Lower Athabasca (15 percent) regions. Marten are of particular importance in the Smoky/Wapiti (23 percent), Lower Peace (15 percent) and Lesser Slave (14 percent) regions.

This information summarizes the harvests of the key species from registered traplines. There is no regional information on the fur harvests by other categories of licenced trappers so that a complete regional assessment cannot be provided. However, survey estimates of the composition of fur harvested in the region are also quite similar to the actual fur harvest for registered traplines. Beaver is the key species and accounts for 41 percent of the reported catch. Muskrat are second in importance (35 percent) followed by coyote (14 percent), and marten (eight percent). These percentages are quite similar to the fur harvest data summarized in Table 12-3.

12.4 Use of River Mainstems

Survey data indicate that about 24 percent of trappers have their traplines within 10 kilometres of the mainstems of the Peace, Athabasca and Slave rivers. Table 12-6 shows that this percentage varies significantly from region to region. In the tributary basins, the percentage of traplines close to river mainstems is very low, but a very large proportion of trappers in the Lower Peace, Lower Athabasca and Slave River/Delta regions trap within a 10-kilometre corridor on either side of the river mainstems.

Table 12-6

Proportion of Traplines Within 10 Kilometres of the Mainstems of the Peace, Athabasca and Slave Rivers

Region	Percent of Trappers
Upper Athabasca	100.0%
Middle Athabasca	50.0%
Middle Peace	0.0%
Lower Peace	100.0%
Slave River/Delta	100.0%
Smoky/Wapiti	0.0%
Lesser Slave	0.0%
Macleod/Pembina	100.0%
Wabasca	0.0%
Lac la Biche	33.3%
Total	24.3%

Table 12-7

Source of Furs for Trappers in Selected Parts of the Basin
(Percent of Total Harvest)

Source	Fort McMurray Area	Athabasca Area	Fort Smith Area
River Mainstems	10%	5%	50%
Major Tributaries	10%	10%	30%
Minor Streams	20%	30%	0%
Large Lakes	10%	15%	15%
Small Lakes	0%	20%	0%
Wetlands/Sloughs	30%	15%	5%
Upland Areas	20%	5%	0%

The number of animals harvested from river mainstems is relatively small. In the Fort McMurray area, less than 10 percent of animals are trapped along the Athabasca River. Trappers in the Athabasca area also reported that less than 10 percent of animals trapped are taken at locations along the mainstem of the Athabasca river. Only in the Slave River/Delta region, where river mainstems can have numerous side channels, does 50 percent of the harvest come from river mainstems. Table 12-7 shows that, in the Fort McMurray area, wetlands and sloughs are the most important source of furs while minor streams are of greatest importance in the Athabasca area.

12.5 Consumption of Animals

Very few trappers eat the animals they trap. Data from the household survey suggest that only about seven percent of trappers consume animals. These trappers are located mainly in the Lower Peace, Slave River/Delta and Wabasca regions -- see Table 12-8. This matches information from the survey of representatives of the trappers' associations. Three of four trappers from the Slave River/Delta and Lower Athabasca regions also reported eating animals caught while trapping.

The key species for consumption are beaver, muskrat and lynx. This includes all parts of beaver and muskrats, plus the hind quarters of lynx. Average reported consumption is about seven beaver, six muskrat and one lynx, although these estimates are based on a very small sample of trappers.

12.6 Consumption of Water

Nearly one-quarter of trappers (24 percent) consume water from surface sources while they are trapping. Of these, 62 percent treat their water before drinking it, and boiling is the usual method of treatment. Table 12-9 shows some regional differences in water-consumption patterns. All trappers in the Lower Peace and Slave River/Delta regions use water from surface-water sources and between half and two-thirds of them boil this water first. The majority of trappers from the

Table 12-8

Consumption of Furbearers by Trappers
(Percent of Trappers)

Region	Consume Animals
Upper Athabasca	0.0%
Middle Athabasca	0.0%
Middle Peace	0.0%
Lower Peace	100.0%
Slave River/Delta	75.0%
Smoky/Wapiti	0.0%
Lesser Slave	0.0%
Macleod/Pembina	0.0%
Wabasca	42.9%
Lac la Biche	0.0%
Total	7.4%

Table 12-9

Consumption of Water by Trappers
(Percent of Trappers)

Region	Consume Water	Treat Water	Method Boiling
Upper Athabasca	0.0%	0.0%	0.0%
Middle Athabasca	0.0%	0.0%	0.0%
Middle Peace	0.0%	0.0%	0.0%
Lower Peace	100.0%	50.0%	100.0%
Slave River/Delta	100.0%	75.0%	100.0%
Smoky/Wapiti	25.0%	100.0%	100.0%
Lesser Slave	50.0%	0.0%	0.0%
Macleod/Pembina	0.0%	0.0%	0.0%
Wabasca	71.4%	80.0%	75.0%
Lac la Biche	33.3%	0.0%	0.0%
Total	23.9%	62.1%	97.0%

Wabasca region also drink treated surface water while trapping. Only a few trappers in the Lesser Slave and Lac la Biche regions reported drinking untreated surface water.

12.7 Recent Changes in Aquatic Resources

Less than half of the trappers (40 percent) have seen changes in the number, quality or health of furbearers over the past 10 years. Such changes were reported by trappers in six of the regions: the Upper and Middle Athabasca region, Slave River/Delta region, Smoky/Wapiti region, Wabasca region, and Lac la Biche region.

A few trappers (only 12 percent) see more animals now. Some report that there are now more marten in the Slave River/Delta region and more beaver in the Wabasca region. Some trappers in the Middle Athabasca also report that animal populations in general have increased.

The majority of trappers (88 percent) believe that there are now fewer animals. This includes at least half of all trappers in four of the six regions, and all of the trappers in the Upper Athabasca and Lac la Biche regions. No specific species of furbearers are mentioned in most cases. However, some trappers in the Wabasca region report seeing fewer lynx. Representatives of the trappers' association also report seeing fewer animals, including lynx, rabbits, beaver, muskrat and mink, but a third of them believe that these declines are just part of normal population cycles.

Very few trappers (less than two percent) made comments on either the health or the quality of furbearers. Comments are that the quality of the fur and meat has declined and that more coyotes have mange. A third of the representatives of the trappers' associations also report a decrease in animal health or quality. One representative from the Fort McMurray area notes that the health of animals has deteriorated because of the oil sands plants. Another trapper from Fort Smith reports that fur is now more coarse, with poor colour.

Table 12-10

Observed Changes in Furbearers in Last 10 Years
(Percent of Trappers)

Region	Observed Changes in Animals	Type of Change				
		More Animals	Less Animals	Poor Quality	Poor Health	Less Habitat
Upper Athabasca	100.0%	0.0%	100.0%	0.0%	0.0%	0.0%
Middle Athabasca	100.0%	50.0%	50.0%	0.0%	0.0%	0.0%
Middle Peace	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Lower Peace	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Slave River/Delta	75.0%	33.3%	66.7%	33.3%	33.3%	0.0%
Smoky/Wapiti	50.0%	0.0%	100.0%	0.0%	0.0%	50.0%
Lesser Slave	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Macleod/Pembina	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Wabasca	57.1%	50.0%	50.0%	0.0%	0.0%	0.0%
Lac la Biche	66.7%	0.0%	100.0%	0.0%	0.0%	0.0%
Total	40.3%	12.3%	87.7%	1.8%	1.8%	22.2%

13.0 RIVER TRANSPORTATION

One other use of the aquatic resources of the northern river basins is river transportation. The mainstems of the Peace, Athabasca and Slave rivers are still used as transportation routes for hauling goods, so the study attempted to survey a representative sample of river-transportation companies to collect some information about the extent of these activities in the NRBS area. Despite various attempts to identify river-transportation companies prior to the survey, questionnaires were sent to only three companies. Only one of these companies responded. Thus, it is not possible to provide a statistically valid overview of river transportation in the basin. Instead, the information presented below has been included to make this report as complete as possible and to provide a little background on river-transportation activities.

The one transportation company that completed the survey has been operating in the Lower Athabasca and Peace-Athabasca delta area for the last 15 years. The company transports about 500 tonnes of freight per year, mostly household items, fuel, food, vehicles and other miscellaneous goods. Freight is moved by boat between Fort McKay, Fort Chipewyan and various small settlements in the delta during the summer months when no alternative forms of surface transportation are available. About half of the total freight is moved in September, prior to river freeze-up, with another 20 percent being moved in May after thaw. The remaining 30 percent of freight is moved during the months of June through August.

During the last 10 years, the volume of freight being moved down the river has decreased. Much of the decline is attributed to a lack of new construction in settlements in the delta, with lower demands for building materials. The volume of freight is not expected to increase during the next 10 years unless any of the delta settlements experience growth or new construction.

Over the last 10 years, the most noticeable changes to the rivers has been a reduction in the flow of the Athabasca River (Mile 138 to Lake Athabasca) and increased flows on the Quatre Fourches River. To date, these changes have not affected river transportation. However, if the trend continues, the lack of spring flows will cause silt loads to settle in the lower reaches of the

Athabasca making navigation of the river nearly impossible in the summer unless extensive dredging occurs.

PART III: WATER MANAGEMENT ISSUES AND CONCERNS

Although the key, initial objective of the household and stakeholder surveys was to identify and describe how the aquatic resources of the northern rivers basins were being used, a second objective was developed as the study proceeded. It was recognized that the surveys would provide a unique opportunity to gather information about northern residents and their attitudes and opinions about water-management issues in the study area. Thus, the surveys were designed to include a series of questions to explore the values, needs and expectations of stakeholders and northern residents. Both open-ended and highly structured questions were used.

The questionnaire was eventually designed to gather five specific types of information:

1. Initially, respondents were asked to react to five statements designed to assess their views about the range and significance of water-quality issues in the northern river basins
2. People were asked to identify the three factors that had most affected northern river basins during the past 20 years. Respondents were asked to describe how these factors had affected them and the aquatic resources of the basin, and then to predict what changes will occur if these factors are not further regulated.
3. Respondents were asked to rank the significance of various factors that may have affected water quality and quantity in the river basins and to also rank the effectiveness of various management actions for dealing with these factors. This question used Best/Worst ranking with a fractional factorial design and analysis of survey responses.
4. Northern residents and stakeholders were asked to describe the three types of measures they would like to see used to monitor the health of northern rivers, and who they think should be responsible for doing this monitoring.
5. The survey asked respondents to identify the three most important recommendations that they think the Northern River Basins Study should make.

The responses to four of these questions, from both stakeholder groups and northern households, are summarized in sections 14 to 17 of the report. Analysis of the ranking question is being undertaken as part of separate study (Project 4121-E1, Intelligent Marketing Systems, 1996).

14.0 IMPORTANCE OF WATER QUALITY ISSUES

The first set of attitude and opinion questions were designed to obtain an assessment of the perceived severity of water-quality problems in the northern basins. Respondents were asked to rate their agreement with five specific statements using a scale that ranged from complete agreement to complete disagreement. Three of the statements provided an assessment of the severity of the water-quality situation that ranged from not serious to very serious, and also included a corrective action that ranged from doing nothing to closing some operations. The other two statements were developed to test support for river basin plans and to assess whether current regulations in the basin are considered excessive. The same basic questions were used in both the household and stakeholder surveys to allow comparisons among the various groups.[1]

14.1 Statement: Water Quality is Not a Major Issue

The first statement used to assess the importance of water quality issues in the basin was that "water quality in the Peace, Athabasca and Slave rivers is not really a major issue at the moment so new restrictions on industrial, agricultural or municipal water are not required". Respondents were asked whether they totally agreed, partly agreed or disagreed with this statement, and were also given the option of being unsure about the validity of the statement. Responses to this question are summarized in tables 14-1 and 14-2.

Table 14-1 compares responses among stakeholder groups, including northern households, and shows some significant differences in perceptions. The majority of the public (72 percent) disagreed with the statement that water quality is not an issue at the moment. Survey responses from environmental and recreation groups and commercial recreation groups were quite similar to those of northern households.

[1] For these questions the stakeholder and household surveys were slightly different, because they were desinged and implemented by different consultants. Stakeholders were asked to respond using a four-point scale while the household survey used a five-point scale. To make interpretation of the surveys compatible, data were recoded such that partial and total disagreement were grouped together as "disagree".

Table 14-1

Reaction to Statement that "Water Quality on the Peace, Athabasca and Slave Rivers is Not Really a Major Issue at the Moment so New Restrictions on Industrial, Agricultural or Municipal Water Are Not Required"

Stakeholder Group:	Agree Completely	Partly Agree	Disagree	Unsure
Households	4.1%	12.0%	71.8%	12.1%
Environmental & Recreation Groups	0.0%	19.0%	76.2%	4.8%
Municipal and Local Governments	12.9%	25.8%	48.4%	12.9%
Industrial Water Users	20.5%	25.6%	23.1%	30.8%
Commercial Recreation Operators	6.3%	6.3%	87.5%	0.0%
Agricultural Groups	11.1%	38.9%	44.4%	5.6%
Agricultural Service Boards	57.1%	14.3%	28.6%	0.0%
Commercial Fishermen	0.0%	13.3%	53.3%	33.3%
Trappers	22.2%	0.0%	77.8%	0.0%

Table 14-2

Household Reaction to Statement that "Water Quality on the Peace, Athabasca and Slave Rivers is Not Really a Major Issue at the Moment so New Restrictions on Industrial, Agricultural or Municipal Water Are Not Required"

Region	Agree Completely	Partly Agree	Disagree	Unsure
Upper Athabasca	2.0%	16.3%	75.5%	6.1%
Middle Athabasca	10.9%	9.1%	60.0%	20.0%
Lower Athabasca	1.9%	9.4%	81.1%	7.5%
Upper Peace	3.8%	11.3%	75.5%	9.4%
Middle Peace	2.2%	13.0%	73.9%	10.9%
Lower Peace	8.0%	14.0%	48.0%	30.0%
Slave River/Delta	0.0%	7.8%	80.4%	11.8%
Smoky/Wapiti	5.6%	10.0%	72.2%	12.2%
Lesser Slave	1.9%	18.9%	64.2%	15.1%
Pembina/Macleod	3.5%	14.0%	72.1%	10.5%
Wabasca	3.8%	13.2%	62.3%	20.8%
Lac la Biche	2.2%	6.7%	68.9%	22.2%
Total	4.1%	12.0%	71.8%	12.1%

The response from industrial water users is quite different. Although there is high uncertainty about the validity of the statement that water quality is not an issue, 21 percent of industrial water users agree with this statement. Other groups that support this conclusion, at least in part, included municipal and local governments, representatives of agricultural service boards, and other agricultural groups. Responses from trappers and commercial fishermen more closely resembled public opinion. Thus, there is a clear difference of opinion among the general public and industry, local government and agriculture about whether water quality is a major issue.

There are also some significant[1] differences of opinion among households in various parts of the region. Table 14-2 shows that more than 80 percent of households in the Lower Athabasca and Slave River/Delta regions disagree with the suggestion that water quality is not currently a major issue in the basin. On the other hand, more households in the Middle Athabasca region feel that water quality is not an issue than do households in any other region. Subsequent analysis showed that this was partly due to the large number of farm households in the Middle Athabasca region. Farm households are more likely to believe that water quality is not an issue than do non-farm households, and this may reflect their reaction to that portion of the statement that suggests there may be new restrictions on agricultural activities in the basin.

The results also indicate that a higher portion of households that participate in recreational activities in the basin disagree with the statement than do non-recreating households. Another general observation is that households in most of the tributary basins are more unsure about water quality than are households in regions along the Athabasca or Peace rivers.

14.2 Statement: Pollution of Northern Rivers is Limited to a Few Locations

The second statement related to water quality was included to determine whether water quality was of concern in only selected parts of the basin, rather than in the basin as a whole.

[1] The word "significant" has been used to denote differences that have been determined to be statistically significant using chi-square tests at a 95 percent level of confidence.

Table 14-3

Reaction to Statement that "Pollution of Northern Rivers is Only a Concern in a Few Locations and More Enforcement of Existing Standards Will Solve These Problems"

Stakeholder Group:	Agree Completely	Partly Agree	Disagree	Unsure
Households	7.6%	30.0%	51.1%	11.3%
Environmental & Recreation Groups	4.8%	40.5%	47.6%	7.1%
Municipal and Local Governments	28.1%	43.8%	28.1%	0.0%
Industrial Water Users	31.7%	22.0%	19.5%	26.8%
Commercial Recreation Operators	12.5%	18.8%	68.8%	0.0%
Agricultural Groups	27.8%	33.3%	27.8%	11.1%
Agricultural Service Boards	57.1%	42.9%	0.0%	0.0%
Commercial Fishermen	26.7%	26.7%	33.3%	13.3%
Trappers	22.2%	33.3%	44.4%	0.0%

Table 14-4

Household Reaction to Statement that "Pollution of Northern Rivers is Only a Concern in a Few Locations and More Enforcement of Existing Standards Will Solve These Problems"

Region	Agree Completely	Partly Agree	Disagree	Unsure
Upper Athabasca	6.3%	25.0%	54.2%	7.0%
Middle Athabasca	7.3%	36.4%	43.6%	8.1%
Lower Athabasca	3.8%	24.5%	62.3%	7.8%
Upper Peace	6.5%	30.2%	54.7%	7.8%
Middle Peace	7.5%	21.7%	65.2%	6.7%
Lower Peace	4.1%	34.7%	44.9%	7.2%
Slave River/Delta	0.0%	21.6%	66.7%	7.5%
Smoky/Wapiti	7.8%	35.6%	46.7%	13.2%
Lesser Slave	11.3%	26.4%	43.4%	7.8%
Pembina/Macleod	10.3%	29.9%	48.3%	12.8%
Wabasca	7.5%	49.1%	39.6%	7.8%
Lac la Biche	11.4%	25.0%	54.5%	6.5%
Total	7.6%	30.0%	51.1%	11.3%

Respondents were asked to describe how much they agree with the statement that "pollution of northern rivers is only a concern in a few locations and more enforcement of existing standards will solve these problems". As shown in Table 14-3, there is more agreement with the suggestion of localized water-quality problems than the proposal that water quality is not an issue, but there are still some significant differences among groups.

Overall, 38 percent of northern households agree with this statement, in whole or in part, while 51 percent disagree. Thus, the public perception seems to be that water quality problems are not just restricted to a few key locations. Again, the response from the environmental and recreation groups is very similar to the results of the household survey. Commercial recreation operators are also skeptical of the validity of the statement, with almost 70 percent disagreement.

More than half of the representatives from all other stakeholder groups at least partly agree with the suggestion that water quality concerns are localized. The highest level of support came from the agricultural service boards and municipal and local governments: over 70 percent of each of these groups agree with the statement. Industrial water users also agree that there are local water-quality problems in the basin, but more that 25 percent of this group are not sure whether this is true. Trappers and commercial fishermen are nearly even split on this question.

Overall, the results again demonstrate an important difference of opinion between public and some stakeholders (local governments, in particular), concerning the importance and distribution of water-quality issues in the basin. Table 14-4 shows how the survey responses vary from region to region, but none of these differences are statistically significant. One conclusion that can be drawn from the data is that more households living in tributary basins agree with the suggestion of localized water-quality problems than do households living along the mainstem regions. There are some difference in terms of whether or not households

Table 14-5

Reaction to Statement that "Contamination of Northern Rivers is a Major Problem and Some Industries or Municipalities Should be Forced to Reduce Effluent Discharges, Even if it Means Closing Some Operations"

Stakeholder Group:	Agree Completely	Partly Agree	Disagree	Unsure
Households	29.6%	45.2%	13.2%	12.0%
Environmental & Recreation Groups	64.3%	16.7%	7.1%	11.9%
Municipal and Local Governments	25.8%	41.9%	29.0%	3.2%
Industrial Water Users	12.5%	25.0%	45.0%	17.5%
Commercial Recreation Operators	87.5%	6.3%	6.3%	0.0%
Agricultural Groups	50.0%	38.9%	11.1%	0.0%
Agricultural Service Boards	57.1%	28.6%	14.3%	0.0%
Commercial Fishermen	53.3%	26.7%	13.3%	6.7%
Trappers	62.5%	12.5%	0.0%	25.0%

Table 14-6

Household Reaction to Statement that "Contamination of Northern Rivers is a Major Problem and Some Industries or Municipalities Should be Forced to Reduce Effluent Discharges, Even if it Means Closing Some Operations"

Region	Agree Completely	Partly Agree	Disagree	Unsure
Upper Athabasca	29.2%	43.8%	16.7%	10.4%
Middle Athabasca	35.7%	39.3%	7.1%	17.9%
Lower Athabasca	22.6%	52.8%	11.3%	13.2%
Upper Peace	33.3%	46.3%	11.1%	9.3%
Middle Peace	37.0%	41.3%	8.7%	13.0%
Lower Peace	12.2%	42.9%	22.4%	22.4%
Slave River/Delta	31.4%	43.1%	7.8%	17.6%
Smoky/Wapiti	28.6%	42.9%	20.9%	7.7%
Lesser Slave	20.8%	47.2%	11.3%	20.8%
Pembina/Macleod	33.7%	46.1%	9.0%	11.2%
Wabasca	26.4%	49.1%	20.8%	3.8%
Lac la Biche	34.9%	46.5%	2.3%	16.3%
Total	29.6%	44.2%	13.9%	12.0%

participated in recreational activities. Recreating households are more likely to disagree with the statement than non-recreating households. However, there is no difference in opinions between farm and non-farm households.

14.3 Statement: Water Contamination is a Major Problem

The third statement survey respondent were asked to consider was whether "contamination of northern rivers is a major problem and some industries or municipalities should be forced to reduce effluent discharges, even if it means closing some operations". This statement combined the concept of basin-wide, water-quality concerns with the suggestion that significant corrective action be undertaken.

Nearly 75 percent of basin households agreed, in whole or in part, that contamination of northern rivers is a major problem. The responses in Table 14-5 show much more support for this statement than for suggestions that water quality is of no concern or that water-quality problems are localized. Thus, in the public mind, water quality in the northern rivers appears to be an important and pervasive concern for basin residents.

The public concern about water quality is shared by the majority of all stakeholder groups with the exception of industrial water users, of whom 45 percent disagree with the idea that water quality issues were so bad that some operations should be closed. In general, these other stakeholder groups actually have a more polarized position on this statement than does the general public. More than 62 percent of representatives of environmental and recreation groups, commercial recreation operations and trappers agree with this statement completely. On this question, only the responses from municipal and local governments are similar to those of the basin households. The observed differences in Table 14-5 are statistically significant.

The belief that contamination of northern rivers is a major problem is shared by households throughout the basin. Although Table 14-6 shows some variation throughout the basin, these

Table 14-7

Reaction to Statement that "Existing Water Management Regulations Are Interfering With Economic Development in the Region and Should be Reduced or Eliminated"

Stakeholder Group:	Agree Completely	Partly Agree	Disagree	Unsure
Households	1.7%	4.8%	74.8%	18.7%
Environmental & Recreation Groups	2.4%	2.4%	92.9%	2.4%
Municipal and Local Governments	6.5%	9.7%	71.0%	12.9%
Industrial Water Users	0.0%	7.5%	67.5%	25.0%
Commercial Recreation Operators	6.3%	6.3%	87.5%	0.0%
Agricultural Groups	11.1%	0.0%	77.8%	11.1%
Agricultural Service Boards	0.0%	0.0%	100.0%	0.0%
Commercial Fishermen	0.0%	6.7%	80.0%	13.3%
Trappers	0.0%	0.0%	66.7%	33.3%

Table 14-8

Household Reaction to Statement that "Existing Water Management Regulations Are Interfering With Economic Development in the Region and Should be Reduced or Eliminated"

Region	Agree Completely	Partly Agree	Disagree	Unsure
Upper Athabasca	2.1%	4.2%	77.1%	16.7%
Middle Athabasca	3.6%	5.5%	70.9%	20.0%
Lower Athabasca	0.0%	3.8%	79.2%	17.0%
Upper Peace	1.9%	1.9%	81.1%	15.1%
Middle Peace	0.0%	0.0%	88.9%	11.1%
Lower Peace	0.0%	8.2%	51.0%	40.8%
Slave River/Delta	0.0%	9.8%	62.7%	27.5%
Smoky/Wapiti	2.3%	5.7%	80.7%	11.4%
Lesser Slave	0.0%	3.8%	67.9%	28.3%
Pembina/Macleod	2.3%	5.7%	66.7%	25.3%
Wabasca	5.7%	28.3%	47.2%	18.9%
Lac la Biche	2.3%	2.3%	76.7%	18.6%
Total	1.7%	4.8%	74.8%	18.7%

regional differences are not significant. In all regions the majority of households agree, completely or partly, that contamination is a major problem. Additional analysis indicates that survey responses are unaffected by urban/rural setting, but households that participate in recreation are more likely to support the suggestion that river contamination is a major problem.

14.4 Statement: Current Water Management Regulations Interfere With Economic Development

The survey was used to test whether current water-management regulations are considered excessive. This was done to provide some guidance as to how the public and stakeholders might react to possible proposals for increased regulations of specific activities within the basin. In the survey, respondents were asked whether they agree with the statement that "existing water management regulations are interfering with economic development in the region and should be reduced or eliminated".

Responses to this question are fairly consistent among stakeholder groups. Table 14-7 shows that a substantial majority of respondents from each stakeholder group do not believe that regulations are interfering with development. While there was some uncertainty for some groups, notably trappers and industrial water users, less than 16 percent of respondents agree, in whole or in part, that current water-management regulations are having an adverse effect on economic development in the basin. Observed differences among groups are significant.

Within the basins, households in each of the 12 regions showed considerable consistency in their responses to this question. Table 14-8 shows that, with the exception of the Wabasca region, less than 10 percent of households believe that regulations are interfering with economic development. In the Wabasca region, this proportion climbed to 33 percent, but the reason for this is not known. In the rest of the regions, the only difference is in the proportion of households that are uncertain what effects current regulations are having on economic development.

Table 14-9

Reaction to Statement that "New Effluent Discharges Should Not be Allowed Until a River Basin Plan Has Been Completed"

Stakeholder Group:	Agree Completely	Partly Agree	Disagree	Unsure
Households	36.5%	45.5%	6.9%	11.0%
Environmental & Recreation Groups	76.2%	9.5%	7.1%	7.1%
Municipal and Local Governments	37.5%	28.1%	28.1%	6.3%
Commercial Recreation Operators	87.5%	6.3%	0.0%	6.3%
Industrial Water Users	19.5%	41.5%	17.1%	22.0%
Agricultural Groups	61.1%	27.8%	0.0%	11.1%
Agricultural Service Boards	28.6%	42.9%	14.3%	14.3%
Commercial Fishermen	85.7%	14.3%	0.0%	0.0%
Trappers	77.8%	11.1%	11.1%	0.0%

Table 14-10

Household Reaction to Statement that "New Effluent Discharges Should Not be Allowed Until a River Basin Plan Has Been Completed"

Region	Agree Completely	Partly Agree	Disagree	Unsure
Upper Athabasca	40.8%	34.7%	8.2%	16.3%
Middle Athabasca	37.5%	42.9%	7.1%	12.5%
Lower Athabasca	34.0%	45.3%	1.9%	18.9%
Upper Peace	39.6%	50.9%	17.5%	1.9%
Middle Peace	40.4%	46.8%	6.4%	6.4%
Lower Peace	24.5%	42.9%	6.1%	26.5%
Slave River/Delta	45.1%	39.2%	3.9%	11.8%
Smoky/Wapiti	33.7%	49.4%	7.9%	9.0%
Lesser Slave	44.4%	40.7%	7.4%	7.4%
Pembina/Macleod	34.5%	47.1%	8.0%	10.3%
Wabasca	35.8%	52.8%	3.8%	7.5%
Lac la Biche	45.5%	38.6%	6.8%	9.1%
Total	36.5%	45.5%	6.9%	11.0%

The location of the household (urban or rural) does not have a significant effect on how households responded to this question, but recreational households show a much higher degree of uncertainty to this question than do non-recreational households.

14.5 Statement: Support for River Basin Planning

The survey was also used to test public and stakeholder support for the possible recommendation that river basin planning be used as a means of addressing water-management issues. Respondents were asked whether they agreed with the statement that "new effluent discharges should not be allowed until a river basin plan has been completed". Responses to this question are summarized in tables 14-9 and 14-10.

Table 14-9 shows that there is considerable support for river basin planning among nearly all stakeholder groups, including basin households. More than 80 percent of most groups agree, at least in part, that no new discharges be allowed until a river basin plan has been completed. Three stakeholder groups have different reactions to the proposal for basin planning. Industrial water users, local and municipal governments and agricultural service boards are less convinced that future effluent discharges be tied to planning, with a fairly high percentage of each group (at least 14 percent) disagreeing with the statement. The greatest support for planning comes from commercial recreation operators, commercial fishermen, trappers, and representatives of environmental and stakeholder groups. More than 75 percent of each of these groups completely agree with completing a river basin plan prior to allowing new effluent discharges.

Table 14-10 shows that within the basin, there is consistent agreement with the proposal not to allow any new effluent discharges until a basin plan has been developed. No significant differences among regions are apparent. Only households in the Lower Peace region show less support for basin planning than elsewhere and this is partly due to the large number of people in this region who are unsure. The only significant factor affecting this decision appears to be whether or not households participate in outdoor recreation. Non-recreating households show

significantly higher support for planning than do households that use the basin for recreational activities.

14.6 Summary

The foregoing analysis clearly demonstrates that basin residents have opinions on water-quality issues in the NRBS area that are significantly different from those of various stakeholder groups. The biggest difference is in the significance of quality issues in the basin. The majority of northern residents feel that river contamination is a major issue in the basin while more industrial water users and municipal and local governments view water quality issues as being of minor concern or limited to a few localized areas. Environmental and recreation groups seem to mirror the public perception, although they tend to be much more alarmed about the severity of river contamination. Stakeholder groups whose livelihood is dependent on water quality (trappers, commercial fishermen and commercial recreation operators) are more concerned about water quality than is the general public. Agricultural groups tend to fall half way between the public and industry views on water quality.

In terms of support for possible changes in basin management, the consensus of opinion among all stakeholder groups is that current regulations are not adversely affecting economic development in the northern river basins. However, municipal and local governments and industrial water users are less supportive of the suggestion that no further effluent discharges be allowed until a river basin plan has been completed. In addition, environmental and recreation groups, trappers, commercial fishermen and commercial recreation operators show more support for river basin plans than does the general public.

15.0 FACTORS AFFECTING WATER QUALITY AND QUANTITY

Respondents to both the household and stakeholder surveys were asked to identify the three factors that have had the greatest effect on the amount or quality of water in the Peace, Athabasca and Slave river basins during the past 20 years. Because open-ended questions were used, the surveys produced a considerable amount of information. This information then had to be reduced into a series of discrete categories so that survey data could be effectively interpreted. A total of 14 major categories were eventually selected for the household survey. These categories reflect various industrial or water-use classifications, although the sample size for each category was also considered. Some categories had to be combined during the analysis of stakeholder surveys because of the smaller sample sizes.

Table 15-1 summarizes these 14 categories and also indicates the relative importance of these categories for each of the stakeholder groups, including northern households. The table shows that seven of the eight groups, including households, identify pulp mills as the key factor that has affected water quality and quantity in the basin during the past 20 years. The only group not listing pulp mills first consists of municipal and local governments which are more concerned about the effects of agriculture on water resources. Similarly, logging is one of the top four concerns identified by all stakeholder groups.

Aside from general agreement on the importance of pulp mills and logging, there is little agreement on the importance of other factors. For examples, northern households view municipal water use and sewage as the second most important factor, yet most of the other groups have very few concerns about municipal activities. Only commercial recreation companies and agricultural groups list municipal water use as one of the top three factors.

The impacts of dams are of considerable importance to a variety of groups, including municipal and local governments, environmental and recreation groups, commercial recreation companies and trappers. However, dams only ranked eighth in importance for households in the entire

Table 15-1

Most Common Factors Affecting the Water Quality and Quantity, by Stakeholder Groups
(Percent of Responses)

	Households	Industry	Municipal/ Local Gov't	Environmental Groups	Commercial Recreation	Agricultural Groups	Commercial Fishermen	Trappers
Pulp Mills	24.3%	15.0%	15.0%	19.0%	29.5%	17.0%	25.0%	19.0%
Logging	10.0%	9.0%	11.0%	15.5%	6.0%	8.5%	12.5%	7.5%
Oil and Gas	3.1%	1.5%	4.0%	3.5%	3.0%	2.0%	18.5%	0.0%
Oil Sands	2.3%	1.5%	0.0%	0.0%	0.0%	0.0%	0.0%	4.0%
Seismic	1.3%	0.0%	0.0%	0.0%	0.0%	0.0%	6.0%	0.0%
Coal mines	0.5%	0.0%	0.0%	0.0%	3.0%	0.0%	0.0%	0.0%
Dams	5.4%	3.0%	15.0%	12.0%	15.0%	10.5%	0.0%	11.5%
Agriculture	8.8%	11.5%	21.0%	8.5%	9.0%	13.0%	12.5%	0.0%
Ag. Chemicals[1]	4.3%	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Other Industries	11.0%	9.0%	13.0%	15.5%	6.0%	15.0%	0.0%	7.5%
Municipal Use	13.0%	6.0%	2.0%	3.5%	12.0%	13.0%	0.0%	4.0%
Recreation[2]	2.4%	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
General Pollution	5.9%	10.0%	2.0%	5.0%	6.0%	6.5%	12.5%	15.5%
Natural Problems	7.7%	13.0%	5.5%	2.5%	6.0%	6.5%	0.0%	11.5%

Table 15-2

Ranking of Factors According to Stakeholder Groups

	Households	Industry	Municipal/ Local Gov't	Environmental Groups	Commercial Recreation	Agricultural Groups	Commercial Fishermen	Trappers
Pulp Mills	1	1	2	1	1	1	1	1
Logging	4	5	5	2	5	6	3	5
Oil and Gas	10	9	7	7	9	9	2	-
Oil Sands	12	9	-	-	-	-	-	7
Seismic	13	-	-	-	-	-	6	-
Coal mines	14	-	-	-	9	-	-	-
Dams	8	8	2	4	2	5	-	3
Agriculture	5	3	1	5	4	3	3	-
Ag. Chemicals[3]	9	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Other Industries	3	5	4	2	5	2	-	5
Municipal Use	2	7	8	7	3	3	-	7
Recreation[4]	11	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
General Pollution	7	4	8	6	5	7	3	2
Natural Problems	6	2	3	7	5	7	-	3

1 Stakeholders comments related to the use of agricultural chemical are included under Agriculture, due to the small sample size for some stakeholder groups.

2 Stakeholders comments related to recreational and tourism activities are included under Municipal, due to the small sample size for some stakeholder groups.

3 Stakeholders comments related to the use of agricultural chemical are included under Agriculture, due to the small sample size for some stakeholder groups.

4 Stakeholders comments related to recreational and tourism activities are included under Municipal, due to the small sample size for some stakeholder groups.

basin. Commercial fishermen are far more concerned about the effects of oil and gas companies than are any other group, while trappers and industrial water users feel that changes in natural conditions, like lower water levels, are of much greater importance than suggested by other groups.

The rest of this chapter of the report examines each of the 14 key factors that have affected water-quality and quantity in the basin during the past 20 years. Each factor is described in terms of how they are perceived to have affected the resources of the basins and the effects they have had on northern households and the various stakeholder groups. There is also a discussion of the likely effects that these factors will have on the environment, stakeholders and northern residents during the next 10 years if no steps are taken to control these factors. Recommended actions to manage these factors are also described.

15.1 Pulp Mills

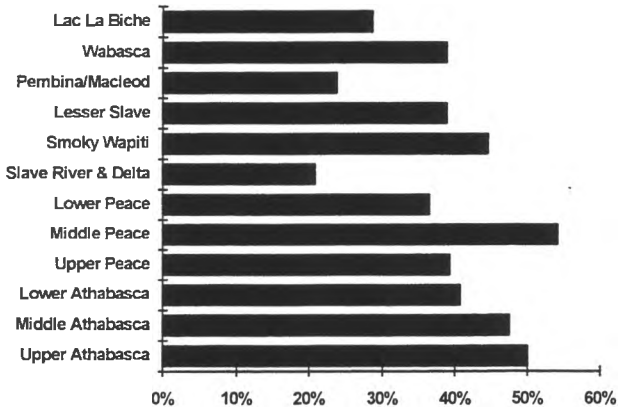
Pulp mills are the most important factor affecting the quality and quantity of aquatic resources in the basin. Nearly 39 percent of households in the basin have concerns about pulp mills. The percentage is higher (over 47 percent) in those regions having pulp mills, and lower elsewhere. Pulp mills are listed as the most significant factor in all regions except for the Slave River/Delta region where the effects of dams are of greater concern. The percentage of people concerned about pulp mills is the same for both urban and rural households, and is unaffected by whether household participates in agricultural or recreational activities.

The main reported environmental effect of pulp mills is the contamination of fish. This effect is of concern to more than one-third of survey households. Other major effects include a decline in water quality (26 percent of households) and an increase in pollutants and contamination (19 percent). Some households believe that pulp mills contribute to environmental degradation in general (seven percent) and are also causing air pollution (two percent), lower water levels (one percent) and more debris in rivers (one percent). About 11 percent of households are

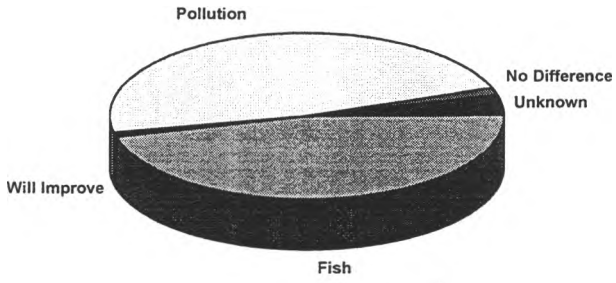
Figure 15-1

Factors Affecting Water Quality and Quantity: Pulp Mills

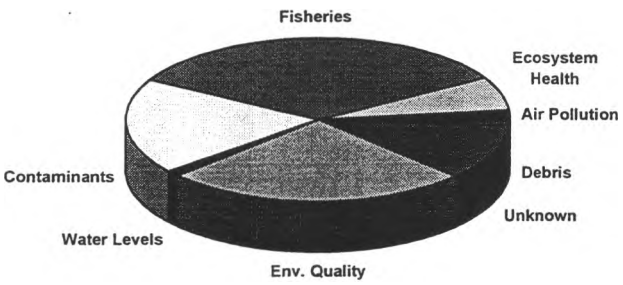
Regional Distribution of Concerns



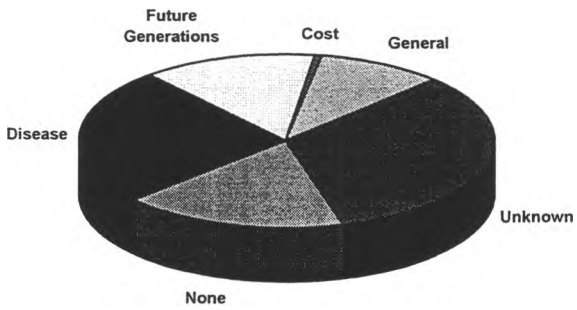
Impacts on Environment in Next 10 Years



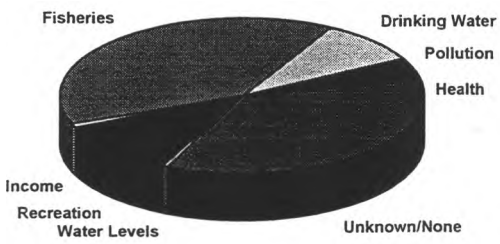
Impacts on the Environment During Past 20 Years



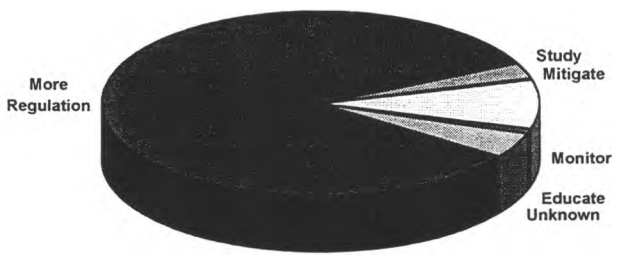
Impacts on Households in Next 10 Years



Impacts on Households During Past 20 Years



Recommended Management Action



unsure about the effects of pulp mills on the environment, especially in the long term.

Households report that they have been most been directly affected by pulp mills through their recreational activities. About 39 percent of households complain that they can no longer catch and eat fish in the basin, while another 11 percent report that pulp mills have limited their ability to boat, swim and enjoy other recreational activities. Only nine percent feel that pulp mills affect them through drinking water supplies, while four percent complain that their health is directly affected. About five percent believe that pulp mills cause a general increase in pollution, and one percent note that their incomes from trapping have dropped as a result of pulp mills. However, 30 percent of households report that they are either unaffected or are not sure whether they have been directly affected by pulp mills.

Without additional control, northern residents believe that pulp mills will cause general levels of pollution in the rivers to increase (48 percent) and lead to increased levels of contaminants in fish (46 percent). While one percent believe that there will be no further deterioration and another one percent expect conditions to improve, the remaining four percent are concerned about increasing levels of disease in the human population.

In terms of direct effects on northern residents, one-third of households are unsure about the continuing effects of pulp mills, and 17 percent believe that there will be no further changes in how they are affected by these operations. Households have three key concerns about how members of their household might be affected in the future. About one-quarter (26 percent) believe that pulp mills will cause increased levels of cancers and diseases, including multiple sclerosis. Another 12 percent are concerned that continued operation of pulp mills will leave little undisturbed areas for future generations. The remaining 10 percent are concerned about a general decline in environmental quality.

There is strong support for increased controls on the pulp industry. Over 83 percent of households propose tighter controls on effluent discharges. There is some support for increased

monitoring (nine percent), additional studies (three percent) and education (one percent). The remaining four percent are unsure about how to address the environmental effects of pulp mills.

As noted earlier, most stakeholder groups also see pulp mills as one of the most important factors affecting the health of rivers. Typical concerns from stakeholders include contamination of fish stocks and water quality as a result of the chemical pollutants associated with pulp mill operations. Of the various stakeholder groups, commercial fishermen show relatively little concern about the potential negative environmental impacts of pulp mills on fish stocks. The majority of stakeholder groups, including commercial fishermen, report that pulp mills have as yet had no major impact on business operations.

All stakeholder groups feel that if no steps are taken to control pulp mills over the next 10 years, the health of the river will decline. Most stakeholders predict that water quality will continue to deteriorate and that fish stocks will become increasingly contaminated and not edible. However, the majority of industrial and municipal stakeholders believe that there will be no significant impact to business.

Three stakeholder groups have significant concerns about future pulp mill operations if no additional controls are implemented. First, trappers feel that pulp mills have been responsible for recent losses of furbearing animals such as beavers. They expect that, without some action, these declines in furbearers will continue and this will affect their incomes. Second, the majority of commercial recreation operators feel that pulp mills have affected tourism potential and have created fears over fish contamination. If pulp mills operations are not controlled over the next ten years, commercial recreation operators are concerned that tourism and fishing will decline. This decline will result from actual adverse effects on the environment as well as the negative public perceptions about these environmental impacts. Third, commercial fishermen are concerned that, over time, fish contaminated by pulp mills will eventually move down rivers into commercially-fished lakes. This is expected to cause declines in both the health and size of the commercial harvest and will result in lower incomes for commercial fishermen.

The majority of stakeholders recommend the need for tougher controls on pulp mills, including an increased need to monitor the amounts of effluent being discharged. Many believe that no pulp mill wastes should be discharged into rivers at all, and that existing mills should be required to clean up. Many support stiffer penalties, controls and enforcement.

15.2 Logging

Nearly 16 percent of households in the basin claim that logging and forestry practices have affected water quality and quantity in the basin over the last 20 years. Comments on logging account for 20 percent of all issues, and this ranks logging fourth in terms of all the factors that have affected the aquatic resources of the basin. Farm households are slightly more concerned about the effects of logging than non-farm households. In addition, logging is of greater concern to households that participate in recreational activities. The highest incidence of concerns about logging comes from households in the Pembina/Macleod, Smoky/Wapiti, Middle Athabasca and Lesser Slave regions. By comparison, less than two percent of households in the Lower Athabasca region are concerned about logging.

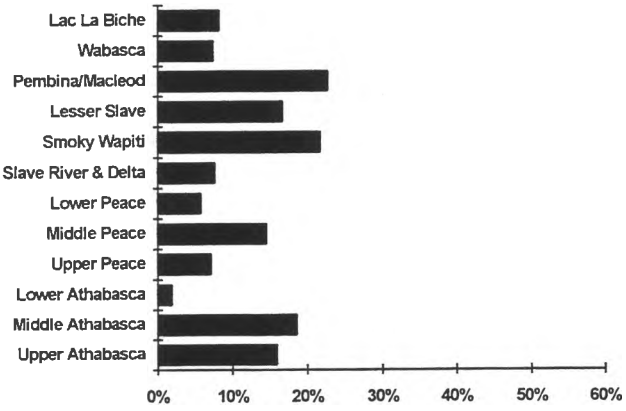
Logging is believed to have caused a wide range of environmental problems. The most important of these are erosion (30 percent of households), increased contamination of water (20 percent), and decreased water quality (19 percent). Other effects include more debris in rivers, lower water levels, habitat loss and lower fish populations, with each of these mentioned by five percent of households. A few households also claim that logging is responsible for changes in weather (one percent) and a decline in air quality (one percent). Five percent of households are unsure what effects logging is having on the environment.

Logging is also having a direct effect on some northern residents. The majority of these effects (reported by 42 percent of households) involve a loss of recreational opportunities, including hunting. Another eight percent of households report that logging has affected fish populations and fishing. However, 30 percent of households believe that they have not been affected by logging. Other households report that logging has adversely affected their drinking water

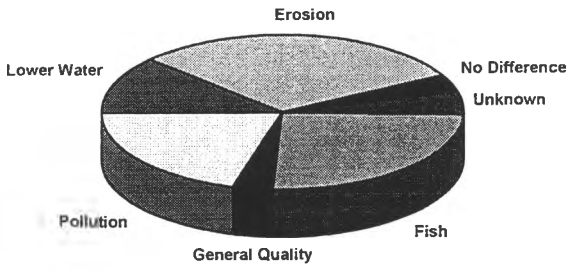
Figure 15-2

Factors Affecting Water Quality and Quantity: Logging

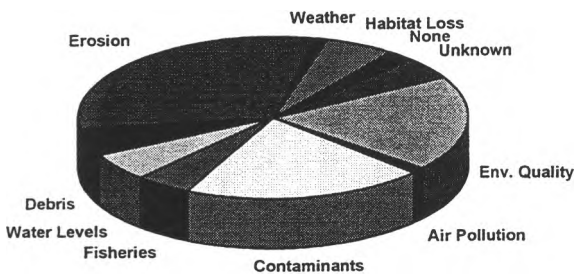
Regional Distribution of Concerns



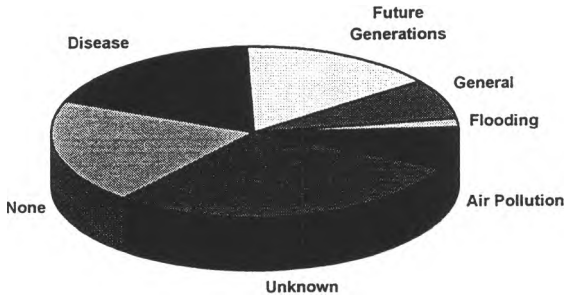
Impacts on Environment in Next 10 Years



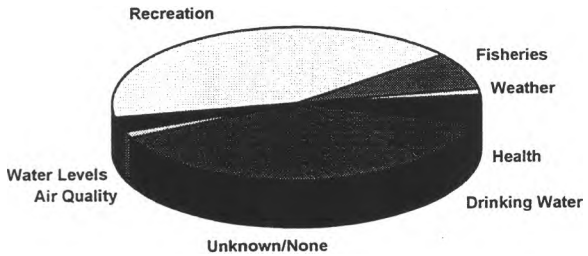
Impacts on the Environment During Past 20 Years



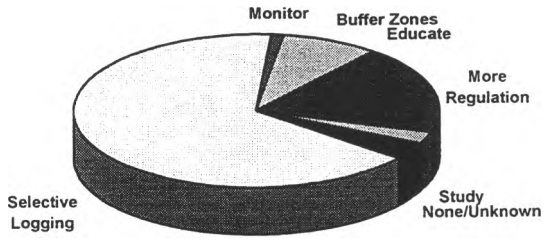
Impacts on Households in Next 10 Years



Impacts on Households During Past 20 Years



Recommended Management Action



supplies (eight percent) or personal health (six percent). Some are also concerned about the effects of logging on water levels, weather patterns and air quality.

Without a change in logging practices, many households are convinced that erosion will continue to remain a problem (30 percent of households), that fish populations will continue to decline (25 percent), and that water pollution will become worse (21 percent). Water levels are also expected to drop (12 percent of households) and water quality will decline (four percent). Five percent are unsure about how logging will affect water quality or quantity in the future, while four percent expect no further changes.

Northern residents have more difficulty identifying how they will be directly affected by future logging activities. Nearly 30 percent of households are unsure how they might be affected while 20 percent expect that they will not be directly affected. The likely effects of future logging include increased diseases (19 percent of households), a loss of recreational opportunities for future generations (15 percent), increased air pollution (eight percent), a general deterioration of ecosystem health (eight percent) and increased flooding (one percent).

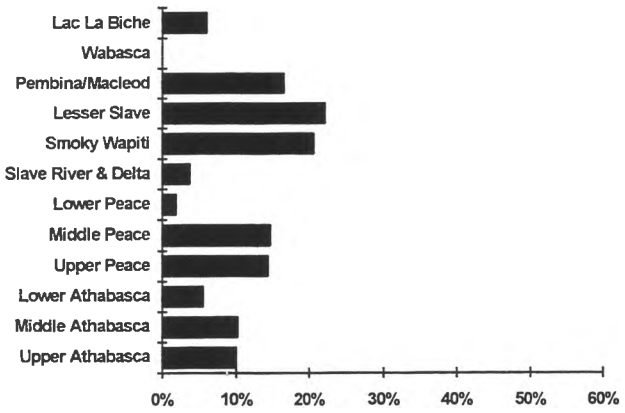
Suggested actions for addressing these problems include the use of selective logging practices (65 percent) and placing tighter controls on the logging industry (17 percent). Some households (nine percent) also recommend larger buffer zones along rivers. Less than two percent of households propose other actions, such as monitoring, more studies and education.

Between six and 16 percent of all stakeholder groups believe that logging activities have negatively impacted the health of northern rivers. There is concern that logging has caused considerable soil erosion, produced higher levels of spring run-off, and has resulted in heavy siltation of rivers and lakes. All stakeholder groups expect that if logging is not properly controlled, the health of the river will be negatively affected. Additional declines in water quality and the resulting negative impacts on fisheries and wildlife are significant concerns reported by all stakeholders.

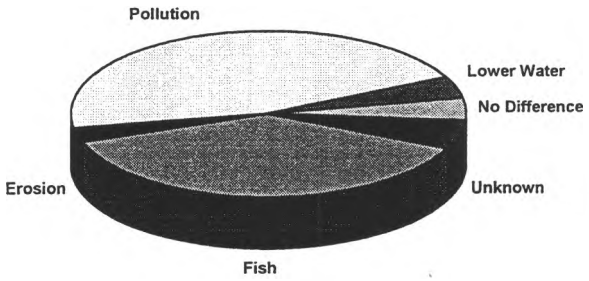
Figure 15-3

Factors Affecting Water Quality and Quantity: Agriculture

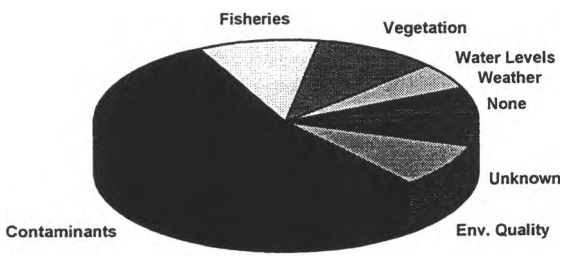
Regional Distribution of Concerns



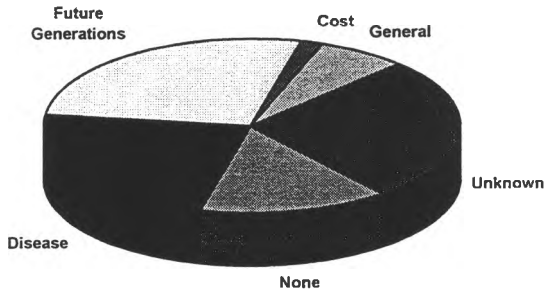
Impacts on Environment in Next 10 Years



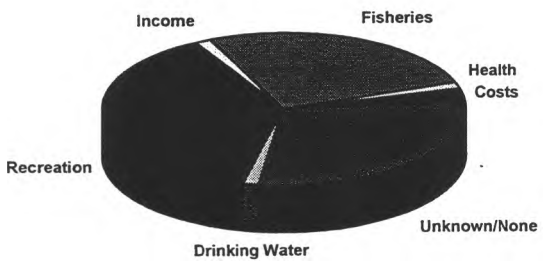
Impacts on the Environment During Past 20 Years



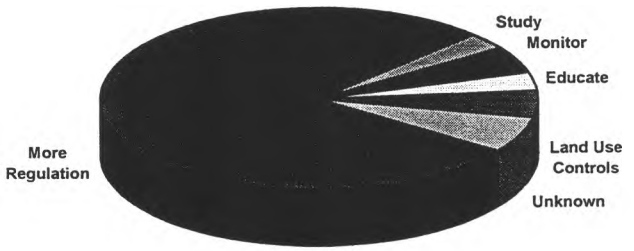
Impacts on Households in Next 10 Years



Impacts on Households During Past 20 Years



Recommended Management Action



In terms of direct impacts on stakeholders, commercial fishermen and trappers are concerned about the siltation of feedbeds and the reduction in trapping areas. Commercial recreation stakeholders have concerns about the aesthetic impacts of logging, and agricultural stakeholders are concerned about water quality. Municipal stakeholders feel that, while logging produces positive economic impacts, these activities damage roadways. The industrial group also associates some negative environmental impacts with logging but does not see any immediate impacts on their operations.

All stakeholders, with the exception of industrial water users, predict that without additional controls, logging will have an impact on their business operations over the next 10 years. Most believe that it will reduce both commercial and recreational fishing opportunities. Agricultural and municipal stakeholders are also concerned that any additional reductions in water quality resulting from logging operations will cause their operating costs to increase.

The majority of stakeholders recommend specific improvements and changes in current logging practices. They recommend the use of smaller cut blocks, implementation of buffer zones along streams and drainage areas, more selective logging, more controlled logging in watersheds, better control over volume and location of clearcutting, and better re-vegetation plans. Stricter monitoring and enforcement are also recommended.

15.3 Agriculture

Overall, agriculture is the fifth most-mentioned factor responsible for affecting water quality or quantity in the northern river basins. Agriculture is of concern to about 14 percent of households in the basin and accounts for nearly nine percent of all factors identified in the household survey. Agriculture is of greatest concern in the Lesser Slave, Smoky/Wapiti, Pembina/Macleod and Upper and Middle Peace regions, but is of no concern whatsoever to households in the Wabasca region. Agriculture is perceived to be a problem by an equal proportion of both urban and rural households, and there is no difference between farming and non-farming households.

The greatest environmental concern related to agriculture is the contamination of river due to both run-off from livestock operations and use of agricultural chemicals. These effects are described by 54 percent of households. Another nine percent report a general increase in river pollution due to agriculture. A small proportion of households (10 percent) believe that agricultural practices have had adverse impacts on fish populations while another 10 percent report that higher levels of algae and other vegetation in rivers is due to agriculture. Other concerns are that agricultural practices have lowered water tables (five percent) or affect weather patterns (three percent). Over six percent are unsure as to what effect agriculture has had on the environment while three percent suggest that the rivers can accommodate the effects of agricultural activities.

Nearly 29 percent of households are either unsure or unaffected by the environmental effects of agriculture. Where direct effects are reported, they are mainly described in terms of recreational activities. Over 38 percent of households report that contaminants from agricultural activities are interfering with boating, swimming or other recreational activities. Another 26 percent blame contamination of fish on agricultural practices. Adverse effects on drinking water (four percent of households), human health (one percent) and income (one percent) are minor concerns.

If agricultural operations continue as they have, the greatest concern is that the general level of pollution will continue to rise; 45 percent of households believe this will occur. Another 37 percent are concerned that fish populations will continue to decline or that fish could no longer be eaten due to increasing levels of contamination. Other anticipated effects include lower water levels (four percent) and increased erosion (three percent). Five percent of households are uncertain about future effects while four percent believe that conditions will not change.

Continuation of current agricultural activities is anticipated to have a number of effects on northern residents. Nearly 28 percent are concerned that current practices are compromising recreational and environmental opportunities for future generations, and 22 percent expect increases in cancer and other diseases because of these agricultural practices. On the other hand, 16 percent believe that environmental conditions will not change further due to agriculture while

28 percent are unsure. A small proportion of households (seven percent) expect a continuing decline in ecosystem health if there is no change in agricultural practices.

The action most recommended for dealing with agricultural practices is to more tightly regulate the agricultural industry. This recommendation comes from 78 percent of the households that believe agriculture has had a significant impact on water quality or quantity in the basin. Two-thirds of these comments specifically mention controls on livestock. Other suggested actions include monitoring agricultural activities and controlling land clearing (five percent each) and educating farmers about the problems and further studying the problems (three percent each). Six percent of households are unsure about what corrective actions could be undertaken.

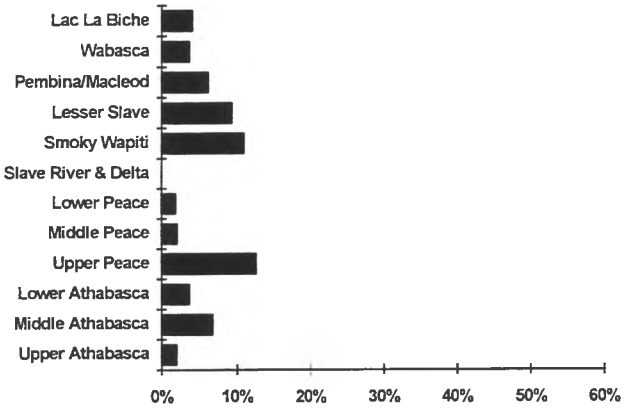
Between nine and 21 percent of stakeholder groups, including 13 percent of agricultural stakeholders, are concerned about the adverse effects of agricultural activities on northern rivers. The most common concern is declining water quality. There are two types of water-quality related concerns: deterioration in water quality due to erosion (caused by land clearing) and contamination caused by the use of agricultural chemicals such as fertilizers, herbicides, and pesticides. Many respondents representing a variety of stakeholder groups feel that agricultural activities has affected the health of fish, wildlife and people. Further reductions in water quality, additional pollution of rivers, and declining fish populations are expected to occur if agricultural activities are not controlled over the next 10 years.

Municipal governments describe several ways in which they are being directly affected by the effects of agricultural activities in the basin. One problem relates to increasing water treatment costs to counteract the effects of agricultural activities. Municipal stakeholders are particularly concerned by the long-term impacts on the costs of operating their water treatment systems if agricultural activities are not controlled in the future. Municipal and local governments are also concerned about having to develop alternative water sources that are not affected by agricultural chemicals and the rising costs of repairing the effects of agriculture-related erosion on hills and roadways.

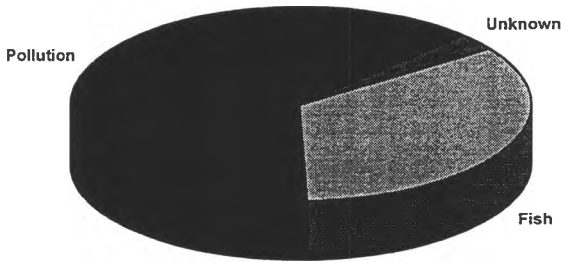
Figure 15-4

Factors Affecting Water Quality and Quantity: Agricultural Chemicals

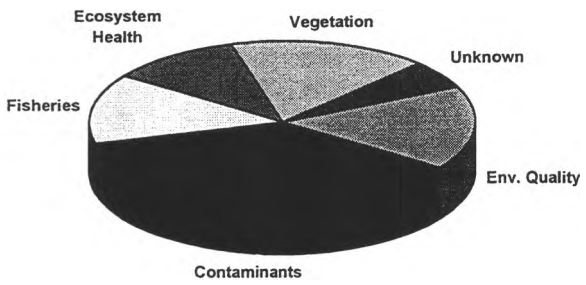
Regional Distribution of Concerns



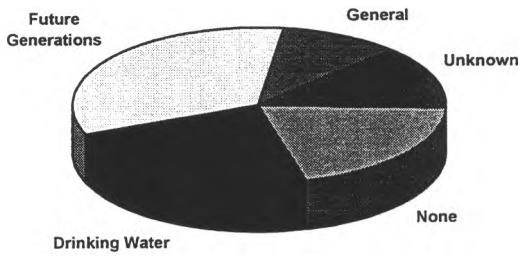
Impacts on Environment in Next 10 Years



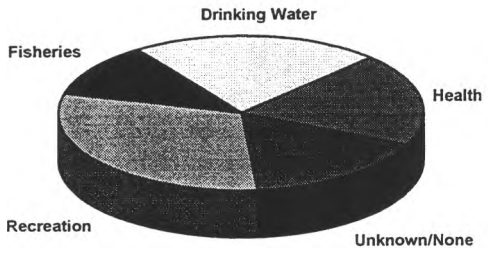
Impacts on the Environment During Past 20 Years



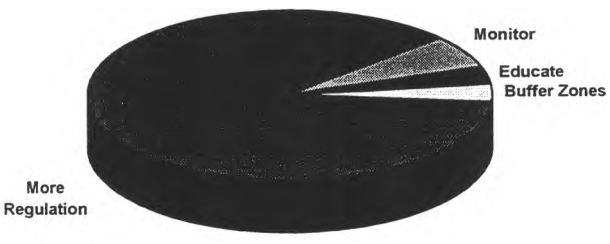
Impacts on Households in Next 10 Years



Impacts on Households During Past 20 Years



Recommended Management Action



Some agricultural stakeholders are also concerned about the effects of agricultural activities on their water supplies. They are worried that continued use of agricultural chemicals will increase their costs of treating water or force them to use treated municipal water. Commercial recreational stakeholders are concerned that the pollution created by agricultural activities will have a negative impact on tourism.

Stakeholder groups recommend various actions to control agriculture-related impacts on rivers and lakes. Aside from a general call for better control and enforcement of activities near water bodies, agricultural, industrial and municipal stakeholders specifically recommend the establishment of buffer zones around or along water bodies. Industrial and municipal stakeholders also see a need for studies to better understand the cumulative and long term effects of agricultural activity.

15.4 Agricultural Chemicals

About seven percent of basin households believe that agricultural chemicals, including fertilizers, herbicides and pesticides, have had an important impact on the aquatic resources of the basin. The use of agricultural chemicals is of above-average concern in the Upper Peace, Smoky/Wapiti and Lesser Slave regions. There is very little concern about this factor in the Upper Athabasca, Middle Peace, Lower Peace and Slave River/Delta regions; less than two percent of households in these regions see agricultural chemicals as a problem. Overall, the use of agricultural chemicals ranks ninth in importance and accounts for four percent of all the water quality/quantity concerns in the basin. Farm households are twice as likely to consider agricultural chemicals to be a threat to the environment compared to urban households. The perception of the threat posed by agricultural chemicals is unaffected by whether the household participated in recreation.

The key environmental effect associated with the use of fertilizers, herbicides and pesticides is increased contaminant levels in water bodies. This effect is reported by 36 percent of households. Increased amounts of algae and a general decline in water quality are each

mentioned by 17 percent of households. Another 11 percent of households are concerned about the effects of agricultural chemicals on ecosystem health. Six percent are unsure how agricultural chemicals affect the environment.

Nearly 17 percent of households indicated that they have not been directly affected by the use of agricultural chemicals. If direct effects have been experienced, most of the impacts relate to a loss of recreational opportunities (31 percent of households), including fishing (11 percent). Contamination of drinking-water supplies is also an important concern (22 percent of households) and another 19 percent of households believe that agricultural chemicals directly affect their health.

Continued use of fertilizers, herbicides and pesticides is expected to have two major impacts on the environment in the future. Increased pollution of water bodies is expected by 63 percent of households, while 34 percent believe that fish populations will decline because of chemical pollution. The remaining three percent of households are unsure about future effects.

Twenty percent of households expect that continued use of agricultural chemicals will have no direct effect on them. Another 13 percent are unsure about future impacts. The remainder are concerned about three types of impact. One-third of households expect that continued use of fertilizers, herbicides and pesticides will substantially impair environmental quality for future generations. Another 23 percent believe that continued use of these chemicals will cause diseases and cancer in northern residents. Ten percent had general concerns about environmental quality.

The vast majority of households concerned about the effects of agricultural chemicals on the aquatic resources of the basin want to see more controls placed on the agricultural industry. Over 87 percent called for more restrictions on the use of fertilizers, herbicides and pesticides, and another three percent propose controlling the use of these chemicals by establishing setbacks from water bodies. Only a few households suggest that monitoring (seven percent) or education

(three percent) can be used to address the concerns associated with the use of agricultural chemicals.

15.5 Oil and Gas

Five percent of households perceive oil and gas operations as factors that have affected the aquatic resources of the northern river basins. This concern comes from households in 10 of the 12 regions, but is of greatest concern to households in the Wabasca region. Over 24 percent of households in this region claim that oil and gas operations have affected the environment. Other regions where oil and gas operations are of concern include the Middle Athabasca and Pembina/Macleod. Farm households are more concerned about the effects of oil and gas operations than are urban households. Of the 14 factors, oil and gas operations rank tenth in terms of the total number of comments.

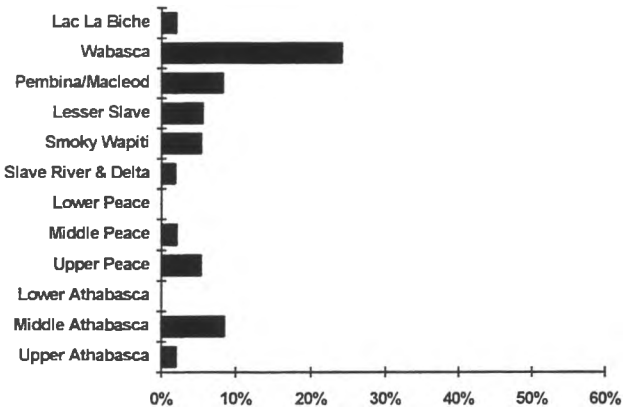
Many households (49 percent) believe that oil and gas operations are responsible for increased levels of contaminants in water bodies. Another 24 percent claim that water quality has been adversely affected by these operations. Minor concerns are that water used by oil and gas operations has reduced water levels (nine percent), that fish populations have been adversely affected (six percent), that air quality has deteriorated (six percent), and that oil and gas operation have caused a decrease in wildlife habitat. Only three percent of households are unsure about the effects of oil and gas operations on the environment, especially in the long term.

The main direct effect of oil and gas operations on northern residents is perceived to be a decline in fish populations and fish becoming more inedible. This effect comes from 28 percent of households. Contamination of drinking water supplies is another major concern, identified by 17 percent of basin residents. Minor concerns include direct impacts on health (seven percent), reduced recreational opportunities (three percent), lower water levels (three percent), air pollution (three percent) and a loss of income from trapping (three percent). However, 35 percent of households believe that they have not been directly affected by oil and gas operations in the basin.

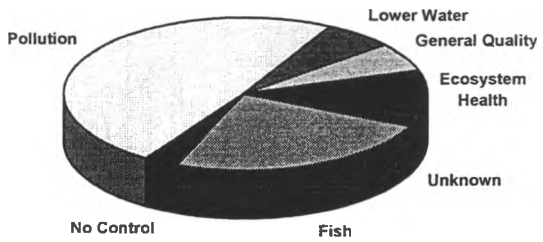
Figure 15-5

Factors Affecting Water Quality and Quantity: Oil and Gas Development

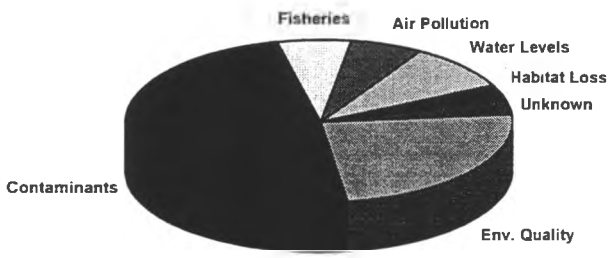
Regional Distribution of Concerns



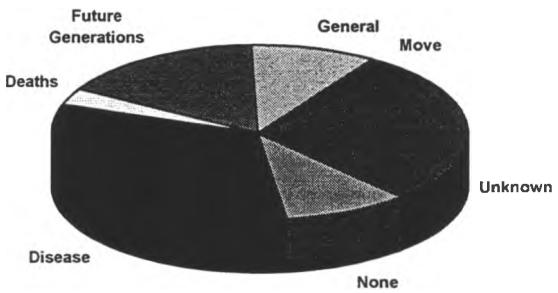
Impacts on Environment in Next 10 Years



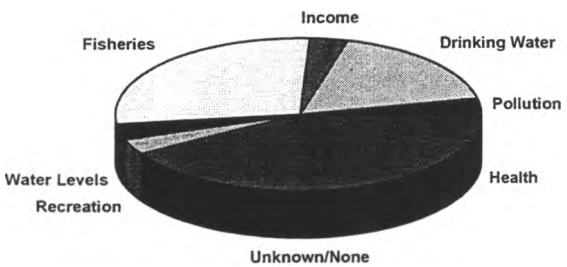
Impacts on the Environment During Past 20 Years



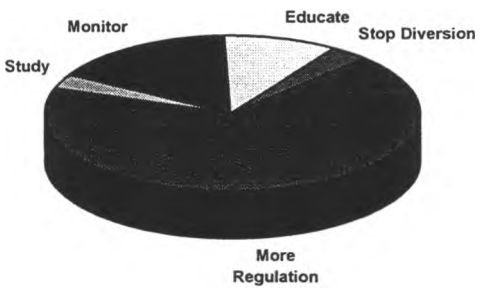
Impacts on Households in Next 10 Years



Impacts on Households During Past 20 Years



Recommended Management Action



The majority of households (54 percent) believe that future oil and gas operations will continue to pollute the aquatic environment or lead to a general decline in environmental quality. A considerable portion (24 percent) also believe that fish populations will decline due to continued oil and gas activities. Others are concerned about the future impacts of the oil and gas industry in terms of lower water levels (six percent) and ecosystem health (nine percent). Only three percent are unsure about the future effects of the oil and gas industry on the environment, and another three percent believe that these effects cannot be controlled.

Ten percent of basin households concerned about oil and gas activities expect that they will not to be directly affected by these operations in the future. Another 26 percent are unsure how they might be affected. For the remainder, the biggest concern (32 percent of households) is in terms of adverse effects on human health, including death (three percent). Concerns about future generations and future environmental quality in general are expressed by 16 percent and 10 percent of households, respectively. A small group claim that they would move out of the basin if conditions get worse.

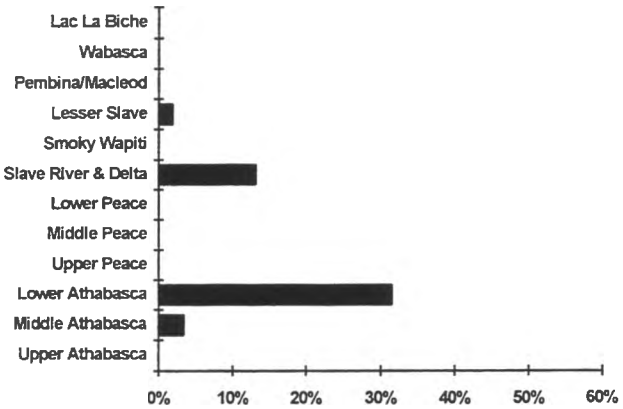
Over 70 percent of households suggest that the oil and gas industry needs to be better regulated. The majority of this group support increased regulations in general, while three percent recommend stopping water diversions for deep well injection and three percent advocate changing waste disposal practices. There is also support for increased monitoring (16 percent), education (10 percent) and studies (three percent) of the impacts of the oil on northern rivers.

With the exception of commercial fishermen, less than four percent of stakeholder groups see oil and gas as one of the most important factors that has affected water quality or quantity in the northern river basins over the last 20 years. Over 18 percent of commercial fishermen are concerned about oil and gas activities in the basin. In the majority of cases, stakeholders are specifically concerned about the negative environmental impacts that the oil and gas industry is having on fish and wildlife. Reduced water quality caused by increasing siltation and spills is another problem.

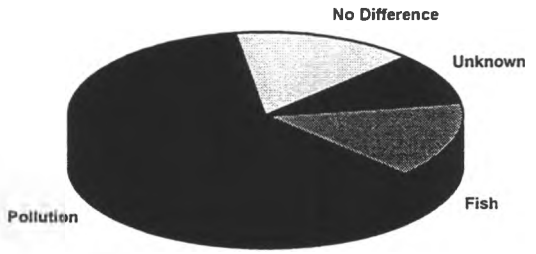
Figure 15-6

Factors Affecting Water Quality and Quantity: Oil Sands

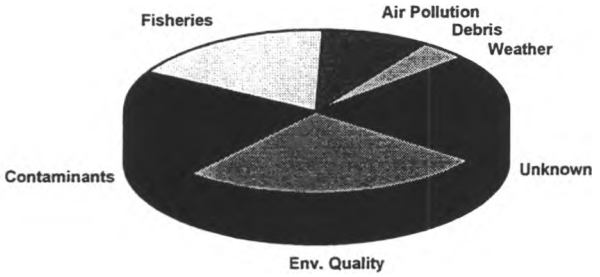
Regional Distribution of Concerns



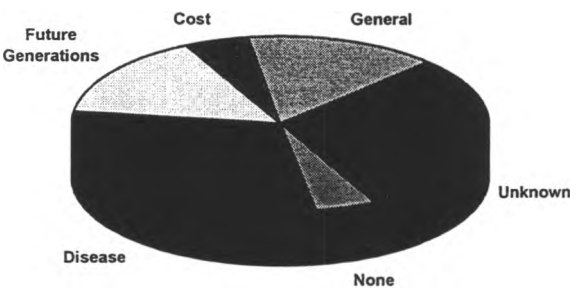
Impacts on Environment in Next 10 Years



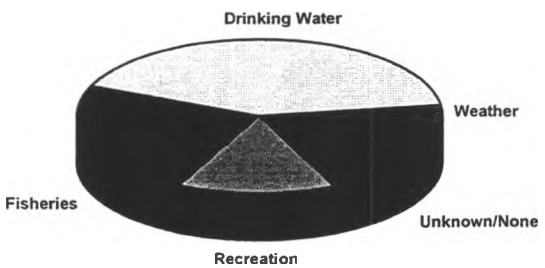
Impacts on the Environment During Past 20 Years



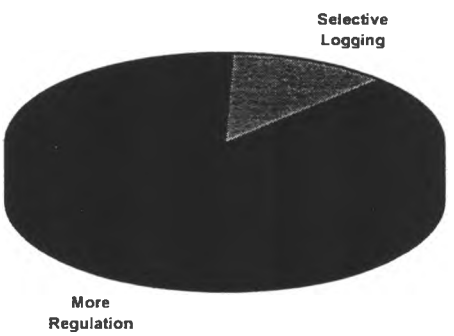
Impacts on Households in Next 10 Years



Impacts on Households During Past 20 Years



Recommended Management Action



In the future, commercial recreation operators are worried that oil and gas roads, drilling sites and processing plants will have a negative impact on the landscape and scenery, thereby reducing tourism potential. Fishermen, industrial and municipal stakeholders predict that oil and gas activities will continue to have a negative impact on water quality. Municipal stakeholders expect that, because of oil and gas activities, their costs of treating raw water now and over the next 10 years will continue to increase.

Stakeholders recommend that oil and gas activities should be more closely monitored and controlled. Many specifically mention the need for better control over air emissions. Decreasing the numbers of new cut lines and the amount of forests being removed because of pipeline activity are also recommended.

15.6 Oil Sands Plants

Oil sands plants are the eleventh most important factor that has affected water quality or quantity in the basin. Concerns about oil sands come from four percent of basin households, with most of these being located in the Lower Athabasca and Slave River/Delta regions. Oil sands are of greater concern to urban households, but this is because there are very few rural households in these two regions.

The major environmental effects of oil sands plants are believed to be a reduction of water quality (26 percent of households), increased contamination of rivers (22 percent), and impacts on fish populations (17 percent). Other effects include a reduction in air quality (nine percent), changed weather patterns (four percent) and more debris in rivers (four percent). Over 17 percent of households are uncertain how the oil sands plants have affected the environment.

For basin residents, impacts on drinking water supplies are the greatest concern, and are mentioned by 35 percent of households. Another 24 percent report that they can no longer catch or eat fish because of the oil sands operations. Other concerns are a general impairment of recreational opportunities (12 percent) and changes in weather patterns (three percent). The

remaining 17 percent of households believe that they have not been directly affected by oil sands plants.

Continued operation of the oil sands plants is expected to have two major environmental consequences. The most common expectation is that plants will continue to pollute the environment (60 percent of households). Another 15 percent of households believe that fish populations will continue to decline because of the oil sands plants. Ten percent of households are unsure how these operations will affect the environment in the future and 15 percent believe that no further damage will occur and that conditions will improve with time.

Thirty percent of households are uncertain how residents of the region will be affected by the continued operations of the oil sands plants, and only five percent believe that they will not be directly affected. The biggest concerns are diseases, including cancer (30 percent of households), further declines in the quality of the environment (15 percent) and impairment of recreational and environmental quality for future generations (15 percent). Five percent also believe that the costs of treating drinking water will rise.

Twelve percent of households concerned about oils sands plants are unsure about what actions could be taken to address their concerns about these plants. The remainder (88 percent) recommend that oil sands plants be regulated to reduce emissions and contaminant loads even further.

Only trappers and industrial stakeholders believe that the oil sands plants have affected water quality or quantity in the northern rivers. The groups raising these concerns are located in the Lower Athabasca region. Trappers feel that the oil sands plants have directly affected their operations and this is due to loss of wildlife habitat. As a result, they recommend that pipelines be located away from rivers and that the levels of discharges from the oil sands plants be continuously monitored and reduced because industry has the ability to comply.

15.7 Seismic and Oil and Gas Exploration

Seismic activities and exploration for oil and gas are the second least important of the 14 factors suggested to have affected water quality and quantity in the northern river basins. Problems associated with seismic activities are reported by only two percent of basin households. The key regions where seismic activities are considered to be important are the Wabasca, Middle Athabasca and Lac la Biche regions. In general, concerns over seismic activities are centred in the tributary basins. Seismic activities are identified as an agent of environmental change in only two of the seven regions adjacent to the mainstems of the Peace, Athabasca and Slave rivers.

The most important environmental effect of seismic activities is increased erosion and the resulting sedimentation of water bodies; this effect is mentioned by 42 percent of households. Another important concern is chemical contaminants, notably oil, in the water (25 percent of households). Minor concerns include declines in fish spawning areas and fish populations (eight percent), losses of wildlife habitat (eight percent), increased debris in rivers and creeks (eight percent) and lower water levels (eight percent).

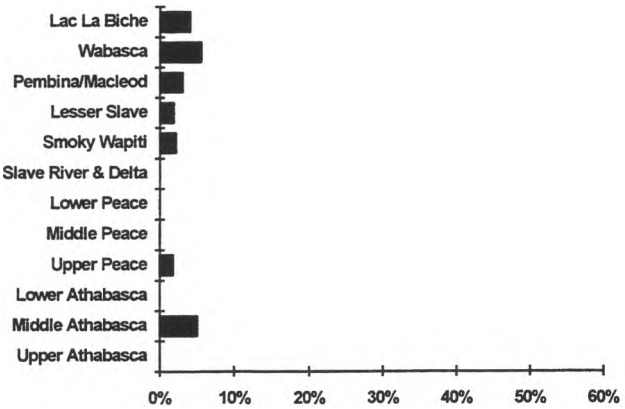
One-quarter of households concerned about seismic activities feel that they have been directly affected by these activities. The greatest concern is a loss of recreational opportunities (25 percent of households). Various other concerns include reductions in trapping income (eight percent), adverse effects on human health (eight percent), impacts on drinking water supplies (eight percent), and lower water levels (eight percent). Another 17 percent of households believe that seismic activities are contributing to the general pollution of land, air and water.

The greatest future concern, in terms of the environment, is that seismic activities will continue to cause a general increase water, land and air pollution (42 percent of households). The continued decline in fish and wildlife populations is another key concern (25 percent). Additional reductions in water levels (17 percent of households) and increased erosion (eight percent) are also mentioned. About eight percent of households are unsure how seismic activities will affect environmental health in the future.

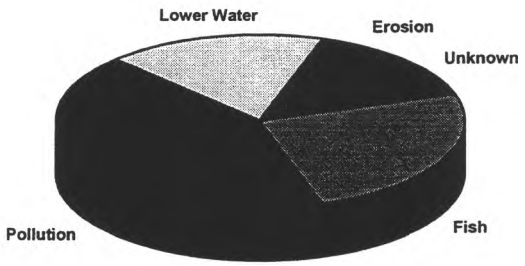
Figure 15-7

Factors Affecting Water Quality and Quantity: Seismic

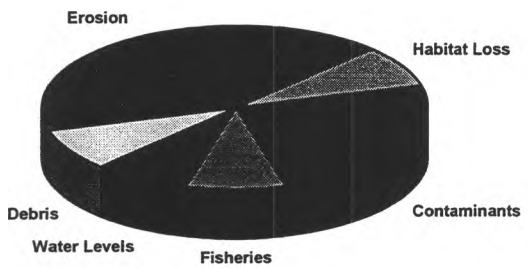
Regional Distribution of Concerns



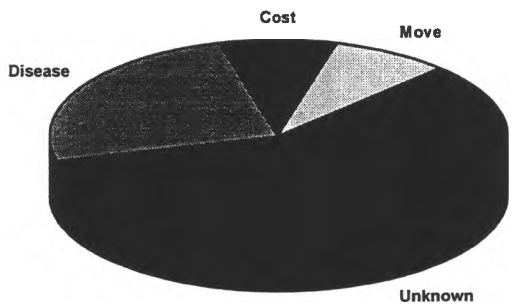
Impacts on Environment in Next 10 Years



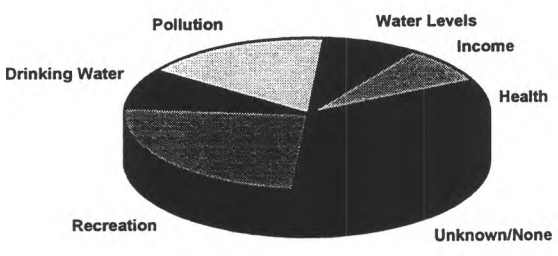
Impacts on the Environment During Past 20 Years



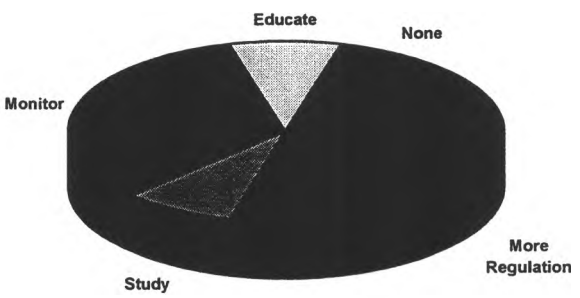
Impacts on Households in Next 10 Years



Impacts on Households During Past 20 Years



Recommended Management Action



The majority of households (58 percent) predict that they will not be directly affected by future seismic activities in the basin. However, 25 percent of households are concerned about future health effects and eight percent expect the costs of treating water will increase. The remaining eight percent claim that they will move out of the region if these activities continue.

The primary suggestion for managing seismic-related problems is increased regulation. This is recommended by 42 percent of households. Many households (33 percent) suggest that the impacts of seismic activities need to be better monitored. A few households recommend studying the problems and developing education programs (eight percent each). Another eight percent recommend that no action be taken because seismic activities are not a significant problem.

Of all the stakeholders, only the commercial fishermen view seismic operations as a threat to water quality or quantity in the basin. Their key concern is that seismic operations cause erosion which could cause sedimentation of spawning beds and a decline in fish populations.

15.8 Coal Mines

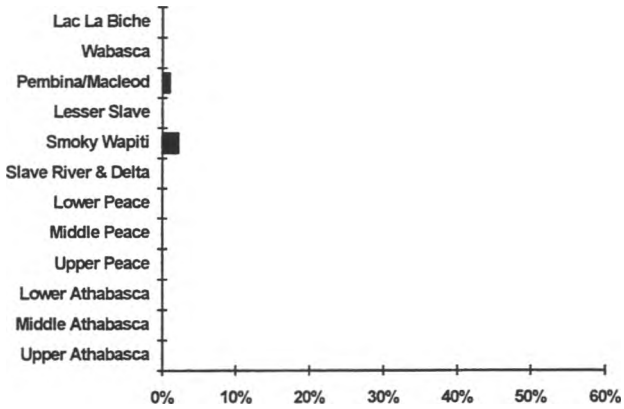
Households in only two regions -- the Smoky/Wapiti and Pembina/Macleod -- have concerns about the effects of coal mines, probably because most of the coal mines in the basin are found in these two regions. However, less than two percent of households in these two regions feel that coal mines have affected water quality or quantity in the basin. This amounts to less than one percent of total households in the northern river basin. The following assessment of how coal mines have affected water quality/quantity and northern households is based on a very small sample size and should be interpreted with caution.

During the past 20 years, households in the two regions believe that coal mines have caused increased erosion and sedimentation (50 percent) and have reduced air quality and caused acid rain (50 percent). If, over the next 10 years, coal operations continue to operate without additional controls, these people believe that fish populations will decline.

Figure 15-8

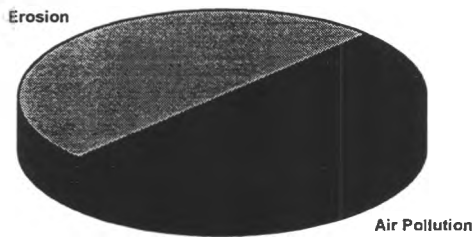
Factors Affecting Water Quality and Quantity: Coal Mines

Regional Distribution of Concerns



Impacts on Environment in Next 10 Years

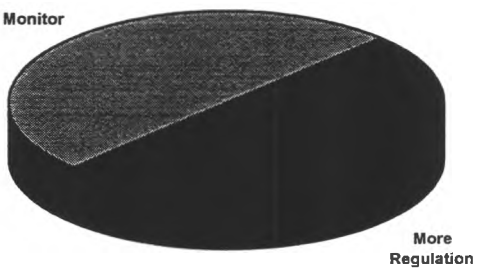
Impacts on the Environment During Past 20 Years



Impacts on Households in Next 10 Years

Impacts on Households During Past 20 Years

Recommended Management Action



Coal operations have had a direct effect on basin households by limiting or impairing their recreational activities (100 percent) and it is expected that continued operation of these mines will make conditions worse in the future. Increased monitoring (50 percent of households) and tighter controls on the coal industry (50 percent) are recommended as the best ways of managing these problems.

The only stakeholder group with concerns about the effect of coals on water quality or quantity in the northern basins is commercial recreation operations. These effects are quite localized, and include excess coal dust in the immediate area of the mines and downstream. It is also claimed that strip mining has destroyed some scenery and that fish quality has been affected.

Better reclamation and dust control are seen as actions that could be recommended to address the environmental concerns associated with coal mines.

15.9 Dams

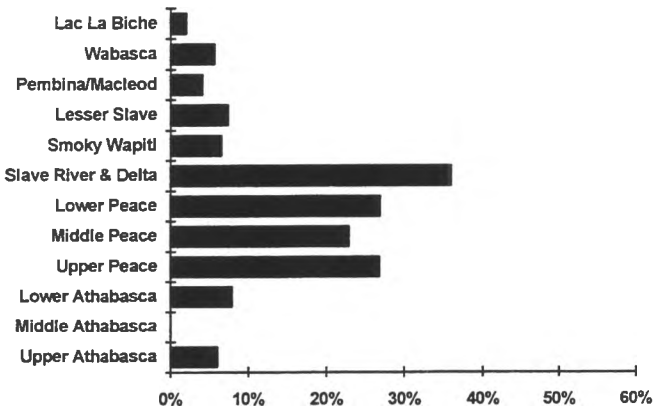
Concerns about dams are highest among households in regions along the Peace River and in the Slave River/Delta region. At least 23 percent of households in these regions indicate that dams, specifically the Bennett Dam on the Peace River in British Columbia, have had a significant effect on water quality and quantity in the basin over the last 20 years. The significance of dams was highest for households in the Slaver River/Delta region, where 36 percent of households identify dams as a key factor, followed by the Upper and Lower Peace regions (27 percent each) and the Middle Peace region (23 percent). As dams are of little importance in the other regions, only 8.2 percent of households in the basin list dams as a key factor on water quality or quantity. The importance of dams is the same for rural and urban households and is not affected by whether or not the household participates in farming or recreation.

The majority of households (59 percent) claim that dams have reduced water levels in the basin, while another 12 percent report that dams have caused flooding, damaging both animal life and habitat. Other reported impacts of dams are that they are having serious overall effects on

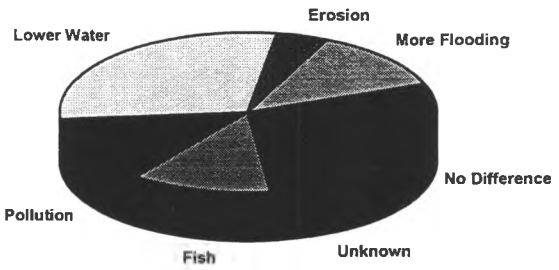
Figure 15-9

Factors Affecting Water Quality and Quantity: Dams

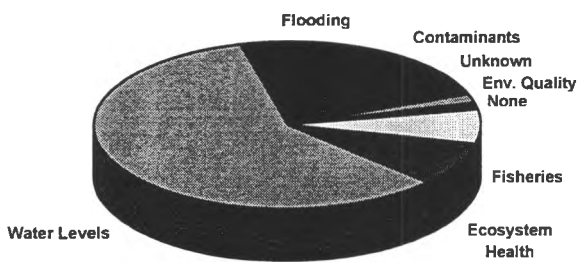
Regional Distribution of Concerns



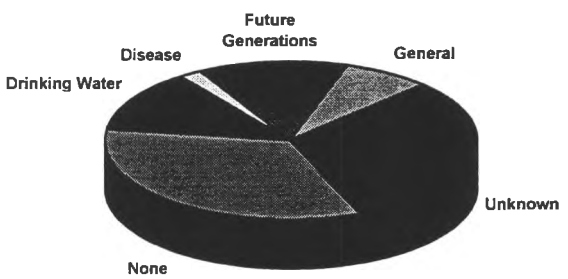
Impacts on Environment in Next 10 Years



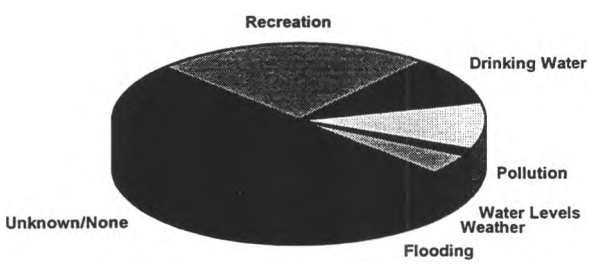
Impacts on the Environment During Past 20 Years



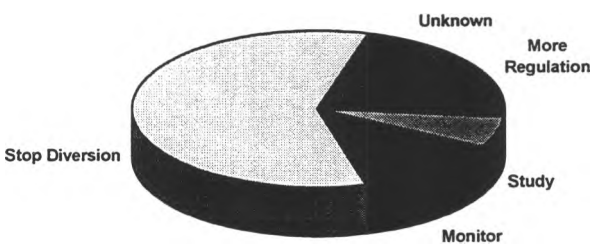
Impacts on Households in Next 10 Years



Impacts on Households During Past 20 Years



Recommended Management Action



habitat. Other reported impacts of dams are that they are having serious overall effects on aquatic ecosystems (eight percent), that they have caused fish populations to decline (three percent), have caused mercury contamination in fish (four percent), or that they have adversely affected water quality (five percent). Another seven percent of households are unsure of the effects of dams, especially over the long run. Only one percent believe that dams are having little or no effect on the health of rivers.

Although dams are of concern to many households, more than 41 percent of these households indicate that there are not directly affected by dams. The most important effect of dams is an impairment of recreation (24 percent of households), especially boating and fishing. Another 10 percent of households feel that dams have affected the quality of their drinking water, while nine percent are directly affected by flooding. The remaining households (16 percent) describe other general impacts of dams to be things like increased pollution and changes in weather patterns.

Without further controls, there is concern that water levels will continue to drop. This concern comes from 29 percent of households. Another 14 percent believe that pollution levels will increase, while 12 percent expect fish populations to further decline, 12 percent expect more flooding to occur, and five percent anticipate increased erosion. However, 18 percent believe that no further changes to the environment will occur or that there is nothing that can be done. Another 11 percent are unsure about the future effects of dams.

One-third of households believe that continued operations of dams will have no direct effect on them, while 32 percent are unsure about future effects. The major effects on households are expected to be deterioration of drinking water (13 percent of households), and a loss of recreational and environmental opportunities for future generations (13 percent). Increased disease is only a minor concern (two percent) and others (seven percent) have general concerns about worsening environmental conditions.

The majority of households (59 percent) feel that the only way of dealing with the problems associated with dams is to stop water diversions and impoundments. Other recommended

actions are to tighten controls on effluent discharges by industry, municipalities and a agriculture (14 percent), to closely monitor river flows (13 percent), and to study the problems further (six percent). About eight percent are unsure about what actions would ameliorate the effects of dams..

Between three and 15 percent of stakeholder groups report significant concerns related to dams and their effects on water levels and water quality. Trappers, commercial recreation operations, agricultural groups, and municipal stakeholders identify some specific problems associated with lower water levels. These problems include lower flows and reduced in fish and wildlife habitat and populations. Another concern is the relationship between water level flows and water quality.

The commercial recreational group is particularly concerned that fluctuations in water levels produce muddy, silty water which, in turn, affects conditions for boat launches and fish populations. There are also concerns that fluctuating water levels have resulted in more debris in the water and the emergence of more sand bars. The commercial recreational group are particularly concerned that if river management is uncontrolled the consequence will be more flooding, the eventual kill-off of fish populations, and that it will become too dangerous to use the river for business purposes. Municipal and local governments predict that unless regulated rivers are better controlled, there will be a loss of arable land due to erosion and that water quality will slowly decline.

Trappers, commercial recreational operations and the one river transportation company have very significant concerns with the short and long-term negative impacts to their business operations. The trappers blame dams for losses in animal populations in the Peace-Athabasca delta area, including muskrat, waterfowl, small animals, foxes lynxes, and fishers. The commercial recreational group state that the river can be unusable due to mud and debris, and that muddy water creates poor docking, swimming and fishing conditions. Too much debris on the river can also be dangerous for boating. The river transportation company reports that the slow down of the flow from Mile 138 of the Athabasca River to Lake Athabasca has resulted in heavy

sedimentation of the Embarrass Channel and Richardson Lake, thereby reducing fish spawning success in this area.

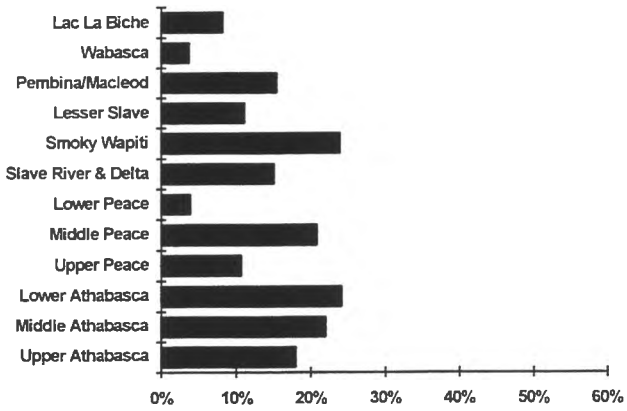
The majority of trappers, commercial recreational operations, municipal and local governments, and the river transportation company are concerned about the long-term negative business impacts that will result unless the operating regimes of dams are modified. The trappers feel threatened by the continued loss of habitat and trapping opportunities. Commercial recreation operations involved in boat tours are worried about potential losses of revenue and increased costs of operation. Municipal stakeholders indicate that uncontrolled river management will cause people to move elsewhere and negatively impact tourism potential and growth. The river transportation group believe that, in the long term, sedimentation will increase and channels will be plugged, shipping will require extensive dredging, and the Athabasca river will ultimately be diverted by Creed Creek directly to the Quatre Fourches River. Industrial stakeholders and many municipal stakeholders report that their operations are not affected currently by dams nor is this expected to change in the future.

The majority of stakeholders recommend that changes be made to the operating plans for dams. They recommend that outflows should be managed according to wildlife and other natural demands and that large and drastic fluctuations in regulated flows be stopped . Specific recommendations include the desire to restore the Peace-Athabasca delta by increasing spring flows, establishing minimum flow requirements for Peace River at the Bennett Dam, putting in a rock structure at Dog Camp on the Quatre Fourches River and rock weirs on the other outflows from the delta, and cleaning out the old channel from the Richardson River to Richardson Lake.

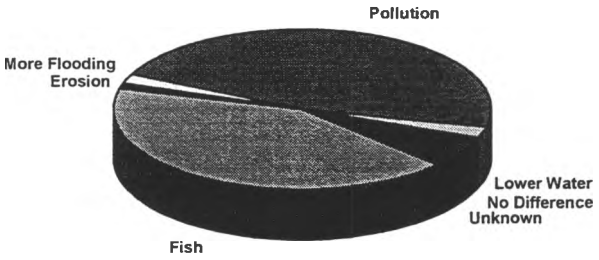
Figure 15-10

Factors Affecting Water Quality and Quantity: General Industry

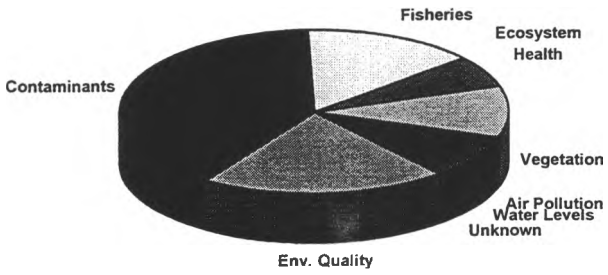
Regional Distribution of Concerns



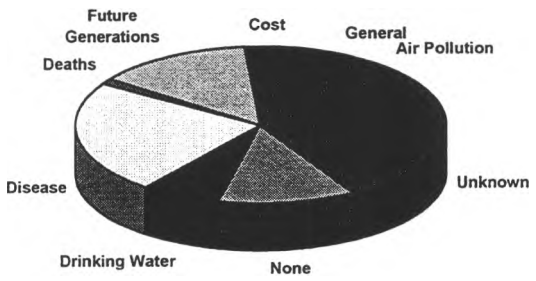
Impacts on Environment in Next 10 Years



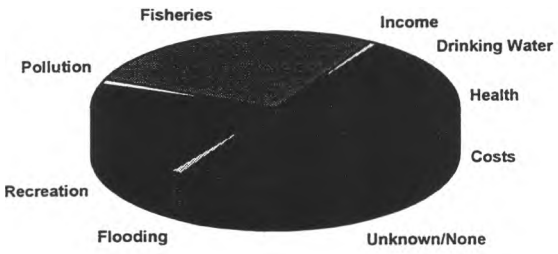
Impacts on the Environment During Past 20 Years



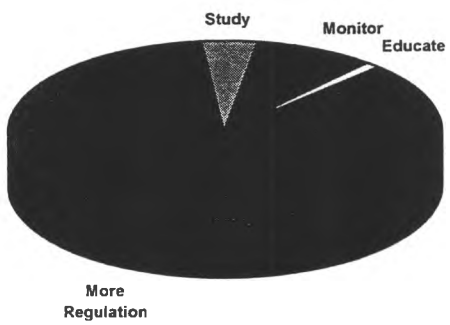
Impacts on Households in Next 10 Years



Impacts on Households During Past 20 Years



Recommended Management Action



15.10 General Industry

Although many households claim that one or more specific industries have adversely affected water quality or quantity in the northern river basins, many households (18 percent) just identified industry in general as being of concern. Overall, general industry ranks third in terms of total comments. Concerns about general industry tend to be higher in urban areas that in rural areas. The regions where general industry is perceived to have had a significant effect on environmental quality include the Lower Athabasca, the Smoky/Wapiti, Middle Athabasca and Middle Peace regions. At the same time, less than four percent of households in the Lower Peace or Wabasca regions are concerned about industry in general.

The greatest concern about general industry relates to chemical contamination of water bodies, through both discharges and run-off. Over 40 percent of households have this concern. An associated concern is that industry has caused a general deterioration in water quality (20 percent of households). Industry is also claimed to have had adverse impacts on fisheries populations (15 percent). Some households (10 percent) report that industrial activities have caused a reduction in vegetation in the basin while increasing algae levels in water bodies. Smaller numbers of households are concerned that industry has an adverse impact on ecosystem health (six percent), has caused lower water levels (three percent), and has reduced air quality (two percent). Four percent of households are unsure what effects industry is having on the environment.

Industrial activities are perceived to have had less of a direct effect on households in the basin. Many households (32 percent) indicate that they are unaffected or unsure how they are affected by industrial activity. A considerable portion of households (21 percent) feel that industrial activities have affected recreational activities, in that water levels are too low for boating and the water is too dirty for swimming. Another 27 percent believe that industrial activities are responsible for contaminated fish and declining fish populations. Only 12 percent are concerned that industrial activities have affected their water supply and one percent believe that water treatment costs have risen because of industrial activities in the basin. Small numbers of

households feel that industrial activities have affected their incomes (one percent) or caused flood damage (one percent). Some households also report that industrial activities have adversely affected their health (four percent), with air pollution being mentioned by another one percent.

Basin residents have two key concerns about the future environmental effects of industrial activities. Over 46 percent are concerned that additional pollution of the environmental will occur, resulting in a general deterioration of the aquatic environment. Another 42 percent are convinced that fish populations will continue to decline. Three other effects are also expected. Some households are concerned about more flooding (two percent) while a similar proportion are worried about lower water levels. One percent are concerned about worsening erosion problems. Five percent are unsure about future effects while only one percent claim that continued industrial activity will have no direct effect on the environment.

About 60 percent of households believe that they will be adversely affected by continued industrial activity, while 29 percent are unsure and 11 percent believe that they will be unaffected. Increased disease, including cancer, is expected by 24 percent of households, while one percent even expect deaths to occur. Almost 14 percent of households believe that continued industrial activity will adversely affect recreation and environmental quality for future generations. Another nine percent are concerned about a general increase in pollution levels. Deterioration of drinking water supplies is of concern to seven percent of households and four percent believe that water treatment costs will rise.

The most-recommended approaches for managing these problems are better regulation of industries and reductions in industrial-effluent loads in the rivers. This recommendation comes from 84 percent of households. An additional two percent suggest the use of selective logging to reduce erosion. Other recommended actions include monitoring industrial effluents (nine percent), more studies (four percent) and public education (one percent).

For many stakeholders, especially environmental and recreation groups and agricultural groups, industrial development in general is perceived to have had a negative impact on water quality in the basin and, if not controlled, will lead to the gradual decline of the health of the rivers. Trappers and agricultural stakeholders are particularly concerned about adverse effects on fish and wildlife populations. Agricultural, industrial and municipal stakeholders are worried about water contamination and toxicity.

All stakeholder groups state that, if uncontrolled, industrial development will cause a decline in the health of the river ecosystem and further contamination of fish and wildlife. One municipal stakeholder is also concerned about cattle operations. Agricultural stakeholders are worried about the contamination of water table and wetlands.

In comparison, many industrial stakeholders are not as quick to conclude that the health of northern rivers will continue to deteriorate if industrial development is not controlled over the next ten years. They believe that the health of the rivers will depend on the type and extent of industrial development that occurs over the next ten years. They also suggest that the assimilative capacity and the net affect of cumulative impacts must be further examined in the basin.

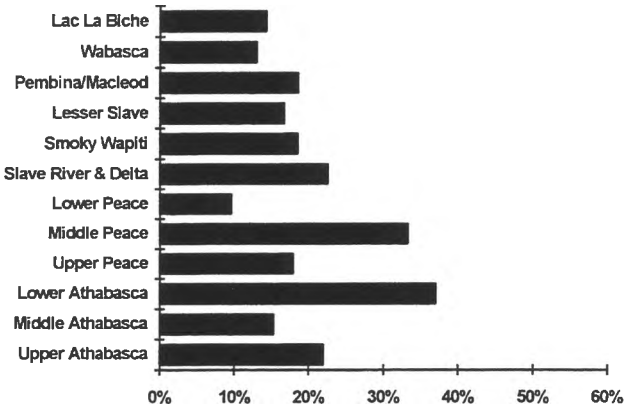
In terms of immediate and long-term affects to business operations, trappers and agricultural groups are most concerned about industrial development causing reductions in wildlife populations and poor water quality affecting cattle and crops. If industrial development remains uncontrolled these two stakeholders foresee significant business impacts. The agricultural group worries that a decline in water quality caused by industrial development will force them to search for alternative and more expensive sources of water, and will also limit tourism potential and fishing.

The majority of industrial stakeholders state that uncontrolled industrial development will have no effect on business operations. However, they caution that heavy controls could put northern companies at a competitive disadvantage with companies elsewhere. Some industrial

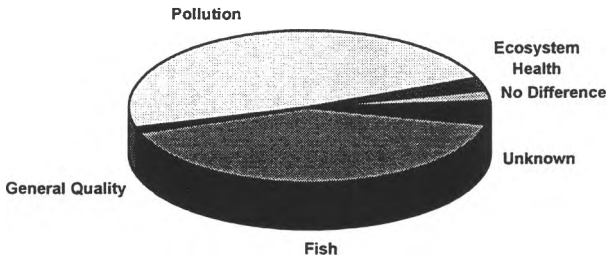
Figure 15-11

Factors Affecting Water Quality and Quantity: Municipalities

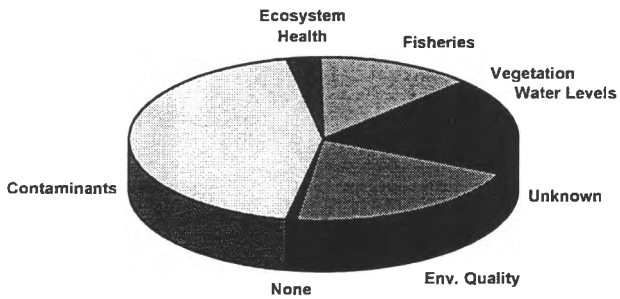
Regional Distribution of Concerns



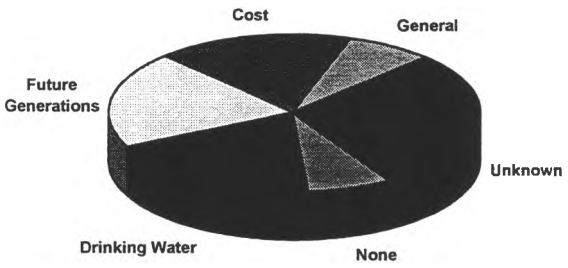
Impacts on Environment in Next 10 Years



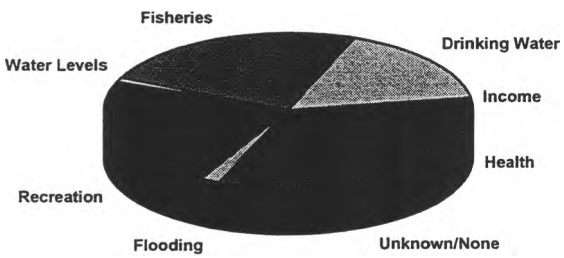
Impacts on the Environment During Past 20 Years



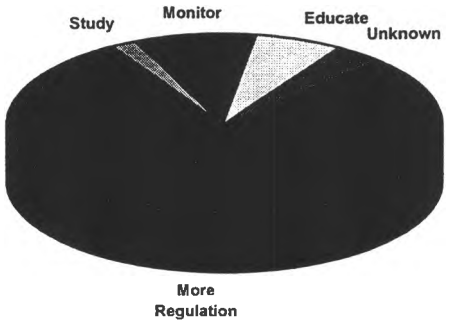
Impacts on Households in Next 10 Years



Impacts on Households During Past 20 Years



Recommended Management Action



stakeholders believe that quality and quantity of effluent will improve anyway. Municipal stakeholders see a conflict between the very positive fiscal benefits of industrial development with the increasing costs of water storage, treatment and metering to meet industrial demands.

To deal with industrial development in general, many stakeholder groups are calling for more monitoring, regulations and enforcement of existing regulations. The specific recommendations include reducing the amounts of effluent being discharged (including zero discharge into rivers), restricting domestic and industrial waste flows, regulating rivers to simulate natural flows, requiring that mill water intake be placed downstream of discharge points, approving no new industrial projects until the effects of current one are known, using existing data to undertake more accurate environmental impact assessments of proposed projects, and preparing a river management plan that identifies river assimilative capacities.

15.11 Municipal Water Use

Municipal sewage is the second most important factor affecting water quality and quantity in the basins. This factor is of concern to 21 percent of households in the basin. This proportion ranges from only 10 percent of households in the Lower Peace region to 37 percent of households in the Lower Athabasca region. Urban households are more concerned about the effects of municipal effluent than are rural households.

The key concern about municipal effluent is impacts on water quality. While 20 percent of households believed that municipalities are causing a general deterioration of water quality in the basin, another 44 percent claim that municipal sewage is a significant source of contaminants and 13 percent believed that sewage is having a serious effect on the health of the aquatic ecosystem. Over 13 percent of households link declining fisheries populations to municipal sewage discharges and four percent blame increased algae levels on these discharges.

Water quantity is a concern to four percent of households which claim that municipal water use has caused a reduction in water levels. One percent of households report that municipal

discharges are not affecting fish or water quality in the basins, but 11 percent are unsure about what environmental effects have occurred.

A large percent of households (27 percent) do not believe that municipal sewage is having any effect on their household or are unsure. However, the remainder identify three major ways in which they are being affected. Nearly one quarter (24 percent) claim that fish populations have declined and that fish are contaminated and cannot be eaten. A similar proportion (23 percent) feel that the quality of recreational opportunities has declined. Another 18 percent believe that municipal effluents have adversely affected their drinking water supply. Six percent suggest that municipal effluents have adversely affected their health and is even responsible for birth defects. The remainder blame municipal effluents for a decline in their incomes from trapping.

The most important future environmental concerns are that continued discharges of municipal effluents will either contribute to more pollution of rivers (48 percent of households) or will further diminish and contaminate fish populations (41 percent). Further declines in ecosystem health are predicted by another four percent of households. The remaining seven percent of households are either unsure about future effects (five percent) and are convinced that no further impacts will occur.

The most frequent recommendation for managing the problems associated with municipal sewage is to better regulate and control sewage discharges. This recommendation comes from 79 percent of households that are concerned about municipal sewage. Additional monitoring is suggested by nine percent of households, while others recommend more public education (six percent) or more studies (two percent). Four percent are unsure what actions should be undertaken to manage municipal sewage.

Commercial recreation operations and agricultural stakeholder groups are most concerned about municipal water use and its effects on water quality and quantity in the basin. Municipal sewage effluent is viewed as a major threat to water quality. Trappers and agricultural stakeholders are

worried that, if this activity remains uncontrolled, fish will become inedible and the recreational use of the river will decline, thereby affecting business operations.

Industrial stakeholders claim that municipal sewage will have no immediate or long term affect on their operations. However, trappers foresee a loss of habitat, wildlife and income if current municipal sewage treatment practices are allowed to continue. And, although some agricultural stakeholders are concerned about the impact that municipal sewage is having on the overall health of the rivers, the long term impacts of these operations are of less concern.

The major recommendation for the control of municipal water use is better and stricter enforcement regarding sewage. Specific recommendations made by the various stakeholder groups include tightening existing guidelines on effluent discharges, more regulation of land clearing and development by municipal and local governments, use of better sewage treatment systems, and developing alternative methods of sewage disposal, such as spreading it on land.

15.12 Recreation/Tourism

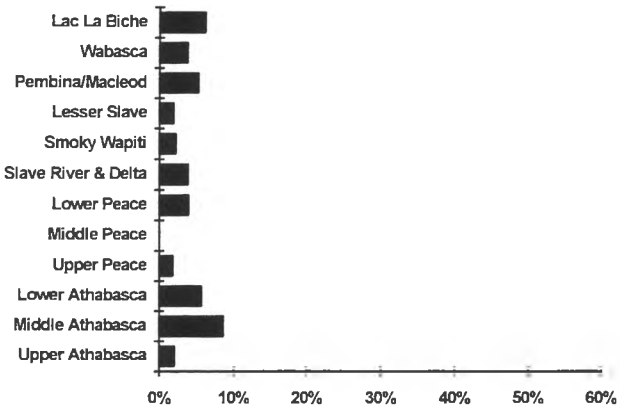
Recreation and tourism rated twelfth overall on the list of factors that have affected water quality and quantity in the basin during the past 20 years. Concerns about these activities come from four percent of households in the basin. Households in the Middle Athabasca region are most concerned about the effects of recreation and tourism, and there is also above-average concern by households in the Lac la Biche and Lower Athabasca regions. However, none of the households in the Lower Peace region recognize recreation or tourism as being an important factor affecting the water resources of the basin. Households that participate in recreation and urban households tend to be more concerned about the effects of recreation and tourism on water than are rural households or households that do not participate in recreational activities.

Garbage left by recreationists and tourists is the greatest environmental concern for northern residents. This issue is of concern to 45 percent of households. Pollution caused by outboard motors is seen as an issue by 21 percent of households while seven percent blame recreational

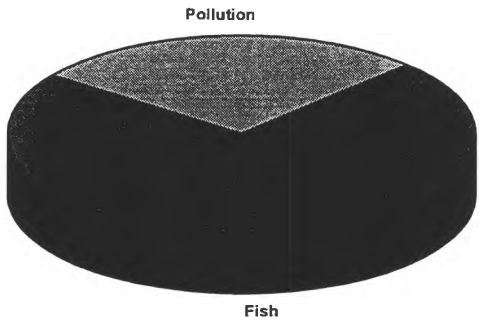
Figure 15-12

Factors Affecting Water Quality and Quantity: Recreation and Tourism

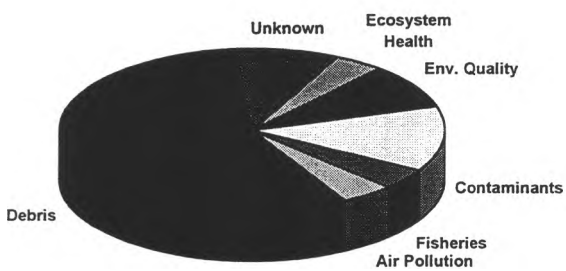
Regional Distribution of Concerns



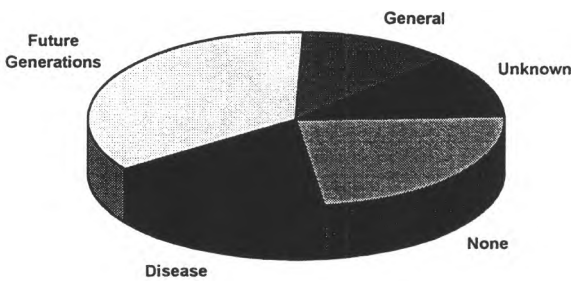
Impacts on Environment in Next 10 Years



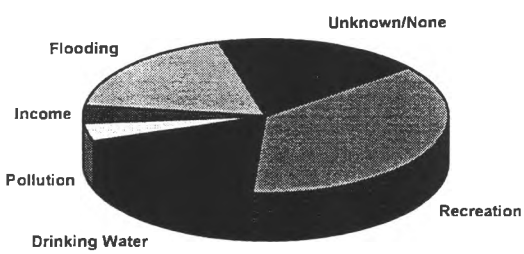
Impacts on the Environment During Past 20 Years



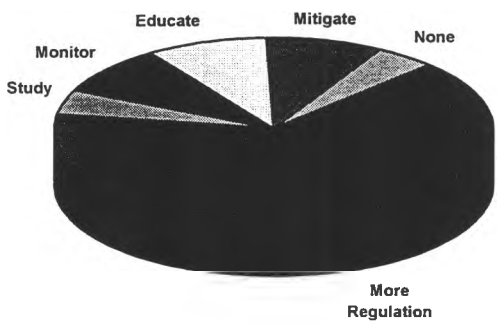
Impacts on Households in Next 10 Years



Impacts on Households During Past 20 Years



Recommended Management Action



activities for a general decline in water quality and 10 percent claime that recreational vehicles are source of environmental contaminants. Other environmental effects associated with recreation and tourism during the past 20 years include a decline in fish populations (one percent), adverse effects on air quality (one percent), and a reduction in ecosystem health (one percent). Seven percent of households are unsure how recreation and tourism has affected the water resources of the basin.

Nearly one out of five households (19 percent) believe that recreational and tourist activities in the region have not affected them directly. However, many of the remaining households are concerned that their use and enjoyment of the recreational resources of the basins are being adversely affected by other recreationists and tourists. About 37 percent report that the recreational quality of the area has deteriorated: there are fewer fish to catch, fewer animals and more disturbances of the land. Another 19 percent feel that crowding and increased accessibility of recreational areas is a concern and one percent believe that these activities are polluting the air and the water. Another large portion of the basin households (19 percent) report that recreation and tourism activities have adversely affected their drinking water supplies. One percent believe that their incomes from trapping have dropped because of growing recreational and tourism activities in the basin.

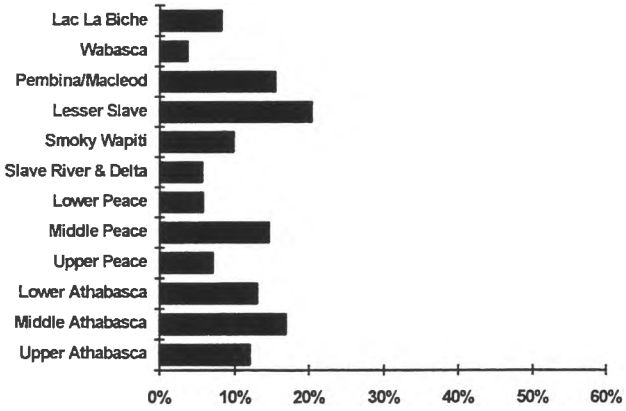
Households concerned about tourism and recreation predict two types of impacts on the environment if no steps are taken to manage these activities. The majority (73 percent) expect fish and animal populations in the basin will decline. The remainder (27 percent) predict that general pollution in the basin will continue to rise.

Continuation of current recreational and tourism practices is anticipated to affect northern households in a number of ways. The greatest concern is that the quality of recreational opportunities for future generations will be compromised (35 percent of households), while another 12 percent predict a general decline environmental conditions. Some (18 percent) even expect recreational and tourism to have an adverse effect on human health. On the other hand,

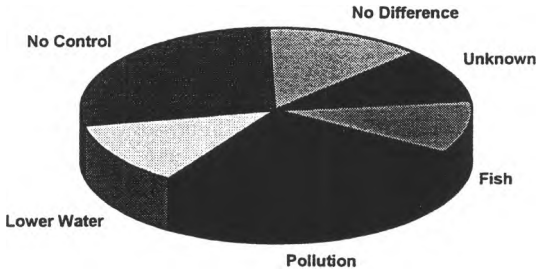
Figure 15-13

Factors Affecting Water Quality and Quantity: Natural Conditions

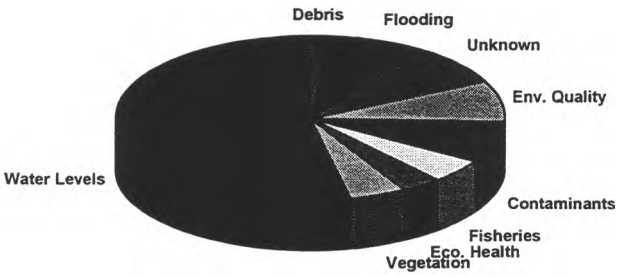
Regional Distribution of Concerns



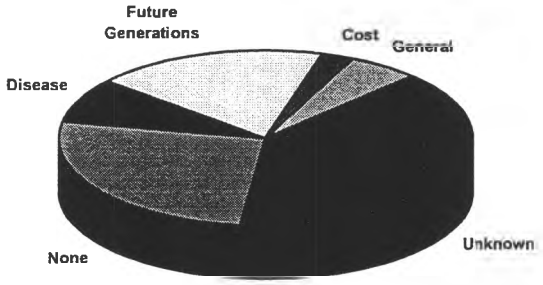
Impacts on Environment in Next 10 Years



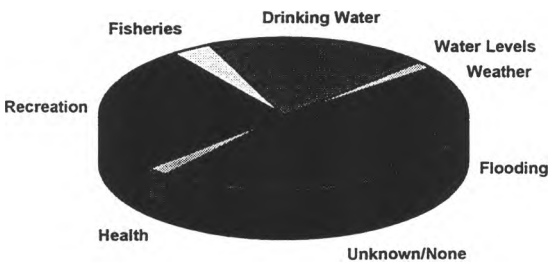
Impacts on the Environment During Past 20 Years



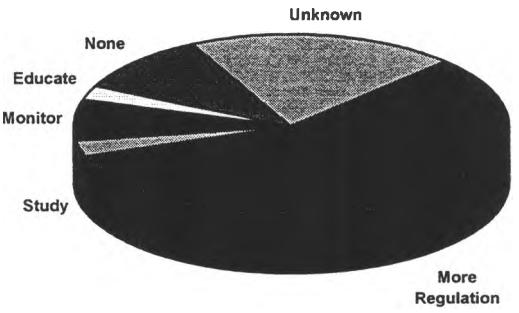
Impacts on Households in Next 10 Years



Impacts on Households During Past 20 Years



Recommended Management Action



nearly 24 percent feel there will be no direct effects on northern households and 12 percent are undecided.

Increased regulation and control of recreation and tourism activities is the most-frequently suggested mechanism for managing the environmental problems associated with these activities. Some households recommend regulating waste disposal practices (13 percent), and others (17 percent) suggest restricting the use of motorized vehicles for recreational purposes. Another 35 percent call for increased regulation in general. Other recommended actions include increased monitoring (nine percent), mitigation of adverse effects including fish stocking (nine percent) and more public education (nine percent). Only one percent suggest studying these problems and another one percent believe that these activities do not represent a significant problem.

15.13 Natural Conditions

Survey respondents are seeing changes in a number of natural conditions, such as low water levels, changing weather conditions and reduced snowfall, that have affected the quality or quantity of water resources in the basin during the last 20 years. Over 12 percent of households describe one or more of these conditions, and natural conditions rank sixth in terms of frequency of comments. Concerns about natural factors are high in six of the 12 regions. These regions include all three along the Athabasca River plus the Middle Peace, Pembina/Macleod and Lesser Slave regions. Farm households tend to be more sensitive to the effects of these natural conditions that are urban households.

More than half (53 percent) of households report that low water conditions have affected water quality or quantity in the basins. One third of these blame this on below-normal snow and rainfall. On the other hand, eight percent of households report that natural factors have lead to increased flooding problems. Other environmental changes resulting from variability in natural conditions include more vegetation (five percent), more natural contaminants (eight percent), a general decline in water quality (eight percent), fewer fish (five percent), and declining

ecosystem health (three percent). Another eight percent are unsure how changes in weather and other natural conditions have affected the water resources of the basin.

Nearly one third of households (32 percent) do not believe that they have been directly affected by changing weather and moisture conditions during the past 20 years. Of those that are directly affected, many households (27 percent) complain about losing recreational opportunities, including water levels being too low for boating. Four percent report that fish populations have declined. Others (20 percent) claim that lower water levels have affected their drinking water supplies. Some households have general comments about changes in weather patterns (nine percent) or increased flooding (five percent). Two percent are complaining that these natural factors have adversely affected their health.

Many people (28 percent) believe that there is no way of controlling natural factors, like weather, and another 13 percent expect that any changes that might occur are just part of natural trends. However, others expect that continuation of recent weather patterns will cause further reductions in water levels (13 percent) and reduced fish populations (11 percent). A general increase in pollution levels is also expected (26 percent). Eleven percent of households are uncertain about future effects.

Only about a third (34 percent) of households believe that they will be adversely affected if recent trends in weather conditions continue. About 26 percent expect no effects while 40 percent are unsure how they might be affected. Anticipated effects include a loss of recreation and environmental opportunities for future generations (18 percent), more drinking water problems (eight percent), higher water treatment costs (three percent), and a general decline in environmental quality (two percent).

Although many of the changes in environmental conditions are attributed to what were considered "natural" conditions, a considerable portion of households (58 percent) believe that steps can be taken to minimize that adverse consequences of these conditions. For example, some (eight percent) want water diversions to end, 12 percent want effluent discharges into water

bodies to be reduced, and 10 percent want land use practices, such as reducing clear-cut logging, to be changed. The other 28 percent of households just call for increased regulation in general terms.

Less frequent suggestions are that conditions be monitored (seven percent) or studied (three percent), or that public education programs be developed (three percent). However, 10 percent suggest that no recommendations be made to deal with the natural factors that are affecting water resources and 20 percent are unsure how these changes could be managed.

The majority of stakeholder groups see lower rain fall and drought conditions as the most significant natural problems affecting the health of the rivers. Trappers, agricultural, recreation and industrial groups all describe specific problems caused by decreased precipitation, low water levels, and low flow. These problems include contamination of water and fish populations because of less dilution, reduced small animal populations due to dried-out sloughs, and disrupted spawning of fish. Industrial water users believe that lower water volume has caused increased sedimentation, contamination, and warmer water temperatures which, in turn, have negatively affected fish and vegetation. A small percentage of trappers and industrial stakeholders complain that they are being unfairly accused of causing negative environmental impacts that are actually due to natural causes.

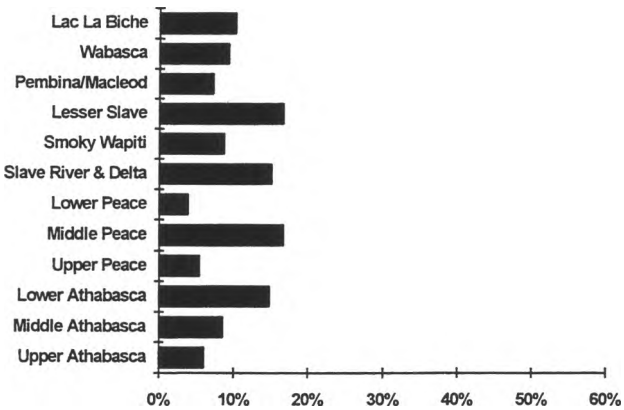
In terms of direct effects on stakeholders, industrial water users believe that their operations will not be affected by low water levels now or in the future. Trappers are worried that any continuation of low water levels will mean additional reductions in animal populations and that this will further affect their livelihood.

The majority of suggested recommendations focus on the need for various water management practices that would ameliorate natural problems. These recommendations include allowing natural runoff in spring and summer (no new dams), rain dancing and cloud seeding to increase precipitation, implementing better operating plans for existing water control structures, and

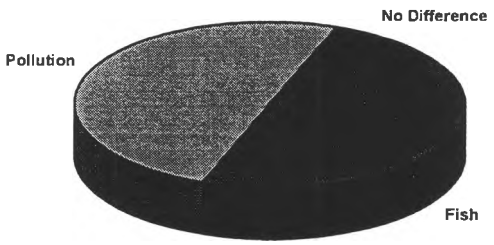
Figure 15-14

Factors Affecting Water Quality and Quantity: General Pollution

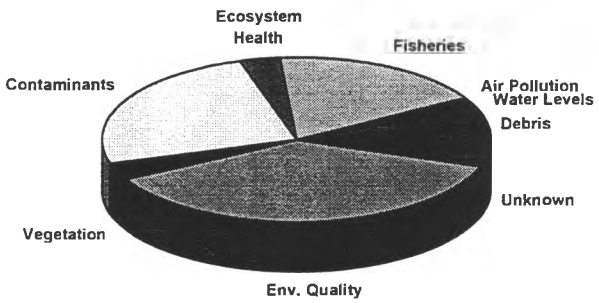
Regional Distribution of Concerns



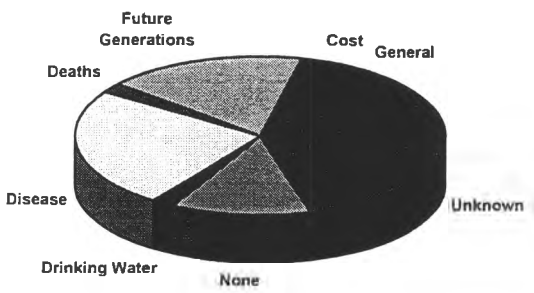
Impacts on Environment in Next 10 Years



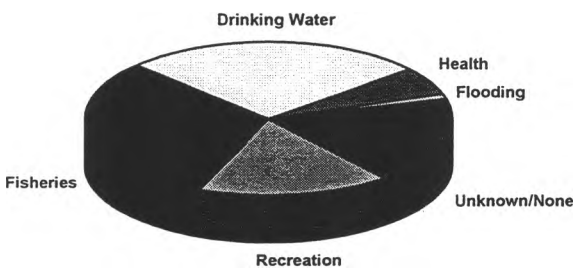
Impacts on the Environment During Past 20 Years



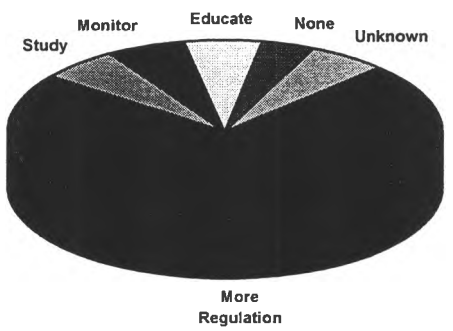
Impacts on Households in Next 10 Years



Impacts on Households During Past 20 Years



Recommended Management Action



increasing publicity that demonstrates that variability in water levels is a natural phenomenon and is little affected by human activities.

15.14 General Pollution

Although most households tied pollution effects to a specific type of land or water use, just over nine percent are concerned about pollution in general. These households are largely urban and do not participate in recreational activities. Concerns about general pollution problems are most frequent among by households in the Middle Peace, Lesser Slave, Slave River/Delta and Lower Athabasca regions. General pollution effects rank seventh overall in terms of frequency of responses.

Over the past 20 years, pollution in general is perceived to have caused a wide range of environmental problems. Most households (37 percent) report that water quality has deteriorated because of pollution and 25 percent are concerned about higher levels of contaminants in rivers and lakes. Another 18 percent suggest that fish populations have declined. Numerous other problems are identified. These include increased vegetation (algae) growth (three percent), more garbage (two percent), lower water levels (three percent), and increased air pollution (two percent). Three percent are concerned that ecosystem health has declined. Seven percent are unsure how pollution in general has affected the quality or quantity of water in the northern river basins.

About 19 percent of households feel that they have not been directly affected by pollution in the basin. The most significant effect of pollution on households is related to recreational activities. While 17 percent complain that the recreational qualities of the study area have been declining due to pollution, 31 percent specifically mention declining fish populations and problems with contaminated fish. Pollution of drinking water is another concern, and is mentioned by 27 percent of households. Six percent said that their health has been adversely affected by pollution.

Two types of environmental effects are expected if pollution is to continue. Many households (48 percent) are concerned about the effects of pollution in general, while 42 percent expect fish and wildlife populations to continue to decline. A few households (three percent) are concerned about declining ecosystem health. Seven percent expect that no additional changes will occur.

The effects of continued pollution on northern households are of considerable concern. Many households (25 percent) believe that pollution will cause increased diseases, like cancer, and other health problems while a small proportion (two percent) feel that pollution will directly cause some deaths. Drinking water is a minor concern (two percent of households) and four percent expect the costs of treating water for drinking to increase. Another major concern is that continued pollution will limit recreational and environmental quality and opportunities for future generations (18 percent of households). One-third of households that are concerned about general pollution effects are unsure how they might be directly affected but 12 percent expect no additional changes to occur.

Increased regulation of industrial, municipal and agricultural activities is the recommended approach for managing these general pollution problems. Tighter controls are suggested by 73 percent of households concerned about pollution. Other actions, such as more studies, increased monitoring, and developing education programs, are each suggested by six percent of households. A small number (four percent) believe no action is necessary and six percent are uncertain how to manage these problems.

Between two and 16 percent of all stakeholder groups report that general pollution has affected water quality, fish and wildlife populations, and vegetation in the northern river basins. Trappers have specific concerns about reductions in furbearer breeding habitat and believe that pollution is causing a concentration of contaminants in fish populations.

All stakeholder groups, except municipal and local governments, see various negative consequences of allowing general pollution to continue over the next 10 years. These consequences include negative affects on water quality and fish and wildlife populations. The

agricultural stakeholders and the river transportation company also predict that uncontrolled pollution will lead to a reduction in recreational activities and tourism/ecotourism opportunities.

Stakeholder groups are divided on the affect that general pollution will have on future business operations. Trappers, commercial recreation and agricultural stakeholders are all concerned about the viability of their operations if general pollution remains uncontrolled. Reductions in furbearers, trapping areas, water quality, and reduced tourism and recreation potential will have significant impacts on their incomes. However, the majority of industrial claim that uncontrolled pollution will have no effect on their operations.

Stakeholder see a number of ways to deal with general pollution problems and enhance the quality of water in the northern basins. Their recommendations include reducing the amounts of effluents being discharged from any source (including zero discharge), full treatment of all effluents, and placing controls on land-use activities (such as agriculture) that can cause non-point sources of pollution.

16.0 ECOSYSTEM HEALTH AND MONITORING

Two of the overall objectives of the Northern Rivers Basins Study are to assess the health of northern rivers and to recommend how ecosystem health is to be monitored. While work to address these objectives is being done as part of other projects being undertaken as part of the NRBS, where ecosystem health is being defined in terms of biological factors, the survey was used to ask northern residents and stakeholders to describe river health in their own terms. They were also asked to describe how the health of northern rivers should be monitored; what should be monitored; how frequently should monitoring be done, who should do the monitoring; and, who should pay for monitoring.

Initial analysis of the household survey responses yielded 78 different measures of ecosystem health. However, there was considerable overlap between some of these measures and ultimately these were combined into 13 general categories. Four of these categories were reported by less than one percent of basin households; these categories include climate, air quality, erosion and groundwater. Another category consists of management actions rather than measures of ecosystem health. Thus, survey responses generated eight major categories of ecosystem health. As shown in Table 16-1, these eight include water quality, water quantity, pollutants, ecosystem health, fish ,vegetation, wildlife, and human use.

In all 12 regions, the three most frequently mentioned measures of ecosystem health are water quality, the size and health of fish populations, and the types of pollutants entering the system. As shown in Table 16-1, these three measures are described by 55 percent, 38 percent and 28 percent of households, respectively. For the other five less important categories, there is considerable variation from region to region. However, the overall pattern of responses shows no significant differences among regions.

The corresponding survey results for the stakeholder groups are summarized in Table 16-2. The pattern of river health measures reported by most stakeholder groups is similar to the survey responses from northern households. Water quality is the most frequently mentioned measure

Table 16-1

Major Measures of River Health Identified By Households in the Northern River Basins

(Percent of Households)

	Water Quality	Water Quantity	Pollutants	Ecosystem Health	Fish	Vegetation	Wildlife	Human Use
Upper Athabasca	52.0%	8.0%	44.0%	8.0%	40.0%	12.0%	0.0%	4.0%
Middle Athabasca	52.5%	10.2%	23.7%	10.2%	35.6%	6.8%	5.1%	5.1%
Lower Athabasca	66.7%	13.0%	25.9%	11.1%	48.1%	7.4%	3.7%	7.4%
Upper Peace	51.8%	16.1%	30.4%	7.1%	23.2%	5.4%	1.8%	5.4%
Middle Peace	56.3%	10.4%	31.3%	2.1%	39.6%	0.0%	0.0%	8.3%
Lower Peace	32.7%	5.8%	21.2%	0.0%	26.9%	3.8%	5.8%	0.0%
Slave River/Delta	52.8%	20.8%	32.1%	3.8%	34.0%	1.9%	3.8%	7.5%
Smoky/Wapiti	70.7%	10.9%	28.3%	6.5%	35.9%	4.3%	1.1%	5.4%
Lesser Slave	70.4%	13.0%	20.4%	9.3%	50.0%	13.0%	1.9%	5.6%
Pembina/Macleod	35.1%	13.4%	29.9%	5.2%	38.1%	10.3%	0.0%	6.2%
Wabasca	63.0%	5.6%	13.0%	0.0%	59.3%	9.3%	1.9%	1.9%
Lac la Biche	32.7%	2.0%	14.3%	4.1%	34.7%	4.1%	0.0%	6.1%
Total	54.7%	11.4%	28.4%	6.7%	38.0%	7.2%	1.5%	5.7%

of river health for seven of the eight stakeholder groups. Fish populations and levels of pollutants are also the second and third most frequently mentioned health measures. All other river health measures are of minor importance except for water quality. Four of eight stakeholder groups feel that water quality is a more important measure of river health than is suggested by the results of the household survey.

16.1 Water Quality

Nearly 55 percent of households suggest measuring the quality of water as a means of assessing the health of northern rivers. Various aspects of water quality are suggested. While some respondents suggest monitoring specific features like oxygen levels or certain types of contaminants, nearly 40 percent of the survey respondents just mention water quality in general terms.

Water quality is the most common measure of river health reported by households in 10 of the 12 regions. Monitoring of water quality is of considerable importance in the Smoky/Wapiti, Lesser Slave, and Lower Athabasca regions. In these three regions more than two-thirds (66 percent) of households suggest that various aspects of water quality be measured to assess the health of northern rivers. In comparison, water quality is mentioned by less than one-third of households in the Lac la Biche and Lower Peace regions.

As shown in Figure 16-1, about 62 percent of the water quality measures being selected relate to specific indicators that could be used to assess river health. About 21 percent of suggested water quality measures involve testing river water for general levels of contaminants while 10 percent of comments suggest monitoring for toxic substances. Biological measures include oxygen levels (six percent of responses) and levels of phosphorous and other nutrients (six percent). Other suggested measures include monitoring the colour or appearance of water (11 percent of responses) and monitoring taste and smell (eight percent).

Table 16-2

Major Measures of River Health Identified By Stakeholders in the Northern River Basins

(Percent of Respondents)

	Water Quality	Water Quantity	Pollutants	Ecosystem Health	Fish	Vegetation	Wildlife	Human Use
Households	54.7%	11.4%	28.4%	6.7%	38.0%	7.2%	1.5%	5.7%
Environmental and Recreation Groups	76.7%	18.6%	13.9%	9.3%	27.9%	0.0%	2.3%	4.7%
Municipal and Local Governments	41.2%	2.9%	8.8%	2.9%	11.8%	0.0%	0.0%	5.9%
Commercial Recreation Operators	41.2%	23.5%	11.8%	0.0%	23.5%	0.0%	0.0%	17.6%
Industrial Water Users	47.7%	11.4%	15.9%	4.5%	29.5%	0.0%	0.0%	2.3%
Agricultural Groups	50.0%	5.6%	27.8%	0.0%	22.2%	0.0%	0.0%	0.0%
Agricultural Service Boards	71.4%	28.6%	28.6%	0.0%	42.9%	14.3%	0.0%	28.6%
Commercial Fishermen	25.0%	18.8%	12.5%	0.0%	31.3%	0.0%	0.0%	0.0%
Trappers	44.4%	11.1%	11.1%	0.0%	66.7%	0.0%	0.0%	0.0%

There are some regional variations in what aspects of water quality should be tested. Testing for oxygen is suggested more frequently by households in the Middle Peace and Lesser Slave regions. Suggestions for monitoring levels of pollutants account for over 30 percent of the water quality measures proposed by households in the Wabasca region but less than 10 percent of Middle Athabasca region households. Levels of toxic substances are more important to households in the Smoky/Wapiti and Middle Athabasca regions. Water smell is of concern to households in the Wabasca region while the greatest support for monitoring water colour and appearance comes from households in the Middle Athabasca and Lesser Slave regions. Concerns about nutrient levels come from households in the Middle and Upper Peace regions.

Stakeholders also describe the same sorts of water quality measures. About 48 percent of responses propose specific measures of water quality. These include levels of contaminants in the water (27 percent of responses), levels of phosphorous and other nutrients (six percent), oxygen levels (five percent), toxic substances (three percent), and testing of sediments (four percent). Representatives of environmental and recreation groups and local and municipal governments show more interest in testing for levels of contaminants than do the other stakeholder groups.

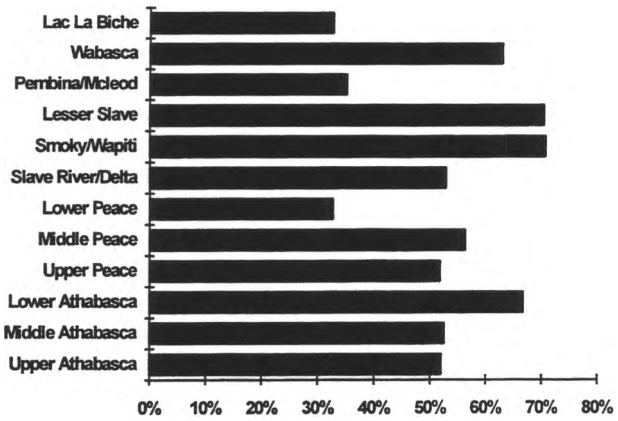
Suggestions on how frequently water quality should be monitored range from hourly to every five years. However, the largest portion of the responses support testing water quality monthly (38 percent) or weekly (26 percent). Less than 19 percent of households propose yearly or less frequently. A similar percentage (17 percent) report that water quality ought to be tested daily or more frequently. Stakeholder groups also suggest that water quality should be monitored monthly (45 percent) or weekly (21 percent).

Households are split on who should be responsible for monitoring water quality: 42 percent favour government, while 32 percent propose that monitoring be done by an independent agency. About 10 percent support the idea that water-quality monitoring be done by universities, while nine percent suggest that this monitoring be done by the general public.

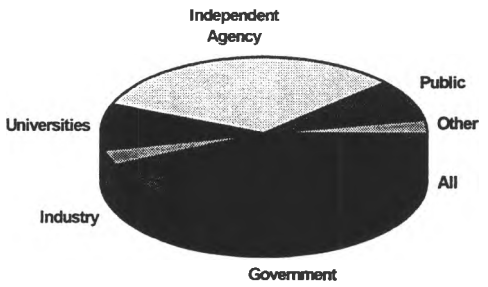
Figure 16-1

Measures of River Health: Water Quality

Regional Support for Monitoring Water Quality



Responsibility for Monitoring



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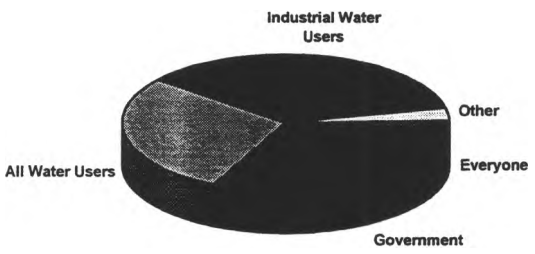
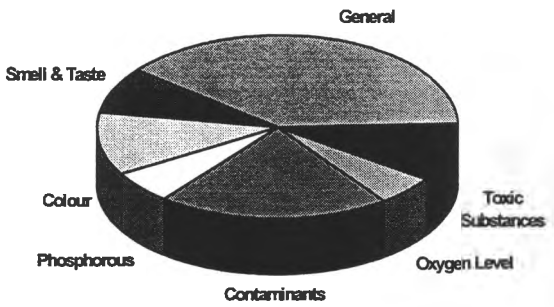
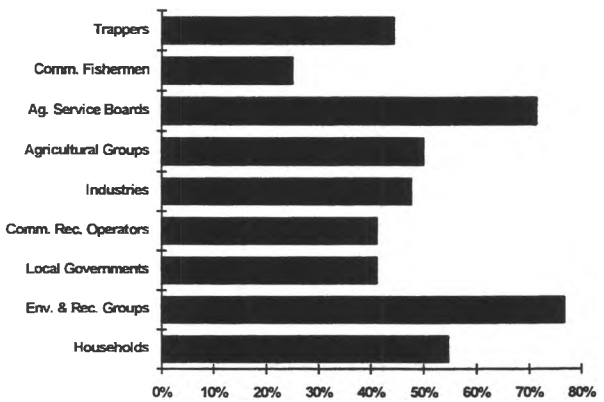


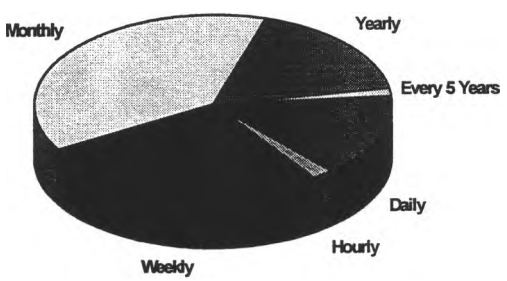
Key Water Quality Indicators



Stakeholder Support for Monitoring Water Quality



Frequency of Monitoring



Only three percent of households believe that industry should be responsible for the monitoring. Stakeholder suggestions for who should undertake water-quality monitoring are nearly identical to the household responses.

While basin residents show little support for industry being responsible for water quality monitoring, many (36 percent) feel that industry should pay the costs of monitoring. In comparison, 31 percent feel that government should pay these costs and 29 percent believe that monitoring costs should be borne by all water users. Stakeholders propose different responsibilities for monitoring costs. Over 40 percent feel that these costs should be borne by all water users while only 26 percent believe that industry should pay these costs. About 27 percent of stakeholders feel that the government should pay for the costs of water quality monitoring.

16.2 Water Quantity

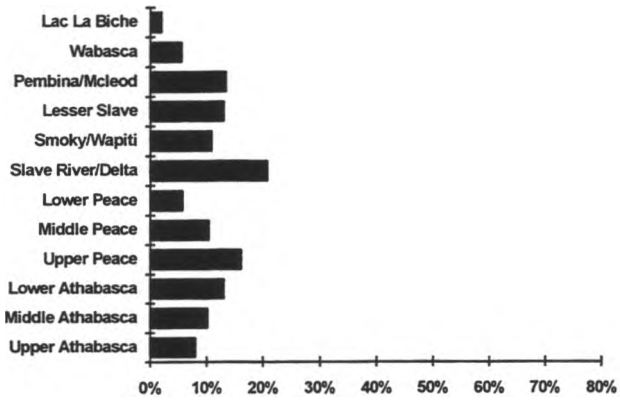
About 11 percent of households think that the health of the rivers should be measured in terms of water quantity, and they suggest that flows be monitored. The need to monitor flows is particularly important for households in the Slave River/Delta (20.8 percent) and the Upper Peace (16.1 percent) regions Less than six percent of households in the Lac la Biche, Wabasca, and Lower Peace regions consider flow monitoring to be a measure of river health. In general, water quantity and monitoring of flows are of greater concern to households in regions along the Peace River basin and the Slave River/Delta than elsewhere in the basins.

Table 16-2 shows that 11 percent of industrial water users and trappers also recommend measuring river health in terms of river flows. Most other stakeholder groups place greater emphasis on monitoring flows. These groups include agricultural service boards (29 percent of respondents), commercial recreation operators (24 percent), commercial fishermen (19 percent) and environmental and recreation groups (19 percent). Less than six percent of local and municipal governments or agricultural groups suggest that river flows be monitored.

Figure 16-2

Measures of River Health: Water Quantity

Regional Support for Monitoring Water Quantity



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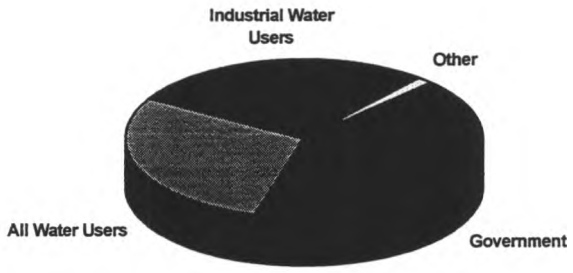
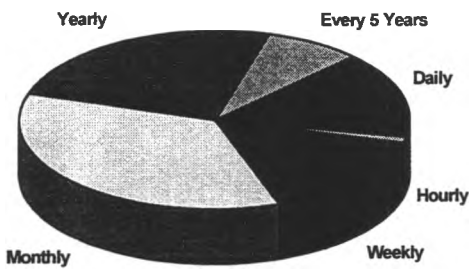
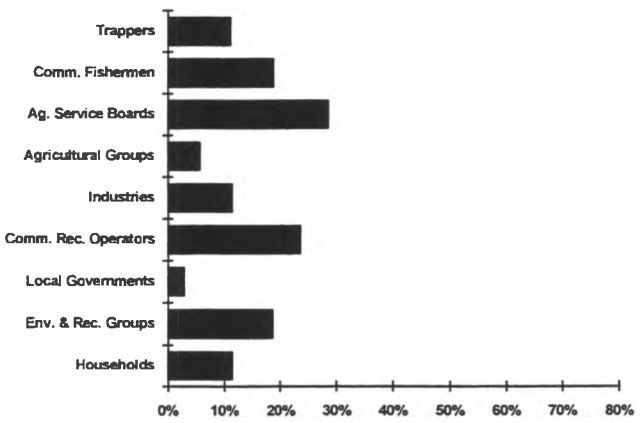


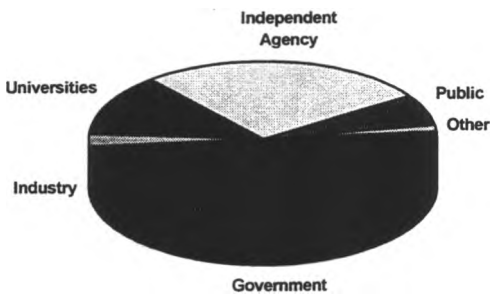
Frequency of Monitoring



Stakeholder Support for Monitoring Water Quantity



Responsibility for Monitoring



There is strong support for monitoring rivers flows on a monthly basis. This is recommended by 37 percent of households. Another 28 percent of households believe that yearly testing is sufficient. Monitoring on either a weekly basis or a daily basis is suggested by 16 percent of households. Stakeholders propose less frequent monitoring of river flows. Nearly 38 percent of stakeholders recommend measuring flows every year, while 29 percent suggest monthly monitoring. Another 17 percent propose weekly flow measures while 13 percent are in favour of daily monitoring.

Half of the households believe that government should be responsible for monitoring river flows while 27 percent favour the concept of an independent agency overseeing the monitoring. Giving universities responsibility for flow monitoring is supported by 13 percent of households and only three percent think that flow monitoring should be done by industry. Stakeholders have the same suggestions, with 50 proposing that this is a government responsibility and 20 percent suggesting this be done by an independent agency.

Many households (42 percent) also believe that government should be responsible for the financing of the monitoring system. Another 29 percent feel that all water users should pay for the monitoring while 28 percent think that this cost should be borne by industrial water users.

For basin households, the emphasis on government taking responsibility for flow monitoring may reflect their recognition that flow issues go beyond individual water users and, in the case of the Peace River, involve other provincial governments. Stakeholders, on the other hand, are nearly equally split on who should pay for flow monitoring. While 30 percent support having the government pay monitoring costs, 35 percent believe these costs should be borne by all water users and a similar percent suggest that industrial water users pay these costs.

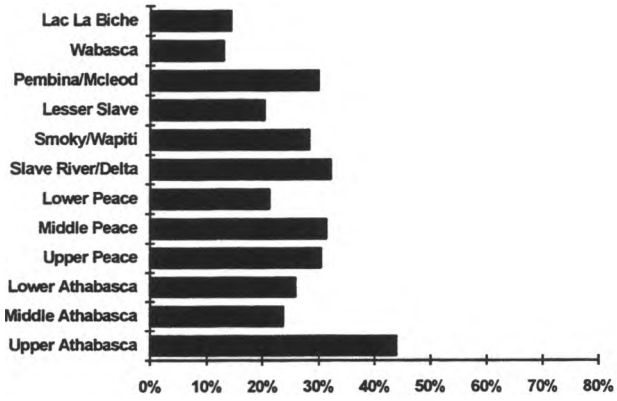
16.3 Pollutants

Within the basin about 28 percent of households believe that river health can be assessed by monitoring the amount and types of pollutants entering rivers. Above average interest in

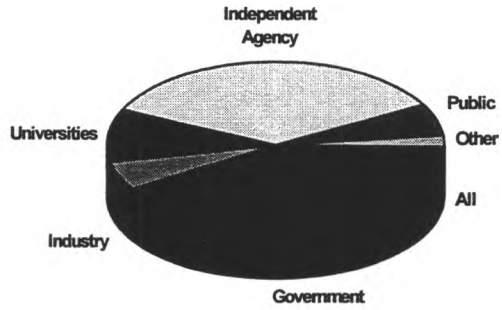
Figure 16-3

Measures of River Health: Monitor Pollutants

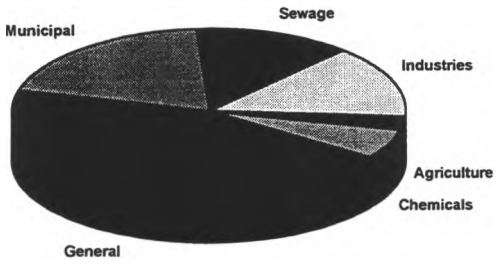
Regional Support for Monitoring Pollutants



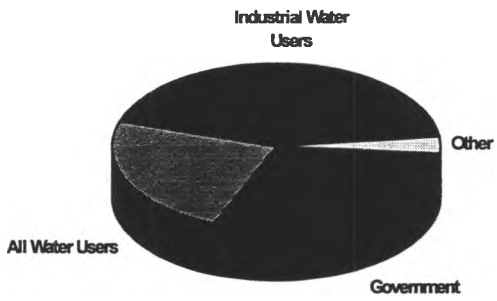
Responsibility for Monitoring



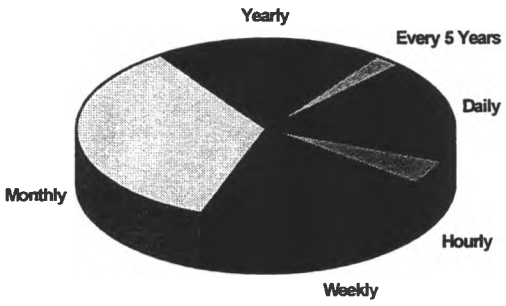
Key Sources of Pollution



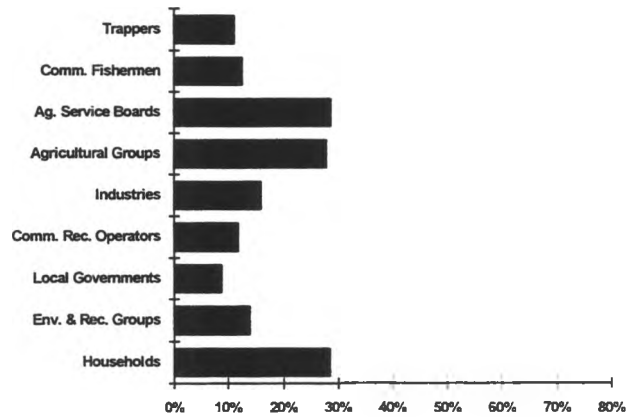
Financial Responsibility for Monitoring



Frequency of Monitoring



Stakeholder Support for Monitoring Pollutants



monitoring pollutants comes from households in the upper reaches of the Athabasca and Peace rivers, the Middle Peace region and the Slave River/Delta region. However, less than 15 percent of households in the Wabasca or Lac la Biche regions suggest that river health can be assessed by monitoring pollutants.

This category of response includes both general reference to pollutants and various specific types of pollutants. As noted in Figure 16-3, the key sources of pollution include municipalities (18 percent of responses), industries (13 percent), and agriculture (three percent). Other responses target sewage (12 percent) and chemical (five percent). The remainder (42 percent) offer general comments about measuring pollutants. While concerns about industrial pollutants are fairly evenly distributed throughout the basin, the concerns about municipal effluent are centred in the Upper Athabasca, Smoky/Wapiti and Pembina/Macleod regions.

Similar measures are proposed by stakeholders. While many stakeholders (36 percent) propose monitoring pollution levels in general, 46 percent of responses suggest monitoring municipal effluent and four percent believe that agricultural pollution should be assessed. Although none of the stakeholders specifically mention measuring effluents from industry, 11 percent feel that chemical pollutants should be monitored.

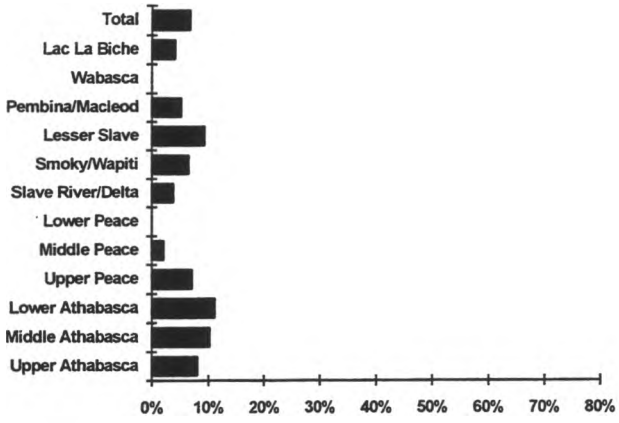
Monthly measurements are the preferred frequency of monitoring. This is proposed by 35 percent of households. Weekly testing is suggested by 24 percent of households while 19 percent support yearly tests. Another 18 percent of households feel that pollutants should be tested daily. Stakeholder groups show no overall preference. The same proportion of respondents (26 percent) suggest that pollutants be monitored every week, every month, and every year.

In terms of who should be responsible for monitoring pollutants, more households recommend an independent agency (38 percent) than any other organization. There is also very strong support for government monitoring (37 percent). Only small number of responses suggest that pollution monitoring be done by universities (nine percent) or industry (seven percent). A

Figure 16-4

Measures of River Health: Ecological Indicators

Regional Support for Ecological Indicators



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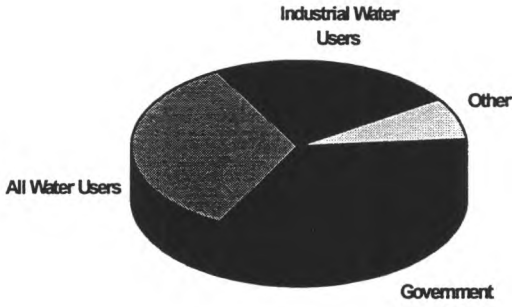
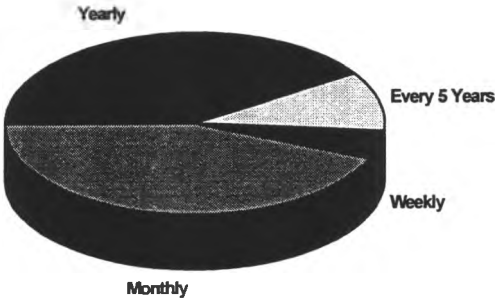
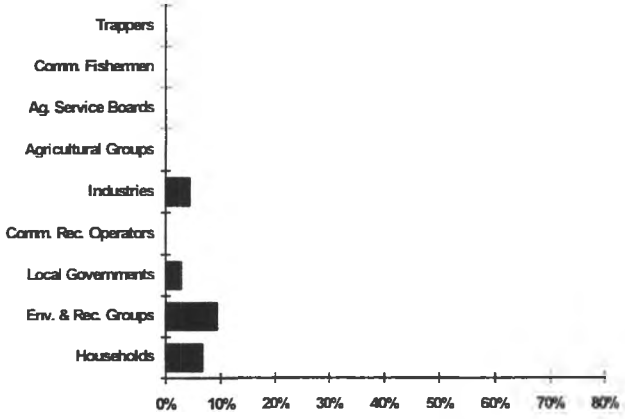


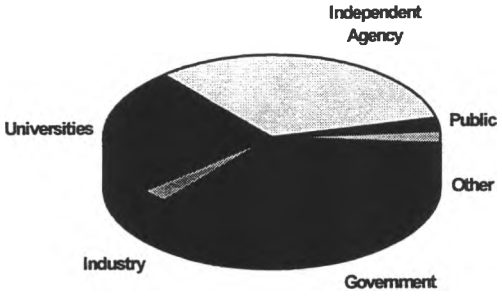
Frequency of Monitoring



Stakeholder Support for Ecological Indicators



Responsibility for Monitoring



similar response comes from stakeholders. About 35 percent suggest that monitoring be done by an independent agency compared to 25 percent support for government monitoring. However, 20 percent of respondents believe that monitoring be done by some organization other than government, industry, universities, an independent agency or the general public.

Households favour the idea that industry should pay the cost of monitoring pollutants. Nearly 48 percent support this idea. In comparison, 26 percent propose that government should pay these costs while another 22 percent feel that all water users should for pollution monitoring. Survey responses from stakeholders show a similar trend. One-third of respondents feel that industry should pay the costs of monitoring and one-quarter believe that the government should pay this cost. However, 29 percent of stakeholders believe that pollution monitoring costs be paid by all water users.

16.4 Ecological Indicators

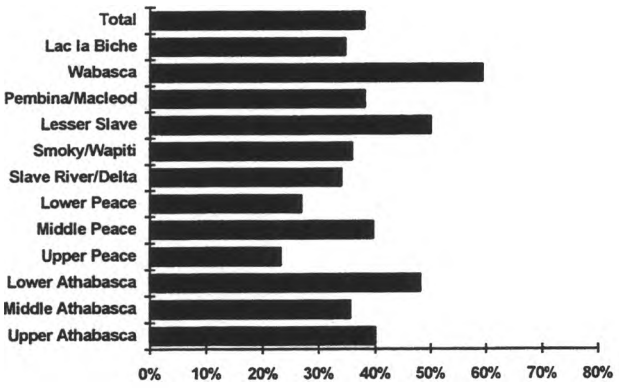
Households in 10 of the 12 regions propose using various ecological indicators to assess the health of northern rivers. Ecological indicators are discussed in terms of a broad environmental monitoring program that would ensure that aquatic life can be supported. Three specific measures are identified. These include assessing the biological status of the ecosystem, studying changes in the food chain, and monitoring the reproductive rate of forests. Overall, ecological indicators are suggested by almost seven percent of households. The majority of support for these types of ecological indicators come from households in the Upper and Middle Athabasca region.

Only three of the eight stakeholder groups propose measuring river health in terms of ecological indicators. These include representatives and environmental and recreation groups, municipal and local governments, and industrial water users. Although most of these describe ecological indicators in general terms, some suggest monitoring biodiversity while others propose that the sustainability of ecosystems be monitored.

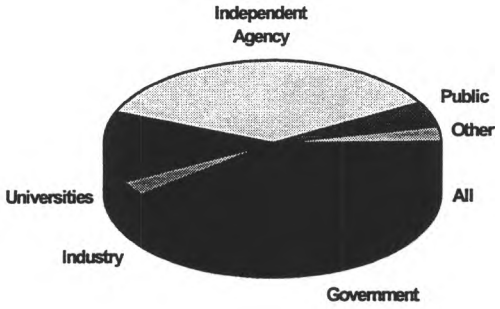
Figure 16-5

Measures of River Health: Fish Populations

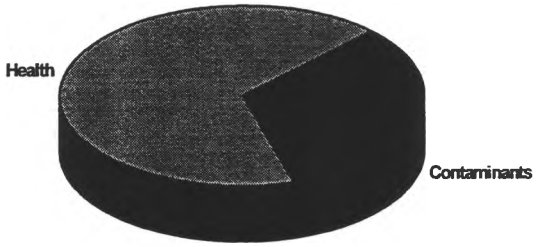
Regional Support for Monitoring Fish



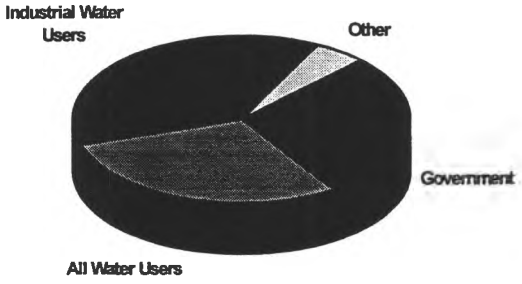
Responsibility for Monitoring



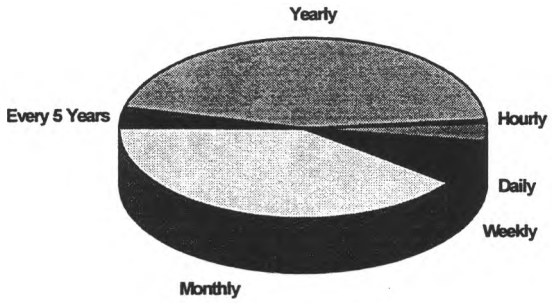
Fish Population Indicators



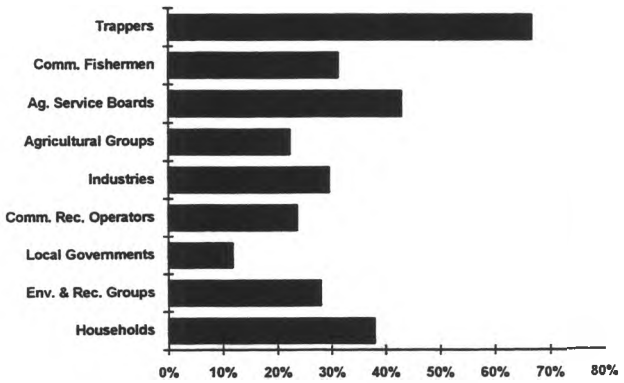
Financial Responsibility for Monitoring



Frequency of Monitoring



Stakeholder Support for Monitoring Fish



Monitoring of ecological indicators is of longer-term concern to basin households and stakeholders. Nearly 44 percent of households indicate that monthly monitoring is appropriate for this measure while most of the remainder propose that monitoring occur less frequently. Over 10 percent propose that ecological indicators be monitored every five years. Stakeholders recommend even longer intervals between assessments. Over 57 percent propose monitoring every year while 29 percent suggest that ecosystem assessments be completed every five years.

Households are split on the question of who should be responsible for monitoring ecological indicators. About 35 percent suggest that the government should be responsible while 33 percent suggest this be done by an independent agency. However, there is more support for universities being responsible for assessing ecological indicators than for any of the other indicators. About 25 percent of households think that the university should be responsible for ecosystem monitoring. Stakeholders, on the other hand, believe that government ought to undertake ecosystem monitoring (50 percent of responses). Most of the others (38 percent) feel that ecosystem monitoring be done by an independent agency.

Households prefer that either the government or all water users should pay for the costs of ecosystem monitoring: 33 percent of households support each of these options. Only 23 percent propose that industry pay these costs. The majority of stakeholders (57 percent) feel that the costs of ecosystem monitoring be borne by all water users, with 29 proposing that government pay these costs.

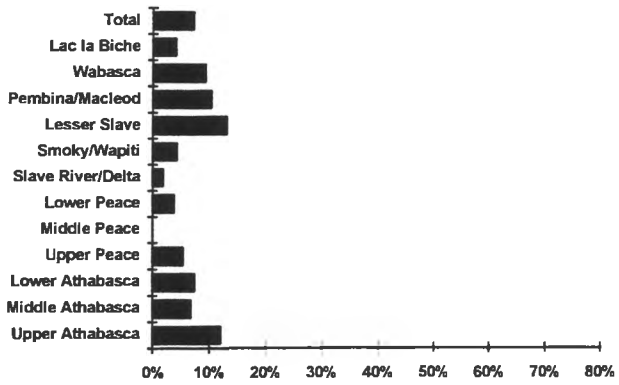
16.5 Fish

Healthy fish populations are considered to be an important measure of river health for about 38 percent of households in the basin. Proposals for this indicator come from least 23 percent of households in one region (Upper Peace) and as many as 59 percent of households in the Wabasca region. Above-average interest in assessing the health of fish populations is apparent in survey responses from households in the Lesser Slave, Lower Athabasca, and Upper Athabasca regions.

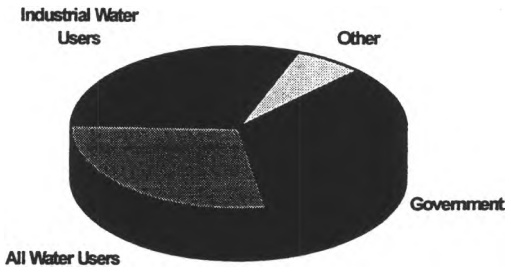
Figure 16-6

Measures of River Health: Vegetation

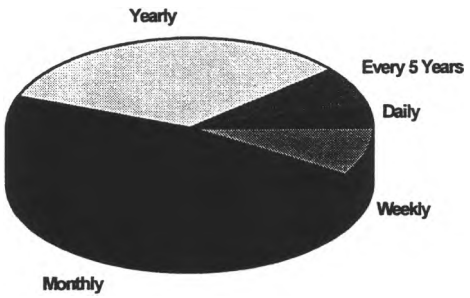
Regional Support for Monitoring Vegetation



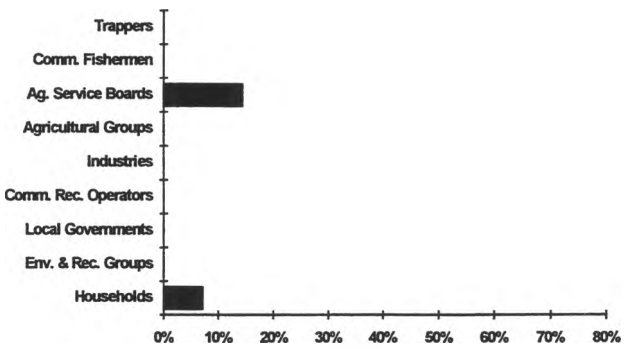
Financial Responsibility for Monitoring



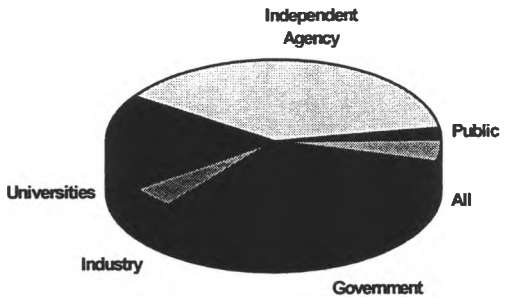
Frequency of Monitoring



Stakeholder Support for Monitoring Vegetation



Responsibility for Monitoring



Some stakeholder groups show more interest in monitoring fish than others. The health of fish populations is of considerable importance to trappers, agricultural service boards and commercial fishermen. However, representatives of local and municipal governments show little interest in defining river health in terms of the health of fish populations.

Two types of fish monitoring are proposed. The majority of households (67 percent) are concerned about the health of fish in terms of human consumption while the others suggest that fish contamination be addressed in more general terms. However, in the Lower Peace and Wabasca regions, testing fish for contaminants is of greater interest that assessing fish health in terms of human consumption. Stakeholders are also concerned about the size of fish populations.

Households recommend that changes in fish health and populations be monitored less frequently than most other river-health indicators. Over 44 percent of households propose yearly monitoring of fish while four percent suggest that tests on fish be conducted every five years. Monthly monitoring is suggested by 40 percent of households. Stakeholders have similar suggestions for frequency of monitoring. Half of the respondents recommend annual testing of fish health while 22 percent want monthly monitoring. Another 18 percent suggest that monitoring of fish populations occur every five years.

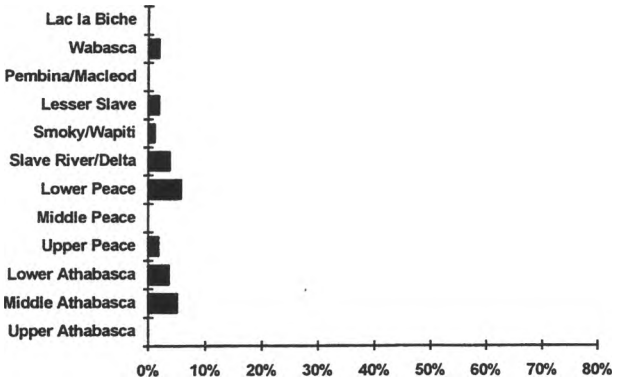
Although more households (38 percent) favour having the government being responsible for fish monitoring, there is also strong support (36 percent) for having this work done by an independent agency. About 14 percent of responses suggest that fish testing be done by universities. Stakeholders generally agree with households. Just over 40 percent of stakeholders recommend that fish monitoring be done by government and 35 percent favour testing by an independent agency.

Industry is generally seen as the group that ought to be paying the costs of fish monitoring. This suggestion comes from 37 percent of households while less than 29 percent prefer that the costs of fish monitoring be borne by either all water users or the government. In contrast, 38 percent of stakeholders propose that government pay these costs, while only 21 percent believe that

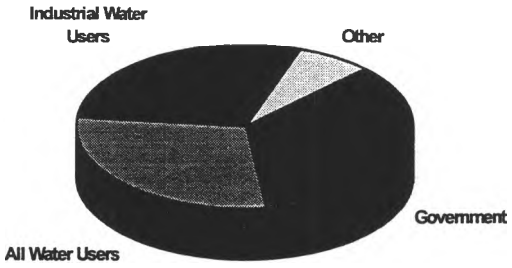
Figure 16-7

Measures of River Health: Wildlife

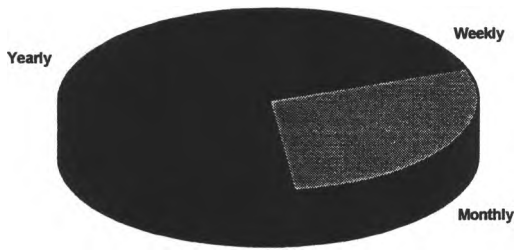
Regional Support for Monitoring Wildlife



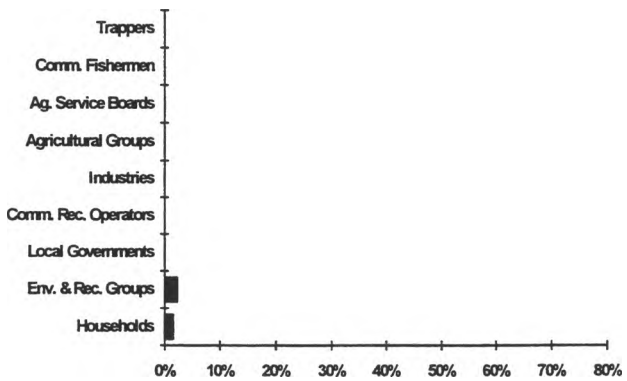
Financial Responsibility for Monitoring



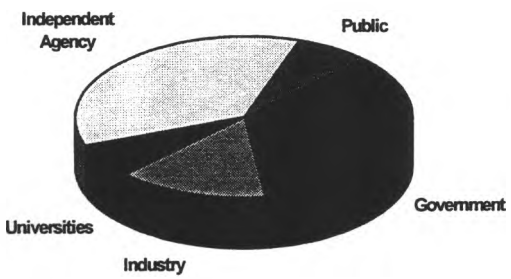
Frequency of Monitoring



Stakeholder Support for Monitoring Wildlife



Responsibility for Monitoring



industrial water users pay for fish monitoring. Most of the other stakeholders (33 percent) believe that all water users should be responsible for paying fish monitoring costs.

16.6 Vegetation

Only seven percent of basin households propose measuring of river health in terms of vegetation. They suggest that algae growth in rivers and the health of vegetation along rivers be monitored. This indicator is proposed by more than 10 percent of households in the Lesser Slave, Upper Athabasca and Pembina/Macleod regions. Agricultural service boards are the only stakeholder groups to suggest monitoring vegetation. Monthly monitoring is the preferred option for 47 percent of households while 33 percent of households propose yearly testing. Another seven percent feel that vegetation be monitored every five years. Annual testing is suggested by stakeholders.

There is considerable support for having vegetation monitoring be done by an independent agency (38 percent of households) and some (19 percent) feel that universities should do this testing. Only 32 percent feel that government ought to have this responsibility. Stakeholders believe that vegetation monitoring should be done by government.

Households favour having government pay the cost of vegetation monitoring. While 35 percent prefer this option, 30 percent feel that industry should pay these costs and 28 percent believe that these costs should be borne by all water users. Stakeholders think that financial responsibility for vegetation monitoring belongs to all water users.

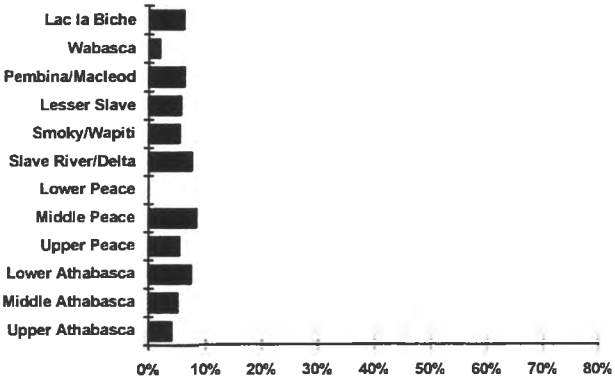
16.7 Wildlife

Less than two percent of basin households propose that the health of wildlife populations be used to assess the overall health of northern rivers. This measure of river health comes from households in eight of the 12 regions, with greatest support coming from households

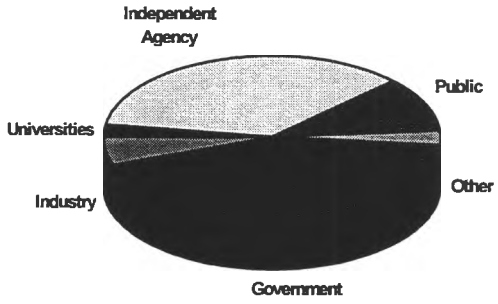
Figure 16-8

Measures of River Health: Human Use

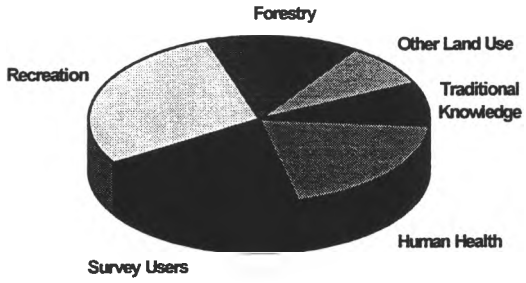
Regional Support for Monitoring Human Use



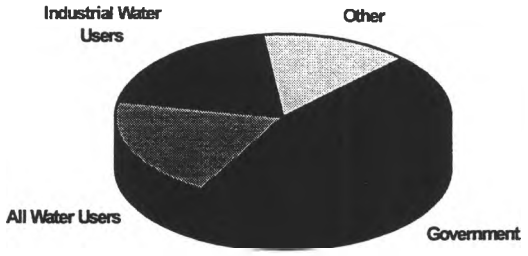
Responsibility for Monitoring



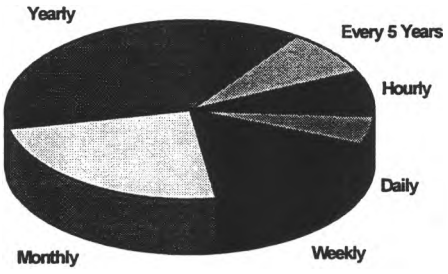
Human Use Indicators



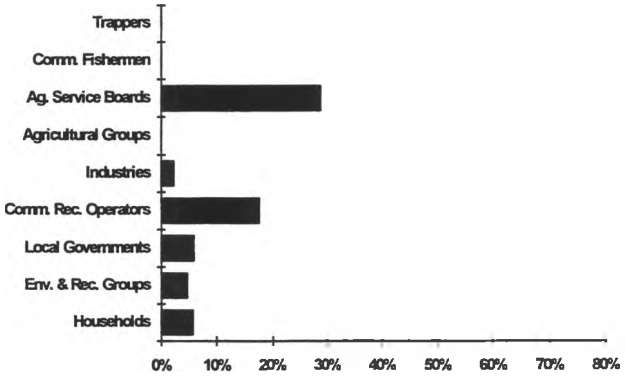
Financial Responsibility for Monitoring



Frequency of Monitoring



Stakeholder Support for Monitoring Human Use



in the Middle Athabasca and Lower Peace regions. Environmental and recreation groups are the only stakeholder group to suggest wildlife monitoring.

The majority of households (64 percent) think that wildlife monitoring should be conducted annually. Only 33 percent believe that monthly testing of wildlife was necessary. Yearly testing of wildlife is also supported by the stakeholders.

Equal proportions of households (36 percent) suggest that responsibility for wildlife monitoring belongs either to government or an independent agency. There is also relatively strong support (14 percent) for industry taking the lead role in wildlife monitoring. Stakeholders prefer that this responsibility be given to an independent agency.

More than one-third of households (36 percent) believe that government should pay the cost of wildlife monitoring. Most of the remainder are even split as to whether these costs should be borne by all water users or just industrial water users. Stakeholders prefer that all water users pay the costs of wildlife monitoring.

16.8 Human Activities

About six percent of basin households believe that rive health can be assessed by monitoring and controlling human activities that have a direct impact on natural resources. As shown in Figure 16-8, these activities include recreation (29 percent of responses), forestry practices (14 percent), and other land use activities such as road and pipeline development (nine percent). Others (20 percent) feel that the health of basin residents should be assessed regularly. Still others (20 percent) propose that the public ought to be periodically surveyed about their perceptions of river health. Traditional knowledge is also considered be of value in assessing river health (nine percent).

Households in all the regions except the Middle Peace propose monitoring of some aspects of human use. However, monitoring of human use and human health is of greatest concern to

households in the Middle Peace, Slave River/Delta and Lower Athabasca regions. Five of the eight stakeholder groups also propose measuring river health in terms of human uses and human health. These measures are of most importance to agricultural services boards and commercial recreation operators. The indicators being proposed by stakeholder groups include forestry practices (38 percent), other land uses (25 percent), recreation and aesthetics (25 percent), and traditional knowledge (12 percent).

Thirty-eight percent of households favour yearly monitoring of human health and resource-use activities. Another 24 percent feel that monthly testing is appropriate. For stakeholders, equal proportions (30 percent) propose monitoring on a monthly or a yearly basis. Assessing human health and activities on five-year intervals is proposed by about 10 percent of both stakeholders and northern households.

Both households and stakeholders prefer that government be responsibility for measuring human health and resources use activities. This suggestion comes from 43 percent of households and 30 percent of stakeholders. Households also support the idea that this monitoring be done by an independent agency (35 percent) while this option is favoured by 20 percent of stakeholders. Over 10 percent of both households and stakeholders think that the general public be given responsibility for assessing human health. And, while only five percent of households think that industry should be given this responsibility, this option is preferred by 20 percent of stakeholders.

There are considerable differences of opinion among households and stakeholders about who should pay for the costs of measuring human health and resource use activities. About 36 percent of households think that the government should bear these costs while 67 percent of stakeholders feel that industrial water users should pay. Most of the remaining households are equally split (20 percent each) as to whether all water users or industrial water users should pay these costs. Part of this difference may be due to the different mix of indicators used by each group. Stakeholders tend to focus on resource use activities, where industries could monitor their

own activities, while households are concerned about human health which is typically a government responsibility.

16.9 Other Measures

Four other categories of river health measures are proposed by basin residents. These include such things as monitoring climate, air quality, erosion and groundwater. However, each of these measures is proposed by less than one percent of basin households. For these indicators, households prefer monitoring of climate on a yearly basis, while air quality should be tested daily and erosion should be assessed weekly or yearly. Responsibilities for measuring these indicators are split between government and an independent agency, and the majority of households proposing these measures feel that government should assume the financial responsibility for doing the monitoring.

16.10 Summary

Table 16-3 summarizes the measures of river health suggested by northern households, based on the majority of responses. The table shows a number of important trends. First, the frequency of monitoring reflects a perception of the immediacy of threats. For the majority of indicators, monthly monitoring is suggested. However, for indicators like fisheries, wildlife and human uses, changes will take longer to occur and so annual monitoring is suggested.

Second, in terms of who should undertake monitoring, there is a clear indication that government should be taking the lead role. However, there is strong support for an independent monitoring agency and, in the case of vegetation and wildlife, at least the same proportion of households prefer such an agency over government.

Third, households appear to suggest that where industrial effluents are considered to be the source of a problems, such as water quality, fisheries or pollution, industries ought to be paying the costs of monitoring. For the other indicators, where natural variability or other public

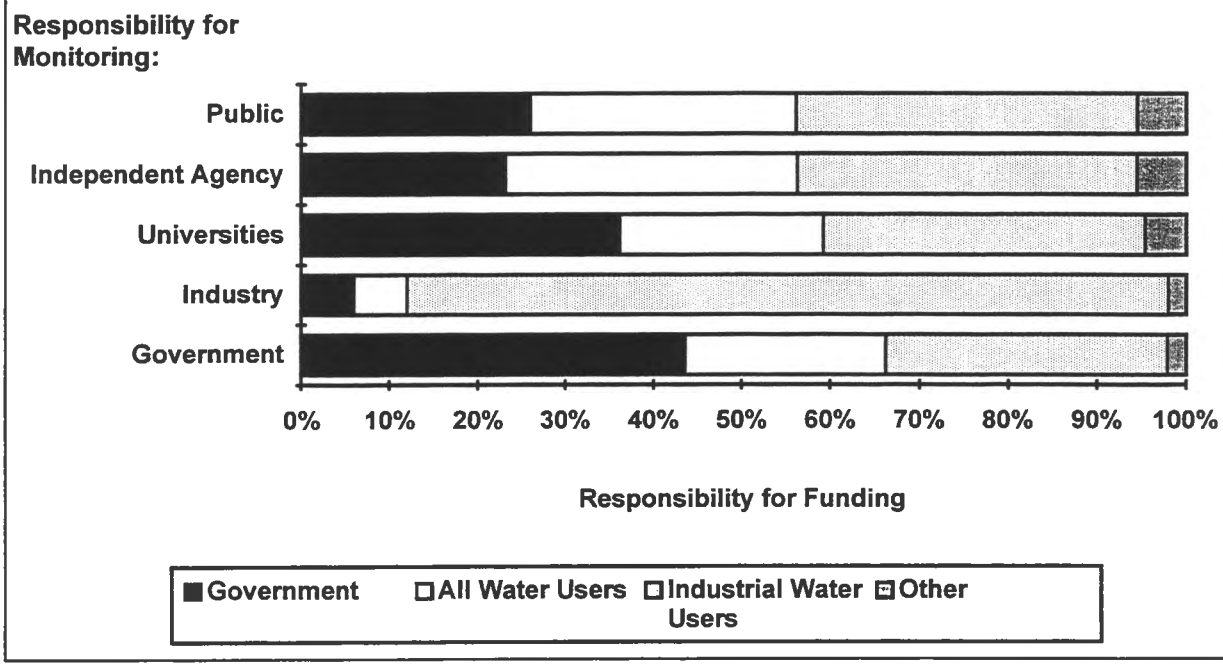
Table 16-3

Summary of Preferences for River Health Monitoring

Indicator	Frequency	Responsibility	Funding
Water Quality	Monthly	Government	Industrial Water Users
Fish	Yearly	Government	Industrial Water Users
Pollutants	Monthly	Government	Industrial Water Users
Water Quantity	Monthly	Government	Government
Vegetation	Monthly	Independent Agency	Government
Ecosystem Health	Monthly	Government	Government All Water Users
Human Use	Yearly	Government	Government
Wildlife	Yearly	Government Independent Agency	Government

Figure 16-9

Household Preferences for Monitoring Responsibility and Funding Sources



activities may be to blame, the government is expected to pay monitoring costs.

A number of other patterns emerge from the data. Figure 16-9 shows that there is an important relationship between who is responsible for doing the monitoring and how monitoring is funded. Households that support government monitoring also tend to believe that the government should be responsible for funding monitoring programs. Where respondents suggest that industry be responsible for monitoring river health, they also believe that industrial water users should be paying for monitoring programs. However, households that propose that monitoring be done by an independent agency, also suggest that costs of monitoring be borne by industrial water users and all water users, rather than just government. Those households that propose universities be involved in monitoring prefer that funding come from industrial water users and government, rather than all water users.

Figure 16-10 shows that the various stakeholders groups tend to have different preferences regarding who should be responsible for monitoring. For example, municipal and local governments are very strong in their belief that monitoring should be done by governments. Agricultural services boards share this belief. Compared to households, environmental and recreation groups prefer universities and show less support for government monitoring. Agricultural groups and trappers show much less support for government monitoring than other groups and prefer that monitoring be done by an independent agency. Commercial recreation operations and industries also show more support for independent monitoring agency than for government monitoring.

Stakeholders also have different views on who should pay the costs of monitoring river health. As shown in Table 16-11, municipal and local governments and agricultural services boards prefer that government fund monitoring, while commercial fishermen, commercial recreation operators and agricultural groups believe that industrial water users should bear the costs of monitoring. The majority of industry responses suggest that monitoring costs be paid by all

Figure 16-10

Suggested Responsibility for River Monitoring, by Stakeholders
(Percent of Responses)

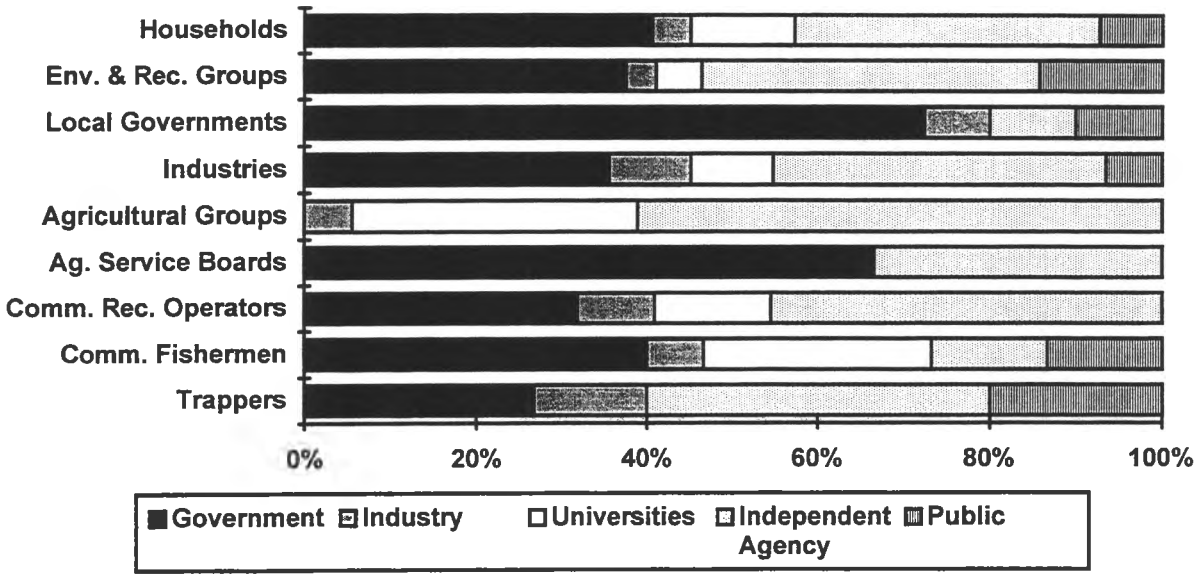
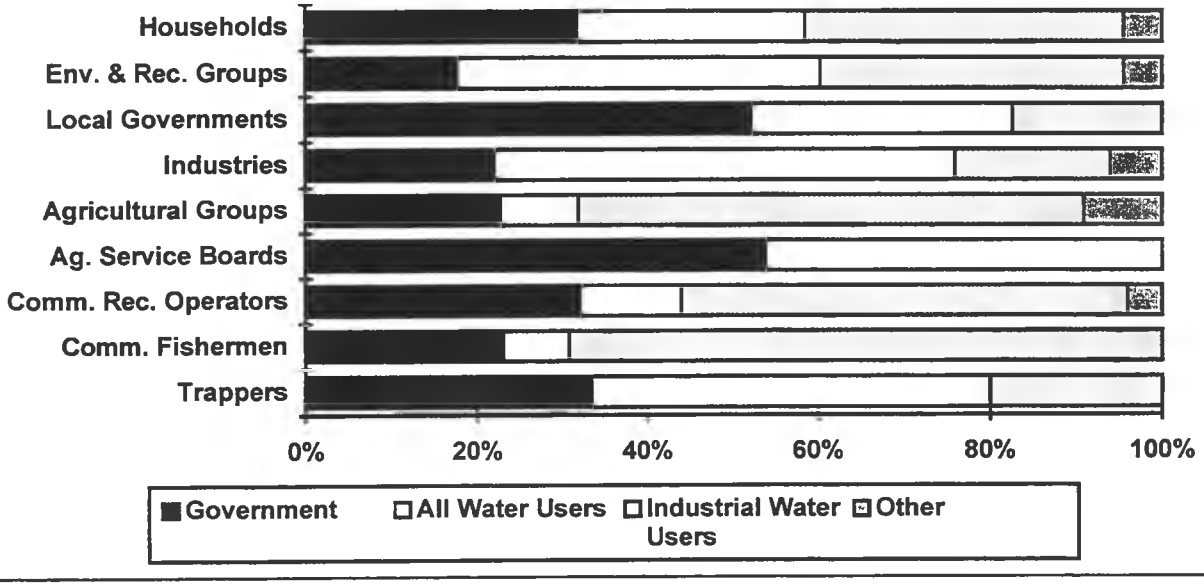


Figure 16-11

Suggested Responsibility for Funding River Monitoring, by Stakeholders
(Percent of Responses)



water users and they show very little support for the idea that industrial water users should responsible for these costs.

The preferences of environmental and recreation groups are quite close to those of northern households, although these groups place a greater onus on all water users, rather than government, to pay for monitoring river health.

17.0 RECOMMENDATIONS FOR THE FUTURE MANAGEMENT

The third approach for assessing attitudes and opinions about water resource use in the Northern River Basins Study area asked respondents to describe the three most important recommendations that the Study should make. This was an open-ended question that provided respondents with maximum flexibility to explain what management actions they feel should be undertaken to address current issues in the basin. About 60 percent of households responded to this question.

To interpret the resulting information, responses from both the household survey and stakeholder surveys were reviewed to identify major themes or categories. Survey responses were then coded into these various categories so that a quantitative assessment of survey responses could be undertaken. A total of 45 general categories were ultimately identified. Analysis of the 45 still show considerable diversity of responses, but over 80 percent of the survey responses could be captured in 10 key recommended actions. This analysis focuses on these 10 major categories of recommendations. Table 17-1 provides a summary of the recommendations made by households in each of the 12 regions in the basin. Their recommendations are then compared to the corresponding information from the various stakeholder groups in Table 17-2.

17.1 Recommendation 1: Reduce Effluent Loads

The most frequent recommendation is that the amount of effluents and chemicals being dumped into rivers and lakes needs to be decreased. This recommendation comes from 23 percent of households in the basin. Specific recommendations are that municipal and industrial discharges (especially from pulp mills) need to be reduced. Other suggested actions include controlling agricultural pollution and run-off. Many households simply recommend that there is a " need to clean up water before it enters rivers and lakes".

This recommendation is of particular importance in the Slave River/Delta region where 38 percent of households want effluent loads to be reduced. Above-average numbers of households

Table 17-1

Summary of Management Recommendations for the Northern River Basins, by Region of Household
(Percent of Households)

	Reduce Effluent Loads	Monitor Industrial Activities	Enforce Strict Laws	Stop Certain Activities	Develop Strict Regulations	Make Polluters Pay	Protect Environment	Basin Management Plan	Public Awareness & Education	Conduct of NRBS Studies
Upper Athabasca	22.0%	24.0%	16.0%	12.0%	14.0%	12.0%	14.0%	6.0%	2.0%	8.0%
Middle Athabasca	25.4%	16.9%	22.0%	5.1%	16.9%	3.4%	3.4%	8.5%	5.1%	1.7%
Lower Athabasca	27.8%	31.5%	16.7%	11.1%	9.3%	5.6%	13.0%	5.6%	7.4%	3.7%
Upper Peace	23.2%	12.5%	19.6%	14.3%	8.9%	10.7%	3.6%	3.6%	3.6%	3.6%
Middle Peace	31.3%	18.8%	4.2%	10.4%	18.8%	8.3%	2.1%	0.0%	4.2%	4.2%
Lower Peace	23.1%	9.6%	17.3%	9.6%	5.8%	1.9%	3.8%	5.8%	1.9%	0.0%
Slave River & Delta	37.7%	26.4%	18.9%	5.7%	5.7%	11.3%	13.2%	15.1%	5.7%	11.3%
Smoky Wapiti	22.8%	23.9%	22.8%	15.2%	8.7%	9.8%	7.6%	3.3%	6.5%	4.3%
Lesser Slave	16.7%	29.6%	24.1%	11.1%	14.8%	11.1%	3.7%	5.6%	5.6%	5.6%
Pembina/Macleod	22.7%	14.4%	12.4%	14.4%	8.2%	4.1%	6.2%	3.1%	0.0%	2.1%
Wabasca	20.4%	20.4%	5.6%	3.7%	11.1%	9.3%	1.9%	3.7%	7.4%	1.9%
Lac la Biche	14.3%	8.2%	6.1%	6.1%	8.2%	2.0%	8.2%	6.1%	2.0%	6.1%
Total	23.3%	20.5%	17.1%	12.4%	10.4%	7.4%	7.3%	4.4%	4.0%	4.0%

in the Middle Peace, Lower Athabasca, and Middle Athabasca regions also recommend reducing effluent loads. Overall, the reduction of effluent loads is the first priority for households in eight of the 12 regions. The percentage of households making this recommendation is lower in the tributary basins (especially Lac la Biche) than in regions along the mainstems of the Athabasca and Peace rivers.

The percentage of stakeholders that recommend reducing effluent loads varies considerably from group to group. Some stakeholder groups that rely on environmental quality for their livelihood, such as trappers and commercial recreation operations, are very supportive of an immediate decrease in effluent loads. On the other hand, less than nine percent of groups that generate effluents, including municipal governments and industries, believe that current the extent of effluent loads entering water bodies needs to be changed. Recreational and environmental groups also show low support for reducing effluent loads and offer some recommendations concerning how effluents might be better managed in the future.

17.2 Recommendation 2: Monitor Industrial Activities

Just over 20 percent of households recommend that industrial activities need to be monitored more regularly. Respondents suggest that monitoring should include: measures of water quality (including groundwater), number and health of fish and wildlife, discharges of pulp mills, river flows, and sediment loading. Others recommend that monitoring focus on industrial activities, including pulp mills and the oil industry. Some respondents feel that monitoring be used to establish baseline data on the health of rivers and lakes.

The greatest support for increased monitoring is in the Lower Athabasca region where this action is recommended by over 31 percent of households. Monitoring is also important to households in the Lesser Slave and Slave River/Delta regions. However, fewer than 10 percent of households in the Lower Peace and Lac la Biche regions recommend monitoring of industrial activities.

Table 17-2

Summary of Management Recommendations for the Northern River Basins by Northern Households and Stakeholder Groups
(Percent of Respondents)

	Reduce Effluent Loads	Monitor Industrial Activities	Enforce Strict Laws	Stop Certain Activities	Develop Strict Regulations	Make Polluters Pay	Protect Environment	Basin Management Plan	Public Awareness & Education	Conduct of NRBS Studies	Research
Northern Households	23.3%	20.5%	17.1%	12.4%	10.4%	7.4%	7.3%	4.4%	4.0%	4.0%	1.9%
Environmental and Recreation Groups	9.3%	7.0%	14.0%	30.2%	37.2%	7.0%	9.3%	11.6%	4.7%	4.7%	2.3%
Municipal & Local Governments	8.8%	17.6%	8.8%	5.9%	26.5%	5.8%	2.9%	23.5%	0.0%	2.9%	5.9%
Industrial Water Users	6.8%	6.8%	9.1%	2.3%	13.6%	2.3%	2.3%	11.4%	2.3%	4.5%	11.4%
Agricultural Groups	20.0%	16.0%	8.0%	12.0%	32.0%	0.0%	16.0%	12.0%	4.0%	20.0%	0.0%
Commercial Recreation	29.4%	11.8%	0.0%	11.8%	23.5%	0.0%	0.0%	5.9%	0.0%	23.5%	0.0%
Commercial Fishermen	0.0%	6.3%	6.3%	31.3%	18.8%	0.0%	0.0%	0.0%	0.0%	18.8%	12.5%
Trappers	77.8%	22.2%	11.1%	22.2%	22.2%	22.2%	33.3%	22.2%	0.0%	0.0%	0.0%

Although monitoring is high on the list of recommendations for northern households, there is less support for this action by some stakeholder groups. About seven percent of both industrial water users and environmental and recreation groups recommend more monitoring. In comparison, over 16 percent of municipal governments and agricultural groups would like to see increased monitoring of water quality in the basin.

17.3 Recommendation 3: Enforce Strict Laws

The third most common recommendation is that there needs to be increased enforcement of strict laws on pollution and use of chemicals. This recommendation comes from 17 percent of basin households, and is particularly popular among households in the Lesser Slave, Smoky/Wapiti and Middle Athabasca regions. Suggested actions include "zero tolerance on second infractions" and increased inspections.

Only trappers and environmental and recreation groups recommend increased enforcement of strict pollution control laws at rates similar to those of basin households. For all other groups, nine percent or less recommend that increased enforcement should be one of the key recommendations of the NRB Study.

17.4 Recommendation 4: Stop Certain Activities

Over 12 percent of basin households recommend that certain types of economic activities need to be stopped. Key suggestions are that clear cutting of forests be stopped, that no more mills or industrial plants be allowed to dump effluents into rivers, and that no more dams be built. Another common suggestion is that buffer zones be established between rivers and lakes and industrial or farming/ranching activities to protect water quality and reduce erosion. A one-kilometre buffer zone is recommended. Other respondents call for a decrease in road and pipeline construction, and no more draining of muskegs. It is also suggested that the use of motor boats be restricted on some lakes and rivers.

The highest percentage of recommendations to end these selected activities comes from households in the Smoky/Wapiti, Pembina/Macleod and Upper Peace regions. In comparison, very few households in the Wabasca regional are calling for limits to be placed on industrial activities.

Some stakeholder groups are highly supportive of the idea that the NRB Study recommend stopping certain types of activities. Over 30 percent of environmental and recreation groups and commercial fishermen recommend that activities like industrial waste discharges and use of tailings ponds be stopped immediately. They also suggest that water from northern basins should never be exported, and that no additional dams be developed. In comparison, less than six percent of municipal governments and industrial water users propose that these types of activities be stopped.

17.5 Recommendation 5: Develop Strict Regulations

Action to develop stricter regulations on waste discharges and municipal sewage is recommended by over 10 percent of households. They suggest that pollution standards for industry be tightened, that forestry operations (particularly logging) be controlled to limit erosion, and that agricultural activities and mining practices be more regulated. The need for stricter regulations is of particular concern to households in the Middle Athabasca, Middle Peace, and Wabasca regions.

The development of stricter regulations on both land and water uses is the most common recommendation for four of the seven stakeholder groups. There is strong support for increased regulation of logging and forestry practices, including on private lands. There are also suggestions for more regulation of cattle grazing and water extraction industries. More than 25 percent of representatives of environmental and recreation groups, agricultural groups and municipal and local governments recommend developing stricter regulations. Industrial water users also recommend developing stricter regulations but they are concerned that all sources of pollution be treated equally and that the regulations be enforceable.

17.6 Recommendation 6: Make Polluters Pay

Seven percent of households recommend that the NRB Study support the use of various economic incentives and disincentives to regulate pollution. These include such things as making polluters pay for discharging effluents, and heavy fines if problems are not cleaned up immediately. The highest level of support for using economic incentives to address water quality problems comes from households in the Upper Athabasca, Slave River/Delta and Lesser Slave regions.

Representatives of four of the seven stakeholder groups recommend the use of "polluter pay", and this is especially popular with trappers and representatives of environmental and recreation groups. Industrial stakeholders also support the use of polluter pay and economic instruments as a cost-effective way of reducing pollution levels.

17.7 Recommendation 7: Protect the Environment

Protection of the environment, especially water resources, is recommended by seven percent of basin households. Respondents see a need to protect wetlands, to set aside natural areas where no development is allowed, and to preserve river systems. Some respondents recommend that economic interests not be the primary factor in deciding how and what resources should be used and that environmental considerations ought to prevail in some cases. Protection of the environment is of greatest importance to households in the Upper and Lower Athabasca and Slave River/Delta regions.

Five of the seven stakeholder groups also mention protection of the environment. Trappers, agricultural groups and recreation and environmental groups have various suggestions for protecting the environment, including preserving ecosystems, protecting provincial and national parks, and limiting access to certain areas.

17.8 Recommendation 8: Basin Management Plan

The eighth most-frequent recommendation is that a basin-wide management plan be developed. Four percent of households recommend the use of basin planning. Planning is very strongly supported by respondents from the Slave River/Delta region. Some respondents feel that the primary role of the plan should be to provide a framework that establishes priorities for things like human health in the context of resource development.

There is stronger support for developing a resource management plan for the region among stakeholders than there is from northern households. Considerable support for planning comes from municipal and local governments, trappers environmental and recreation groups and industrial water users. Many representatives of these groups recommend that plans be developed for individual regions within the basin, and that plans be developed in consultation with stakeholders.

17.9 Recommendation 9: Public Awareness and Education

Four percent of households suggest that more environmental education and awareness programs be developed. About half of these households propose that educational efforts ought to be directed towards the education of children, while the remainder support awareness programs for the general public. Households in the Wabasca and the Lower Athabasca regions are most supportive of developing additional public awareness and education programs.

Only a small proportion of three of the seven stakeholder groups recommend increased public awareness and more education programs. This action is of particular importance to representatives of the environmental and recreation groups.

17.10 Recommendation 10: Conduct of the NRB Study

Respondents have several recommendations concerning how the NRB Study should be conducted and completed. Such comments come from four percent of households. Some respondents feel that it is important that the study findings be interpreted and presented in an honest manner to the public and that the proposed solutions be reasonable. Others suggest that the study propose some concrete actions that can be implemented quickly. Over 11 percent of households in the Slave River/Delta region have suggestions the describe how the NRB Study should be completed.

Numerous stakeholder representatives have general suggestions concerning the recommendations of the NRB Study, but did not suggest what specific actions should be taken. They ask that recommendations deal with pulp mills, river management, erosion, water quality, oilfield development, mitigation of damages and future sustainable development.

17.11 Other Recommendations

Northern households and stakeholders also have several other types of recommendations for the Study Board. For northern households, the most important of these recommendations are that more research be done on water quality issues (two percent of households), that there be more public input into decisions (one percent), that more controls be placed on fishing (two percent), and that control of river flows be reviewed to prevent flooding and protect the rivers (three percent).

For some stakeholder groups, additional research into water quality issues is a frequent recommendation -- see Table 17-2. Industry frequently mentions the need for more research, as do commercial fishermen, and, to a lesser extent, local and municipal governments and environmental and recreation groups. There is special interest in undertaking more research into the effects of logging and farming practices on water quality, and on the combined effects of different effluents. Other recommendations made by stakeholders are that stakeholders should be

involved in future decision-making processes and that the NRB Study provide recommendation on how to mitigate current problems.

17.12 Summary

There are some important difference in the types of recommendations suggested by northern households and the various stakeholder groups. The results of the household survey suggest that basin residents want the NRB Study to make recommendations that will act to quickly resolve current problems. The emphasis is on immediate reduction of effluent loads, more monitoring, more enforcement, and stopping certain activities.

On the other hand, industries and municipal governments are suggesting the NRBS take a less active approach on water management issues. These groups recommend more research and the development of basin management plans, eventually leading to stricter regulations.

Other stakeholder groups, notably environmental and recreation groups and agricultural groups, offer recommendations that tend to fall more in the middle in terms of immediacy of action. Rather than advocate immediate reduction in effluent discharges, they propose developing strict regulations for existing activities and stopping expansion of selected future activities.

PART IV FUTURE RIVER BASIN MANAGEMENT OPTIONS

One of the other questions posed by the Northern River Basins Study Board was:

16. What kind of interjurisdictional body can be established, ensuring stakeholder participation, for the ongoing protection and use of the river basins?

To help the Board answer this questions, a series of questions regarding support for some sort of ongoing, intergovernmental and stakeholder committee responsible for the protection and use of river basins were included in the survey. The survey also questioned respondents about the roles and responsibilities of such a committee, and their willingness to participate. Responses to these questions are provided in this part of the report.

Table 18-1

Support For Establishment of an Ongoing, Inter-Governmental and Stakeholder Committee Responsible for Protection and Use of River Basins
(Percent of Responses)

Stakeholder Group	Committee Should Be Established	Committee Should Not Be Established	Don't Know
Households	77.6%	4.5%	17.9%
Environmental & Recreation Groups	92.1%	2.6%	5.3%
Municipal & Local Government	73.3%	13.3%	13.3%
Industrial Users	63.2%	5.3%	31.6%
Agricultural Groups	68.8%	6.3%	25.0%
Agricultural Service Boards	37.5%	12.5%	50.0%
Commercial Recreation Operators	100.0%	0.0%	0.0%
Trappers	77.8%	11.1%	11.1%
Commercial Fishermen	45.5%	0.0%	54.5%

Table 18-2

Household Suggestions on the Roles and Responsibilities of an Ongoing, Inter-Governmental and Stakeholder Management Committee,
(Percent of Responses)

	Roles and Responsibilities	Agree	Disagree	Don't Know
1.	Provide Advice to Federal, Provincial and Territorial Governments	87.8%	3.1%	9.1%
2.	Conduct and Coordinate Research	81.3%	5.3%	13.4%
3.	Prepare Resource Management Plans	81.2%	6.4%	12.4%
5.	Develop Education Programs	80.8%	5.6%	13.6%
4.	Develop Resource Regulations	81.0%	6.7%	12.3%
6.	Oversee Enforcement of Regulations	76.4%	11.7%	11.9%
7.	Issue Licences and Permits	52.8%	22.0%	25.2%

18.0 FUTURE MANAGEMENT STRUCTURE

There is widespread support for establishing an ongoing, inter-governmental and stakeholder committee that would be responsible for the protection and use of northern river basins. Between 70 and 80 percent of households in all 12 regions in the basin support this idea, and less than five percent are opposed. The remaining households (18 percent) are unsure about the need for such a committee.

The various stakeholder groups also support establishment of an inter-governmental and stakeholder committee, although there are some significant differences among groups. Table 18-1 shows that support for a committee ranges from 38 to 100 percent of stakeholder groups, although a very large proportion of some stakeholder groups are unsure. Agricultural service boards show the lowest support for creating a government/stakeholder management committee, followed by commercial fishermen. However, for both groups, 50 percent or more are unsure. At the other extreme, 92 percent of environmental and recreation groups support the establishment of this type of management committee.

18.1 Role and Responsibilities of an Inter-Governmental and Stakeholder Management Committee

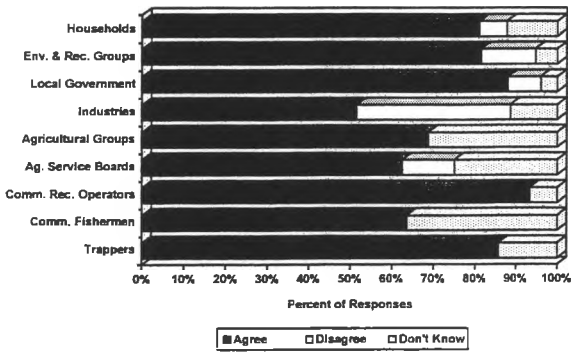
In order to define the roles and responsibilities of a possible management committee, survey respondents were asked to indicate whether or not the felt this committee should be responsible for seven specific functions. These choices covered a broad range, from advisory to regulatory.

Table 18-2 shows the majority of households believe that an inter-governmental and stakeholder management committee should be responsible for six of the seven management functions. More than 75 percent of households feel that the committee should provide advice to federal, provincial and territorial governments (88 percent), coordinate and conduct research (81

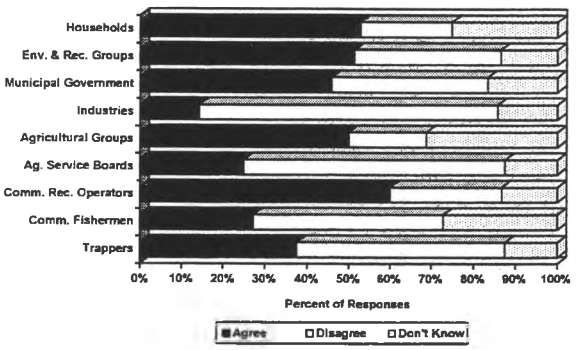
Figure 18-1

Household and Stakeholder Suggestions on Selected Roles and Responsibilities of an Ongoing, Inter-Governmental and Stakeholder Management Committee,

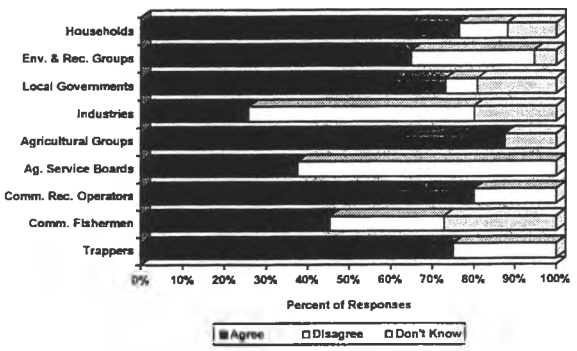
Develop Resource Regulations



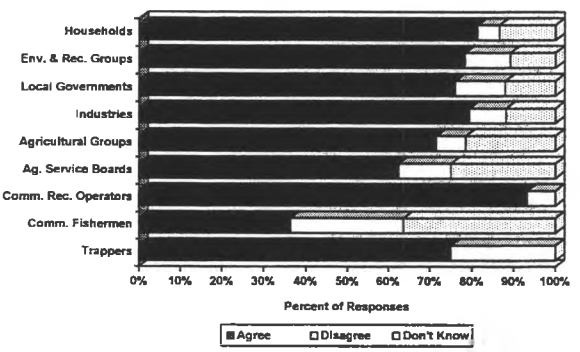
Issue Licences and Permits



Oversee Enforcement of Regulations



Conduct and Coordinate Research



percent), prepare a basin management plan (81 percent), develop regulations (81 percent), develop education programs (81 percent) , and oversee enforcement (76 percent). In contrast, only 53 percent of households believe that such a committee should be responsible for issuing licences or permits.

These conclusions are unanimous among households in all 12 of the regions, with no significant differences except for the proposed role of conducting and coordinating research activities in the basin. For this function, the differences among regions are due to a high degree of uncertainty and a lack of support from households in the Upper Peace and Lower Athabasca regions.

While households are unanimous in their assessment of the roles and responsibilities of an inter-governmental and stakeholder management committee, stakeholders are not. Responses from stakeholders show significant differences in whether the proposed committee should take on four specific roles. As shown in Figure 18-1, these four include regulatory functions, such as developing regulations, enforcing regulations and issuing licences and permits, as well as coordinating and conducting research. For the other three functions (providing advice to government, developing basin management plans and public education), stakeholders and households both believe that these are appropriate functions for the proposed management committee.

Where significant differences do occur, industrial waster users and agricultural service boards have very different views from the other stakeholders. Respondents from these two groups show very low support for empowering a committee to develop regulations, oversee enforcement, or issue licences and permits. Trappers and commercial fishermen also do not support the proposal that the committee issue licences or permits.

The other potential role where there is a significant difference among stakeholder groups relates to coordinating and conducting research. For this function, the differences are based more on

Table 18-3

Willingness of Stakeholder Groups to Participate on an Inter-Governmental and Stakeholder Management Committee
(Percent of Responses)

Stakeholder Group	Willing to Participate	Not Willing to Participate	Don't Know
Households	81.9%	3.2%	14.8%
Environmental & Recreation Groups	50.0%	18.4%	31.6%
Municipal & Local Governments	29.0%	22.6%	48.4%
Industrial Users	36.8%	28.9%	34.2%
Agricultural Groups	25.0%	37.5%	37.5%
Agricultural Service Boards	50.0%	0.0%	50.0%
Commercial Recreation Operators	66.7%	20.0%	13.3%
Commercial Fishermen	63.6%	0.0%	36.4%
Trappers	87.5%	0.0%	12.5%

different degrees of uncertainty than on whether or not the committee should have this responsibility.

18.2 Participation on the Committee

The majority of households that responded to the survey are prepared to participate on an inter-governmental and stakeholder management committee. Nearly 82 percent are willing to participate. On a regional basis, this proportion ranges from 72 to 94 percent, although there are no statistical differences among regions.

Households are interested in two major types of committee involvement. About 41 percent are prepared to sit as a member of the committee and make decisions and recommendations about water management. Many of these people feel that public members are necessary to balance the influences of special interest groups and that they can provide better information than government employees. Some suggest that committee members be elected while others suggest they be paid. Many also believe that there should be separate committees for individual river basins, rather than one committee for the entire Peace, Athabasca and Slave river basins.

Another 44 percent of households are willing to provide information and advice to the committee. Of these, two-thirds want the opportunity to attend workshops, community forums and other types of meetings so that they can provide input on basin management issues. Another quarter of these households believe that public opinion surveys should be used to canvass public opinion on a regular basis. The remainder want to be designated as formal advisors to the committee.

The remaining 15 percent are prepared to help a committee in other ways. Some are willing to assist in educating the public about management issues, based on the idea that basin residents will make better use of aquatic resources if they understand the implications of their actions. The remainder would like to be involved in data collecting and monitoring.

In contrast to the high support offered by basin households, some stakeholders are not very willing to participate on a management committee. Less than 37 percent of industrial water users, local and municipal governments, and agricultural groups are willing to participate. For most of the other groups, including environmental and recreation groups, more than 30 percent are uncertain about whether they would participate. Only trappers are as enthusiastic about participating on a committee as is the general public.

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Appendix I

Terms of Reference

NORTHERN RIVER BASINS STUDY

DRAFT

SCHEDULE A - TERMS OF REFERENCE

Project 4121-E2: Analysis of Survey Data

I. BACKGROUND & OBJECTIVES

The Northern River Basins Study (NRBS) is a joint project between the governments of Canada, Alberta and the Northwest Territories that commenced in September of 1991. The purpose of the NRBS is "to characterize the cumulative effects of development on the water and aquatic environment of the Study areas by coordinating with existing programs and undertaking appropriate new technical studies". To undertake this study, a Study Board, Study Office and Science Advisory Committee were created. The study area includes the mainstems and main tributaries of the Peace, Athabasca and Slave rivers.

The Study Board developed a vision statement to provide overall guidance for the various technical activities being conducted in support of the study and also identified 16 questions that serve to focus study activities. One of these questions is:

#3. Who are the stakeholders and what are the consumptive and non-consumptive uses of the water resources in the river basins?

Eight component groups have since been established to address these 16 questions and the Other Uses Component is primarily responsible for developing and undertaking research and investigations related to the use of water resources. This group is working in close association with the Traditional Knowledge Component, which is responsible for collecting information on resource use and values of indigenous people and long-time residents.

In order to collect information about stakeholders and their uses of aquatic resources, the Other Uses Component has undertaken surveys of 10 different categories of northern residents, including random samples of the general public and representative surveys of various types of special interest groups. A consultant is now required to analyze the results of these surveys and prepare a report which will generate much of the content for the final synthesis report for the Other Uses Component. A summary of previous projects that have been conducted on behalf of the Other Uses Component and provide the background information for this work is provided in Table 1. A copy of the draft table of contents for the synthesis report is provided as Attachment 1.

Table 1

SUMMARY OF COMPLETED PROJECTS RELATED TO THIS WORK

PROJECT NUMBER	PROJECT TITLE	PROJECT DESCRIPTION
4121-D1	Stakeholder Screening	This project expanded on the list of stakeholders identified as part of Project 4111-B1, contacted the majority of them by telephone and determined potential interest in future data collection activities. A proposal to undertake regional workshops was abandoned in favour of a telephone/mail survey to collect more detailed information on resource use and stakeholder attitudes.
4121-D2	Questionnaire Design and Survey Methods	This project examined several approaches for undertaking a stratified random sample of households in the study area and recommended an approach based on use of telephone sampling tied to 12 specific geographical areas within the basin. A draft of the questionnaire to be used for the household survey was also developed and submitted for review by the Study Board and the Science Advisory Committee.
4121-D3	Implementation of Household Survey	The survey of northern households commenced in mid-January of 1995. Within two weeks about 1400 households had been contacted by telephone and had agreed to complete a detailed questionnaire which was sent out by mail. The raw results of the survey are now available.

4121-D4	Survey of Interest Groups, Industries and Municipal Governments	Nine different types of surveys were developed for specific categories of stakeholders within the basin and questionnaires were sent to approximately 700 different groups and associations by mid-February, 1995. The raw results of these surveys are now available.

Although different questionnaires were employed in the surveys of ten different populations, many of the same questions were used so that comparisons among user groups could be undertaken, especially related to issues and concerns. Different questions were required to identify how the different groups make use of the northern rivers. A description of the ten survey populations and the number of completed survey responses received to date is provided below:

Survey Population	Description	Number Sent	Number Received
General Households	Households were selected at random from each of 12 regions and contacted by telephone to solicit participation in the survey which was sent by mail.	~1400	~715
Agricultural Associations	Includes representatives of various agricultural groups and community agricultural associations.	86	18
Agricultural Service Boards	Organizations created by municipal districts to provide assistance to local farmers.	24	7
Tourism/Recreation Businesses	Includes guides, outfitters and hunting and fishing lodges.	51	17
General Stakeholder Groups	Includes environmental and recreation groups plus Native friendship centres.	160	39
Industrial Users	Individuals or companies holding industrial water licences.	100	43
Municipal & Local Governments	Cities, towns, summer villages and native communities.	112	33
Commercial Fishermen	Individuals and enterprises involved in commercial fishing	47	10
Trappers	Individuals and enterprises involved in trapping	24	9
River Transportation	Individuals involved in commercial river transportation	3	1

Completed responses for each of the ten survey populations have, to a large extent, been codified and been entered into an SPSS/PC+ data base. Verbatim transcripts of written comments on the major open-ended questions have also been prepared and, because of their complexity, these responses have not yet been codified to facilitate analysis of the information.

II. REQUIREMENTS

In general, the Contractor will prepare a detailed statistical analysis of the results of the household survey and all nine stakeholder surveys. This will entail mainly descriptive statistics with testing for significant differences among stakeholder groups and among the 12 regions in the household survey. Where appropriate, survey results will be extrapolated to produce basin-wide estimates of resource use. Analysis will focus on the following:

- An assessment of the representativeness of survey data and potential sources of bias.
- Discussion of water use characteristics, both licenced and unlicenced, and consumptive and non-consumptive. Separate discussions of municipal, domestic, industrial, agricultural, recreational, transportation and others.
- Description of how water use has changed during previous 10 years.
- Discussion of current water management issues, comparing results among various types of water uses.
- Summary of suggestions for water management practices and recommendations that could be proposed by NRBS, comparing survey results among various types of water users.
- Summary of suggestions related to monitoring health of rivers.
- Potential changes in future water use demands and uses.

This information will be summarized in a final report that will comprise a major part of the final synthesis paper for the Other Uses Component and will also be used to produce a summary that could be distributed to basin residents through RiverViews.

In detail, the following tasks will be completed:

1. The Contractor will review the design of the various surveys and the coding of the survey results, based on a review of documentation from projects 4121-D3 and 4121-D4.

2. The Contractor will finish coding the stakeholder surveys, using the coding practices developed for the household survey. In some cases this may just involve adding data labels to identify the codes already used while in other cases, this will involve reviewing the results of individual surveys, assigning numeric codes, entering the numeric codes in the SPSS/PC+ database, and then adding the value labels. The Contractor will work closely with the Project Liaison Officer to ensure that the resulting codes are consistent with and supportive of other areas of research being undertaken by the NRBS.

3. The Contractor will, using the survey results, prepare a description of each type of consumptive and non-consumptive water use. This description will include estimates of the number of users, the amount of use, the location of these uses, how these uses have changed in recent years, and the potential for change in use in the near future. Key types of water us to be addressed are: municipal use; domestic use; agricultural use; industrial

use; recreational uses; traditional fishing, hunting and trapping; river transportation; and commercial fishing. These descriptions should be consistent Section 3.0 of the draft table of contents for the synthesis report.

4. The Contractor will review the summary of written comments related to questions 58 to 72 of the household survey. These questions are common to all surveys and attempt to identify to the factors that have most affected water quality or quantity in the study area.. The Contractor will develop a system for grouping these comments into meaningful categories that are amenable to numeric analysis and then submit this for review by the Project Liaison Officer. Upon approval, the contractor will code all responses and enter them into the respective databases. The Contractor will then undertake a basic frequency analysis of the responses by sub-basin and by stakeholder group, and then provide a written summary of the results. This summary should include a quantitative analysis of which factors were of greatest importance, highlighting any significant differences among groups, plus a qualitative description that summarizes the effects that these factors have had upon basin residents using, as much as possible, their own words. The resulting report should be consistent with Section 4.0 of the draft table of contents for the synthesis report.

5. The Contractor will review the results of questions 75 and 76 of the household survey and the corresponding questions for the stakeholder surveys. These results have been coded but need to be recoded to reduce overlapping categories and to focus the analysis on the key recommendations that respondents would like the Study Board to make. The Contractor will work with the Project Liaison Officer to develop a recoding strategy and to then implement this strategy when completed. The Contractor will then undertake a basic frequency analysis of the responses by sub-basin and by stakeholder group, and then provide a written summary of the results. This summary should include a quantitative analysis of which recommendations were identified most often, highlighting any significant differences among groups, plus a a qualitative description of how this measure should be monitored, who should be responsible for monitoring and who should be paying for monitoring. The resulting report should be consistent with Section 6.2 of the draft table of contents for the synthesis report.

6. The Contractor will review the results of questions 77 and 79 of the household survey and the corresponding questions for the stakeholder surveys. These results have been coded but need to be recoded to reduce overlapping categories and to focus the analysis on the key indicators of river health. The Contractor will work with the Project Liaison Officer to develop a recoding strategy and to then implement this strategy when completed. The Contractor will then undertake a basic frequency analysis of the responses by sub-basin and by stakeholder group, and then provide a written summary of the results. This summary should include a quantitative analysis of which measure of river health were identified most often, highlighting any significant differences among groups, plus a qualitative description of these recommendations using, as much as possible, their own

words. The resulting report should be consistent with Section 6.1 of the draft table of contents for the synthesis report.

7. The Contractor will prepare an simple descriptive analysis of the results of questions 80 to 82 in the household survey, including the development of coding system for question 82. This analysis should highlight any similarities or differences among sub-basins or among stakeholder groups. The results of the analysis will be passed onto the Operations Committee of the NRBS for their use and interpretation.

8. The Contractor will prepare a brief report that describes the results of the analysis undertaken as part of tasks 3 to 6 above. A draft report will be submitted for review and comment, and a final report will then be prepared to incorporate any comments raised during the review process. The final report will eventually become part of the synthesis report for the Other Uses Component.

This study must be completed in two phases. The first phase consists of preparing a very simple overview of the survey results for possible use in the RiverViews publication. This Overview report is due July 15, 1995. The remainder of the analysis must then be completed by August 31, with the draft report being submitted at that time.

The study will be conducted under the supervision of the Component Leader (Bruce MacLock) and Project Liaison Office (John Thompson), and an advisory group which consists of:

- Hugh Seaton, Director, Research and Coordination, Northern Alberta Development Council
- Dr. Terry Veeman, Professor, Department of Rural Economy, University of Alberta
- Dr. Vic Adamowicz, Professor, Department of Rural Economy, University of Alberta
- Dr. Derek Bjonback, Chief, Socio-Economic Division, Environment Canada

III. REPORTING REQUIREMENTS

1) The Contractor is to provide draft and final reports in the style and format outlined in the NRBS Style Manual. A copy of the Style Manual entitled " A Guide for the Preparation of Reports" will be supplied to the contractor by the NRBS.

2) Ten copies of the Draft Overview Report along with an electronic disk copy are to be submitted to the Project Liaison Officer by July 15, 1995. The complete Draft Report is due August 31, 1995.

Three weeks after the receipt of review comments on the draft report, the Contractor is to provide the Project Liaison Officer with two unbound, camera-ready copies and ten cerlox-bound copies of the final report along with an electronic version.

3) The final report is to include the following: an acknowledgment section that indicates any local involvement in the project, Project Summary, Table of Contents, List of Tables, List of Figures and an Appendix with the Terms of Reference for this Project.

Text for the report should be set up in the following format:

a) Times Roman 12 point (Pro) or New Times Roman (WPWIN60) font.
b) Margins are 1" at top and bottom, 7/8" on left and right.
c) Headings in the report body are labeled with hierarchical decimal Arabic numbers
d) Text is presented with full justification; that is, aligns on both left and right margins.
e) Page numbers are Arabic numbers for the body of the report, centred at the bottom of each page and bold.

- If photographs are to be included in the report text they should be high contrast black and white.
- All tables and figures in the report should be clearly reproducible by a black and white photocopier.
- Along with copies of the final report, the Contractor is to supply an electronic version of the report in Word Perfect 5.1 or Word Perfect for Windows Version 6.0 format.
- Electronic copies of tables, figures and data appendices in the report are also to be submitted to the Project Liaison Officer in a spreadsheet (Quattro Pro preferred, but also Excel or Lotus) or database (dBase IV) format. Where appropriate, data in tables, figures and appendices should be geo-referenced.

IV. DELIVERABLES

1. All figures and maps are to be delivered in both hard copy (paper) and digital formats. Acceptable formats include: DXF, uncompressed Eoo, VEC/VEH, Atlas and ISIF. All digital maps must be properly geo-referenced.
2. All sampling locations presented in report and electronic format should be geo-referenced. This is to include decimal latitudes and longitudes (to six decimal places) and UTM coordinates. The first field for decimal latitudes/longitudes should be latitudes (10 spaces wide). The second field should be longitude (11 spaces wide).

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Appendix II

List of Place Names

List of Place Names

This table contains estimates of the amount and types of recreational activity that occurs at major locations identified by basin households. A description of the table is as follows:

1. Place Name - As reported in the household survey from various questions.
2. Code - Numeric code developed in Project 4121-D3 to identify place name in SPSS/PC+ data files.
3. Latitude - Determined using various gazetteer sources. Used for GIS plots.
4. Longitude - Determined using various gazetteer sources. Used for GIS plots.
5. Trips - Estimates of use are based on average number of trips to site, as reported in the household survey, and extrapolated to estimate total trips by basin population.
6. Camping - A "1" denotes that households reported camping at this location.
7. Fishing - A "1" denotes that households reported fishing at this location.
8. Canoeing - A "1" denotes that households reported canoeing at this location.
9. Hunting - A "1" denotes that households reported hunting at this location.
10. Boating - A "1" denotes that households reported boating at this location.
11. Swimming - A "1" denotes that households reported swimming at this location.
12. Picnicking - A "1" denotes that households reported picnicking at this location.

Place Name	Code	Latitude	Longitude	Trips	Camping	Fishing	Canoeing	Hunting	Boating	Picnicking	Swimming
3 Creek Junet	30	56* 25'	116* 53'	119		1					
Alberta Beach	376	53* 40'	114* 21'	12			1				1
Alexander Falls	43	60* 28'	116* 17'	5699	1	1			1	1	1
Amisk Lake	11	53* 22'	112* 30'	6272					1		1
Annette Lake	106	52* 54'	118* 03'	6224	1				1	1	1
Anzac The Gates	255	56* 27'	111* 02'	1921						1	
Area Jasper	249	52* 53'	118* 05'	21784							
Assinve Lake	125			703	1	1					
Athabasca Bridge	221			12	1		1				
Athabasca Ft. Ass	286	54* 20'	114* 46'	983	1			1		1	
Athabasca Golf Club	224	54* 43'	113* 17'	7248	1						
Athabasca Lake	182	58* 42'	111* 08'	442	1	1		1	1		
Athabasca Near	274	54* 43'	113* 17'	1812		1		1			
Athabasca River	39	54* 09'	115* 41'	17590	1	1	1	1	1	1	1
Athabasca River Bridge	221			12							
Athabasca/Ft. McMurray	43	56* 44'	111* 23'	752		1					1
Athba N to Ft. Chip	228	58* 42'	111* 08'	4432	1	1	1				
Atlas Landing	141			992					1		
Bacha Camp	332	52* 35'	112* 58'	806	1	1			1	1	
Back 40	355			544				1			1
Baptise Lake	92	54* 44'	113* 33'	5239	1	1			1		1
Bear Creek	36	54* 25'	116* 02'	4563	1		1		1	1	
Bear Lake	102	55* 16'	119* 00'	1108	1	1					
Beaver Lake	151	54* 46'	111* 55'	16768	1	1			1	1	1
Beaver River	288	54* 22'	110* 15'	78							
Bell Rock NWT	341	60* 02'	112* 06'	480		1				1	
Beriwyn	77	56* 09'	117* 44'	752							
Berland	97	54* 02'	116* 54'	6307	1	1	1	1			
Big Island	360	61* 05'	116* 59'	38		1					
Birch River	10	58* 28'	112* 23'	58	1						
Bistcho Lake	377	59* 37'	118* 28'	209		1					
Boyer Lake	394	58* 27'	116* 04'	2610	1	1			1		
Boyne Lake	293	54* 14'	111* 40'	941		1			1		
Bratue Dam	210	52* 58'	115* 34'	786	1						
Brazeau Dam	127	52* 58'	115* 34'	393	1		1				
Buck Lake	138	52* 57'	114* 47'	1642		1					1
Buffalo River	300	57* 51'	117* 06'	312	1	1		1	1		
Bull Creek	34	54* 04'	115* 23'	721		1					
Burnt River	15	55* 44'	118* 37'	251	1					1	
Burntwood Island	359	58* 55'	110* 37'	38		1					
Cabin NWT	343			230	1						
Cache Lake	199	54* 07'	111* 50'	622						1	
Cadomin	98	53* 02'	117* 20'	1376	1						
Cadotte Lake	246	56* 28'	116* 22'	405		1	1				1
Cadotte River	9	56* 44'	117* 15'	1774	1	1			1		1
Calling Lake	115	55* 13'	113* 09'	4892	1	1			1	1	1
Camp 3	385	53* 24'	117* 34'	38	1						
Camp Many Trees	203			192							1
Camp Nakamum	204	53* 53'	114* 12'	192							1

Place Name	Code	Latitude	Longitude	Trips	Camping	Fishing	Canoeing	Hunting	Boating	Picnicking	Swimming
Candy Meadows	139			727	1						
Canim Lake	387			12							1
Canyon Creek	52	55* 22'	115* 05'	1610	1	1			1	1	
Carrot Creek	329	53* 37'	115* 51'	1376				1			
Carson Lake	102	54* 22'	115* 41'	8090	1	1		1	1	1	1
Carson Lake Prov	146	54* 22'	115* 41'	3291	1	1	1		1	1	
Carter Camp	40	55* 59'	118* 59'	251						1	
Cascades Clearwater	250	56* 42'	110* 17'	393	1						
Chain Lake	154	51* 47'	112* 10'	78		1					1
Charlie Lake	336	56* 16'	121* 01'	627	1	1					
Chinchaga River	47	59* 02'	117* 42'	1013	1	1		1	1	1	1
Chip Lake	171	53* 37'	115* 26'	9830	1	1		1	1		
Christina Lake	64	55* 38'	111* 01'	3650	1	1	1		1		1
Chump Lake	196	54* 38'	121* 31'	1176	1	1					1
Churchill Pk Lac La	292	54* 50'	111* 59'	235	1						1
Clear Lake	144	54* 18'	114* 43'	846	1	1			1		1
Clear Lake Camp	226	54* 18'	114* 43'	815	1	1			1		1
Clearwater Athabasca	227	56* 44'	111* 23'	10357	1	1					
Clearwater River	87	56* 44'	111* 23'	6531	1	1	1	1	1		1
Cold Lake	68	54* 27'	110* 10'	1729		1			1		
Colin Lake	192	59* 31'	110* 12'	192		1			1		1
Conklin	69	55* 38'	111* 05'	3842		1		1			
Connors Ck Grazing R.	160	54* 06'	115* 08'	3045	1			1			
Cotilion Park	149	56* 01'	118* 50'	627	1	1					
Crimson Lake	312	52* 27'	115* 02'	197							
Crooked Lake	174	54* 26'	117* 13'	393		1	1				1
Cross Lake	112	54* 42'	114* 01'	4185	1	1			1	1	1
Ctooje River	19	58* 40'	111* 13'	481							1
Cut Bank	215	53* 41'	113* 31'	721		1					1
Dahlburg Lake	241			983	1	1		1			1
Devonshire Beach	120	55* 29'	114* 44'	7329	1				1	1	1
Diamond Willow Lk	259	55* 20'	115* 16'	1242	1						
Dog Camp	389	58* 42'	111* 08'	58	1						
Dog Head Area	358	58* 43'	111* 11'	173	1	1	1				
Dunvegan Park	37	55* 55'	118* 36'	7601	1	1	1	1	1	1	1
Eagle River	353	54* 12'	115* 46'	1089						1	
Eagles Nest	128			599	1						
Elk Island	335	53* 33'	112* 52'	1253						1	1
Embarass RV	368	53* 18'	116* 54'	197		1					
Emerson Lake	165	53* 45'	117* 06'	983	1	1					1
End of Reno Rd.	167			1573					1	1	1
Engstrom Lake	62	56* 11'	110* 54'	4418	1	1		1	1		1
Entwistle	330	53* 36'	115* 00'	197	1						
Erith Group Camp	280	53* 24'	116* 41'	393	1	1					
Evansburg Camp	314	53* 36'	115* 01'	197	1						
FairFax Lake	169	52* 58'	116* 34'	1376	1	1					
Fawcette Lake	124	55* 16'	113* 52'	5508	1	1		1	1		1
Fickle Lake	161	53* 27'	116* 46'	3146	1	1	1		1	1	1
Fiqure 8 Lake	41	56* 11'	117* 35'	7146	1	1			1	1	1
Fire Bag River	86	57* 43'	111* 28'	384		1		1			

Place Name	Code	Latitude	Longitude	Trips	Camping	Fishing	Canoeing	Hunting	Boating	Picnicking	Swimming
FoFar	132	54* 33'	113* 17'	3321	1	1	1		1	1	1
Foot of the Rapids	371			768	1						
Foother Lake	51	58* 37'	117* 11'	1409					1		
Fork Lake	152	54* 27'	111* 37'	10035	1	1					1
Fox Creek Area	297	54* 24'	116* 48'	934	1	1		1			
Francis Lake	331	55* 00'	111* 30'	590		1					
Fraser River	271			240	1						
Freeman Lake	131	54* 41'	115* 32'	2249	1	1	1				
Freeman River	248	54* 39'	115* 24'	181	1	1					1
Freemand River	237	54* 20'	114* 46'	803		1					
French Creek	354	54* 40'	113* 58'	181							1
Ft McMurray	63	56* 44'	111* 23'	2122	1	1		1	1		
Ft Sask River	275	53* 43'	113* 13'	384	1	1		1			
Ft Vermillion Boat lan	54	58* 24'	116* 00'	835						1	
Ft. Providence	216	61* 21'	117* 40'	52	1	1					
Gardiner Lake	191	60* 33'	105* 50'	384		1					
Germain Lake	365	54* 40'	111* 53'	96		1					
Ghost Lake	333	52* 57'	120* 54'	362		1					
Gods Lake	403			48		1					
Good Fish Lake	396	54* 18'	111* 50'	48	1						
Goose Lake	78	52* 25'	108* 19'	5430	1	1			1		1
Goose River		54* 59'	117* 12'	3754	1	1			1		1
Graham Lake	326	56* 30'	114* 32'	95		1					
Graham Lake	198	56* 30'	114* 32'	522	1				1	1	1
Grande Cache Lake	58	53* 54'	119* 03'	9372	1	1			1	1	1
Grave Flats	213	52* 53'	116* 50'	1999	1	1		1			
Gregoire Lake	72	56* 28'	111* 06'	46104	1	1	1	1	1	1	1
Grene River NWT	370	76* 24'	97* 43'	134	1			1	1		
Gull Lake	308	52* 28'	113* 56'	240		1					
Haig Lake	244	57* 11'	115* 52'	1312	1	1		1	1		
Hanging Stone	88	56* 38'	111* 20'	576	1						
Harmon Valley	1	56* 07'	116* 50'	1252	1	1			1	1	
Hastings Lake	170	53* 25'	112* 55'	5133				1	1		
Hawk Hills	272	57* 14'	117* 28'	887		1			1		1
Hay River	180	59* 02'	117* 42'	162		1					
Hay/Alexander Falls	395	60* 28'	116* 17'	125						1	
Haycamp Island	363	59* 31'	111* 28'	77				1			
Heart River Dam	316	55* 35'	116* 40'	1506		1					
Hilliards Bay	32	55* 29'	116* 02'	17734	1	1			1	1	1
Hinton	35	53* 25'	117* 34'	481	1	1					
Holme Crossing East	267	54* 19'	114* 44'	6312		1				1	1
Home Property	268			3932		1		1			
Hommy Park	263	55* 16'	119* 31'	1442	1						
Honeymoon Lake	186	52* 33'	117* 40'	393	1						
Hook Lake	190	53* 54'	111* 00'	576		1					
Hope Lake	156	54* 39'	112* 38'	254	1	1		1			1
Hutch Lake	49	58* 45'	117* 17'	2621	1	1			1	1	1
Iosigun Lake	262	54* 30'	116* 48'	4806		1					
Irish Lake	208	52* 52'	118* 30'	393	1	1					
Island Lake	223	53* 39'	114* 43'	906		1			1		1

Place Name	Code	Latitude	Longitude	Trips	Camping	Fishing	Canoeing	Hunting	Boating	Picnicking	Swimming
Isoegun Lake	18	54* 30'	116* 48'	2429	1	1			1		
Jack Fish	345	60* 15'	111* 13'	348	1	1					
Jackfish Lake	348	60* 15'	111* 13'	1089		1					1
Jackfish River	350	59* 00'	112* 52'	384	1	1		1			
Jarvis Creek	73	53* 26'	117* 40'	2037	1	1					1
Jarvis Lake	114	53* 27'	117* 47'	4512	1	1				1	1
Jasper	136	52* 53'	118* 05'	246	1		1			1	
Jasper	290	52* 53'	118* 05'	247	1	1	1		1		1
Jerry Lake	261	56* 18'	118* 16'	4806		1					
Joker Lake	243			489	1	1	1	1	1		
Josephine Lake	256	56* 00'	119* 13'	251						1	
Joussard Camp	305	55* 24'	115* 57'	515						1	
Kakisa Lake	380	60* 56'	117* 25'	266	1	1	1		1		
Kakut Creek	234	55* 36'	118* 28'	1880	1						
Kakwa Rec Area	231	54* 22'	118* 35'	125	1						
Kakwa River	27	54* 24'	118* 38'	3945	1			1			1
Keane Creek	458	58* 27'	116* 58'	192		1					
Keone Creek NWT	344	58* 26'	110* 55'	768		1					
Kieyo Park	150	55* 55'	117* 58'	1263							
Kingso Falls	309	55* 20'	115* 26'	240	1					1	
Kozo Lake NWT	342	60* 30'	110* 58'	19		1		1		1	1
Kulthili Lake	364			19		1					
Lac La Biche	137	54* 46'	111* 58'	4313	1	1			1	1	1
Lac Saint Ann	393	53* 41'	114* 26'	12							
LaCardinal Park	76	56* 13'	117* 41'	6014	1	1			1		1
LaCrete Ferry Site	53	57* 58'	117* 09'	522	1	1			1		
Lady Grey	399	60* 50'	110* 43'	38	1			1		1	1
Lake Clair	351	58* 30'	111* 58'	1056	1			1	1		
Lake Iisle	100	53* 39'	114* 43'	6684		1			1		
Lake Lessard	281	53* 47'	114* 39'	197						1	
Lambert Creek	166	53* 22'	116* 49'	590	1					1	
Lawrence Lake	111	54* 57'	113* 40'	1087						1	
Leddy Lake	89	56* 24'	117* 28'	2661	1	1	1	1	1		1
Lesser Slave River		55* 17'	114* 36'	25770	1	1			1	1	1
Lily Lake	311	53* 57'	113* 23'	201		1			1		
Little Paddle River	285	53* 57'	115* 08'	3932	1						1
Little Rapids	383	58* 55'	111* 11'	38	1	1					
Little Smokey River	6	55* 04'	117* 11'	14699	1	1	1	1	1	1	1
LittleBuffaloRiver	382	60* 03'	112* 45'	667	1		1		1		
Lobstick River	172	53* 36'	115* 01	9830	1	1		1	1		1
Locern BC	181	52* 52'	118* 33'	467							
Lone Lake	327	60* 05'	103* 50'	181	1				1		
Long Island Lake	168	51* 30'	120* 25'	7471	1	1			1		1
Long Lake	219	54* 25'	112* 45'	4035	1	1			1		1
Long Lake Prov Pk	60	54* 25'	112* 45'	6735	1	1			1	1	1
Loon Lake	253	56* 29'	115* 26'	624	1			1			
Losers Falls	378			178	1	1				1	1
Lubicon Lake	375	56* 22'	115* 52'	119	1			1			
Lucerne Camp	324	52* 52'	118* 33'	934	1						
Machesis Lake	182	58* 19'	116* 36'	898	1	1	1		1	1	1

Place Name	Code	Latitude	Longitude	Trips	Camping	Fishing	Canoeing	Hunting	Boating	Picnicking	Swimming
Macleod River	95	53* 28'	116* 28'	15029	1	1			1	1	1
Maligne Lake	116	52* 44'	117* 41'	1263	1	1			1	1	
Many Islands	320	50* 08'	110* 03'	501	1	1			1		
Many Lakes	83			375	1					1	
Maqua Lake	189	56* 22'	111* 17'	456	1	1					1
Margaret Lake	143	58* 58'	115* 13'	164		1					1
Marrie Lake	201	54* 38'	110* 15'	590		1			1		1
Martin Lk near Chisholm	277	54* 55'	114* 10'	179				1	1		1
Martin River	99	61* 52'	121* 26'	1985	1	1					1
Martin RV Camp	220			2711	1	1			1		
McCraikens	304			266							1
McKenzie River	357	61* 18'	119* 48'	19		1					1
Mcleod Lake Prov.Pk	233	54* 59'	123* 02'	644	1	1			1	1	1
Medicine Lake	64	52* 53'	117* 55'	2949	1	1					
Miller Lake	162	53* 28'	108* 57'	1966	1	1					
Mink Lake	242	56* 56'	113* 27'	417	1	1		1			
Missawawi Lake	197	54* 44'	112* 11'	1254	1	1			1		1
Mission Farm	405			58							
Mitiouton Camp	229			384	1	1				1	
MI7 Lake	153			157	1	1					1
Moberly Lake	337	55* 50'	121* 44'	627	1	1					
Moon Shine	307	55* 53'	119* 14'	481		1					
Moose Island	384	58* 56'	111* 45'	38	1						
Moose Lake	194	54* 14'	110* 55'	737					1		1
Mosquito Lake	145	62* 25'	103* 48'	362	1	1					
Murray River	111	55* 44'	121* 13'	481		1			1		
Muskec	74	54* 01'	119* 08'	1812							
Muskeg River	457	53* 33'	118* 22'	934	1	1					1
Muskiki Lake	178	52* 19'	105* 42'	508	1	1	1		1		
Muskuta Creek	94	53* 22'	117* 40'	2334		1					
Mussive Lake	28			240							
N Sask River	173	53* 13'	114* 59'	197			1				1
N Sask River	278	53* 13'	114* 59'	3932		1					
Nar Dam Ground	25			1347	1					1	
National Parks		52* 53'	118* 05'	6624	1	1			1		
Never same twice	294			3133							
North Buck Lake	195	54* 38'	112* 31'	2612	1	1			1		1
Nose Creek	184	54* 44'	119* 37'	961							
Notikewin Park	90	57* 17'	117* 07'	1529	1	1			1	1	1
O'Brian Park	30	55* 04'	118* 49'	4200	1	1				1	
O'Conner Lake	460	61* 12'	111* 53'	532	1	1					
Obed Lake	193	53* 34'	117* 08'	778		1					
Old Man Ck Hinton	322	53* 50'	117* 34'	778		1					
One Island Lake	230			125	1						
Orliff Lake	252	55* 23'	113* 33'	725	1	1			1		1
Paddle River Dam	239	53* 53'	115* 04'	1966	1	1			1		
Peace at Cadotte	258	56* 56'	117* 05'	177	1	1			1		
Peace River	11	58* 24'	116* 05'	18432	1	1	1	1	1	1	1
Peace River Bridge	306	55* 57'	118* 36'	1233		1					1
Peace/Hart River	303	56* 14'	117* 17'	637	1						

Place Name	Code	Latitude	Longitude	Trips	Camping	Fishing	Canoeing	Hunting	Boating	Picnicking	Swimming
Peerless Lake	133	56* 38'	114* 40	388	1	1					1
Pembina	101	53* 08'	115* 09'	197	1						1
Pembina at	283	53* 08'	115* 09'	1966							1
Pembina at Dapp Br	282	54* 21'	113* 59'	393							1
Pembina River		53* 36'	115* 00'	13663	1	1		1	1		1
Peppers Lake	113	52* 03'	115* 42'	1556				1			
Petite Lake	96	53* 39'	117* 43'	2033	1	1				1	1
Pierre Grey	72	53* 53'	118* 35'	24030	1	1					
Piers Lake	366			19		1					
Pigeon Lake	122	52* 59'	113* 59'	301	1						
Pigeon Lk PP	232	52* 59'	113* 59'	125	1					1	1
Pine Lake	42	54* 34'	113* 05'	4503	1	1	1	1	1		1
Pine Lake NWT	347	59* 33'	112* 15'	2131	1	1		1		1	1
Pinhurst Lake	175	54* 38'	111* 24'	2195	1	1					
Pinto Creek	183	54* 44'	119* 17'	961							
Pipestone Cr Park	14	55* 04'	119* 06	4085	1					1	
Pipestone creek	21	55* 04'	119* 06'	3845	1				1	1	1
Pratts Landing	321	56* 05'	119* 01'	376	1				1		
Private Land	284			983	1						1
Prov Park	159			786	1	1					
Pyamid Lake	104	52* 55'	118* 05'	2178	1				1		
Radium BC	315	50* 38'	116* 05'	201	1	1					
Rainbow Chow Farm	236			679	1	1					
Rainbow Lake	48	58* 17'	119* 16'	52	1					1	1
Ram River	187	52* 05'	116* 03'	197	1						
Rapids NWT	372	60* 01'	111* 52'	192	1	1			1		
Rapids of the Drowne	340	60* 01'	111* 52'	250						1	
Raven River	164	52* 22'	114* 55'	197							
Redwillow RV	266			9852	1	1			1		1
Richardson River	85	58* 23'	111* 08'	2305		1					1
Riverside Rec	135			91							
Rock Island Lake	134	55* 31'	114* 21'	650	1	1					
Rock Lake	222	53* 28'	118* 17'	1556		1					
Round Lake	119	56* 45'	114* 32'	453	1						
Running Lake	84	56* 40'	119* 02'	214	1	1					
Ruth Lake	70	56* 58'	111* 33'	1921		1		1			
Salt River	373	60* 01'	112* 17'	422	1		1				1
Salt River Camp	352	60* 01'	112* 17'	58						1	
Sandy Lake	205	53* 48'	114* 02'	157					1		
Sandy Point NWT	401	60* 26'	109* 51'	250					1		1
Sask Lakes	260			2103	1						
Sask River	287	54* 05'	112* 47'	392	1	1					1
Sask River Cross	110			197	1						
Saskatoon Island	264	55* 12'	119* 05'	2163	1						
Saskatoon Lake	10	55* 12'	119* 05'	17891	1	1			1	1	1
Saulteaux	79	55* 14'	114* 20'	2973		1			1	1	
Sawridge Rec Area	121	55* 17'	114* 40'	402	1	1					1
Seba Beach	158	53* 33'	114* 44'	197		1					1
Shafts Berry Ferry	301	56* 06'	117* 34'	251							
Shaws Point	235	55* 29'	116* 03'	552	1	1					

Place Name	Code	Latitude	Longitude	Trips	Camping	Fishing	Canoeing	Hunting	Boating	Picnicking	Swimming
Shaws Point	33	54* 46'	111* 39'	7446	1	1	1		1	1	1
Shining Band	103	53* 53'	150* 59'	3007	1	1			1		
Shining Bank Lake	179	53* 50'	115* 60'	5489	1	1	1		1		
Silver Lake	217	50* 24'	113* 48'	355	1						
Simonette River	71	55* 10'	118* 07'	240	1						
Sink Hole Lake	212	53* 20'	115* 16'	2359	1	1		1			
Sir Winston Church	118	54* 50'	111* 59'	1720	1	1			1	1	1
Six Lakes	273	57* 58'	111* 01'	768	1	1		1	1		
Skeleton Lake	155	54* 38'	112* 43'	8508	1	1			1		1
Slave /Moose River	298	54* 30'	11* 03'	2718	1						1
Slave Lake	339	55* 19'	115* 38'	1122	1	1			1	1	1
Slave River	38			2734	1	1	1				1
Slave River Delta	369	61* 13'	113* 40'	269	1			1	1		
Slave RiverIslands	361	59* 57'	111* 46'	1248		1		1	1	1	1
Smith	356	55* 10'	114* 02'	91			1				1
Smoke Lake	17	54* 24'	116* 50'	12452	1	1		1	1		
Smokey Wapiti	265	55* 10'	118* 29'	1682	1	1			1		
Smoky River	22	55* 14'	118* 11'	15527	1	1		1	1	1	1
Snipe Lake	16	55* 07'	116* 50'	3242	1	1			1		1
Snye	67	56* 44'	111* 22'	1921	1	1	1		1	1	1
Sowan Lake	397			131	1						
Spring Lake	26	53* 31'	114* 08'	5287	1	1			1		
Spruce Point	13	58* 33'	112* 22'	1199	1	1			1		
Spruce Point Park	31	58* 33'	112* 22'	4892	1	1			1		1
Steep Bank Lake	295	55* 28'	111* 34'	157		1		1			
Stoney Lake	82	56* 31'	118* 27'	1233	1	1					1
Sturgeon Lake	8	55* 07'	117* 32'	20246	1	1			1	1	1
Sulfur Lake	202	56* 42'	118* 20'	501	1						
Sunny Valley	93			1226		1		1	1	1	
Sunset House	400	55* 07'	116* 52'	24	1						
Swan Hills	130	54* 43'	115* 24'	1205	1	1					
Swan Lake	319	57* 13'	115* 50'	2463		1		1		1	1
Swan River	78	55* 20'	115* 25'	201							
Switzer Park	296	53* 28'	117* 50'	622		1		1			
Sylvan Lake	302	52* 18'	114* 05'	189	1	1			1		1
Talbet Lake	270	53* 05'	118* 00'	240	1						
Taltson River	123	61* 23'	112* 44'	115							
Tangent Park	142	55* 48'	117* 40'	1128	1	1					
Tangent Park	80	55* 48'	117* 40'	2198	1	1				1	1
Tawatinaw River	291	54* 28'	113* 23'	157		1			1		1
Thunder Lake	129	54* 08'	114* 43'	8280	1	1	1		1		1
Thunder Lake P.P.	279	54* 08'	114* 43'	508	1	1					1
Tompkins Landing	50	57* 48'	116* 51'	1315		1			1		
Touchwood	206	54* 46'	111* 20'	1176	1	1			1		1
Trout Lake	374	60* 26'	121* 15'	512	1	1			1		1
Tsu Lake	459	60* 42'	111* 53'	96	1						
Tumbler Ridge Area	310			1682	1	1			1		
Twin Lakes	44	57* 27'	117* 32'	3142	1	1			1	1	1
Two Lake	23	54* 22'	119* 45'	6248		1		1	1		
Utikimis Lake	456	55* 55'	115* 35'	2008		1					1

Place Name	Code	Latitude	Longitude	Trips	Camping	Fishing	Canoeing	Hunting	Boating	Picnicking	Swimming
Utikuma Lake	392	55* 55'	115* 35'	595							
Vandersteen	247	56* 37'	114* 28'	60		1					1
Various Camps	317			319	1	1		1			1
Various Others	999			815	1	1			1		1
Vega Ferry	225	54* 24'	114* 23'	1164	1	1			1	1	
Virginia Hills	123	61* 52'	125* 14'	402	1						
Wabasca Lake	148	56* 00'	113* 53'	2864	1	1	1		1	1	1
Wabasca River	45	55* 57'	113* 49'	376	1	1	1		1		1
Wadlin Lake	46	57* 45'	115* 36'	2036		1			1		
Wandering River	61	55* 19'	112* 31'	1729	1	1		1	1		
Wanogam Lake	218	55* 37'	116* 48'	177		1					1
Wapita River	4	55* 04'	119* 07'	16821	1	1		1	1	1	1
West of Hwy 22	240			4915	1	1		1			1
West Willie	200			590	1						
Whitemud Falls	251	56* 42'	110* 03'	463	1	1			1		
Whitemud River	2	56* 38'	117* 14'	6727	1	1			1	1	
Wild Hay Airstrip	214	53* 52'	117* 33'	860	1	1		1			
Wild Hay River	323	53* 32'	117* 57'	2800	1	1				1	1
Wild Horse Lake	177	53* 16'	117* 48'	3182	1	1			1		
Williston Lake	24			481		1					
Winagami Lake	12	55* 37'	116* 48'	8250	1	1			1	1	1
Windfall Creek	245	54* 12'	116* 14'	234	1	1					
Winifred Lake	254	59* 14'	110* 24'	576		1					1
Wolf Lake	211	49* 25'	110* 56'	1258	1	1					
Wolverine River	299	57* 45'	116* 58'	177		1					
Ya Ha Tinda				197	1						
Youngs Point Prov Pk	55	55* 08'	117* 35'	2163	1	1					
Zetta Lake	209	53* 10'	115* 44'	786	1	1					

Appendix III

Recoding Scheme for Health Measures and Recommendations

Recoding Scheme for Ecosystem Health Measures and Recommendations

Survey questions regarding suggested measures for monitoring of ecosystem health and recommendations that should be made by the Study Board yielded a wide range of answers that could not be easily analyzed. In order to undertake a quantitative assessment of survey responses to these questions, answers were grouped into various categories. The following tables show how survey responses were grouped and recoded.

In the case of ecosystem health measures, initial analysis of survey responses showed 78 different measures. There was considerable overlap among answers, however, and these were combined into 13 primary categories and various secondary categories. The primary categories were used to prepare the analysis in Chapter 16 of the report.

The survey also generated 149 different recommendations. These were initially grouped into 45 general categories which were subsequently reduced to 18 broad categories. The ten most important of these categories are summarized in Chapter 17.

Recoding Scheme for Question on Recommended Measures for Monitoring River Health

#.	Suggested Type of Measurement	Responses	Primary	Code	Secondary	Code
1.	Quality of water	146	Water Quality	1	General	1
2.	Oxygen level	21	Water Quality	1	Oxygen	5
3.	Contamination of fish	31	Fish	2	Contaminants	2
4.	Health of fish, plants, insects, wildlife	136	Fish	2	Health	3
5.	Take samples of water Re: contamination	78	Water Quality	1	Contaminants	2
6.	Monitor fish population	68	Fish	2	Populations	38
7.	Monitor pollutants	64	Monitor Pollutants	3	General	1
8.	Clarity, color	34	Water Quality	1	Colour	6
9.	Monitor water silts/phosphates	19	Water Quality	1	Phosphates	7
10.	Regular testing	2	Monitor Pollutants	3	General	1
11.	Level of sewage wastes	23	Monitor Pollutants	3	Sewage	8
12.	Test for, measure toxicity/chemicals	39	Water Quality	1	Toxicity	9
13.	Amount of water, water levels ,flow, dam control	78	Water Quality	1	Flows	10
14.	Monitor chemicals	10	Monitor Pollutants	3	Chemicals	11
15.	Monitor industrial, agricultural, municipal waste	35	Monitor Pollutants	3	Municipal	12
16.	Protection of natural resources	1	Management	4	General	1
17.	Study of ecosystem quality	22	Ecosystem Health	5	General	1
18.	Vegetation along rivers, plant, algae growth	47	Vegetation	6	General	1
19.	Number of roads, pipelines seismic	2	Human Use	7	Roads/Pipelines	13
20.	Pollutants from mills should be monitored industrial	24	Monitor Pollutants	3	Industry	14
21.	Meat quality in fish, test fish	37	Fish	2	Contaminants	2
22.	Wildlife using river area	12	Wildlife	8	General	1
23.	Chemical analysis before dumping	9	Monitor Pollutants	3	General	1
24.	Thriving ecosystems within river basin	2	Ecosystem Health	5	General	1
25.	Look at water appearance	8	Water Quality	1	Appearance	15
26.	Taste water odor, suitable for human use	22	Water Quality	1	Taste	16
27.	Smell water, odor	9	Water Quality	1	Smell	17
28.	Climate quality, quantity	1	Climate	9	General	1
29.	Amount used recreationally	2	Human Use	7	Recreation	18
30.	Bio Away testing	3				
31.	Ability to support aquatic life	5	Ecosystem Health	5	General	1
32.	Air quality pollutants	4	Air Quality	10	General	1
33.	Litter	2	Monitor Pollutants	3	Litter	19
34.	Ask people who fish and use regularly	3	Human Use	7	Ask Users	4
35.	Temperature	1	Water Quality	1	Temperature	20
36.	Public awareness	2	Human Use	7	Education	21
37.	Recreation abuse	6	Human Use	7	Recreation	18
38.	Health problems of people	6	Human Use	7	Health	3
39	.Community opinions	1	Human Use	7	Ask Users	4
40.	Water management	2	Management	4	General	1
41.	Lands use practices	1	Human Use	7	Land Use	22
42.	Food chains constant motion	2	Ecosystem Health	5	Food Chains	23

#.	Suggested Type of Measurement	Responses	Primary	Code	Secondary	Code
43.	Think about all wildlife, ecosystem	4	Ecosystem Health	5	General	1
44.	Reduce effluent and industry waste, entering river	1	Monitor Pollutants	3		14
45.	Erosion	1	Erosion	11	General	1
46.	Nutrients of rivers	2	Water Quality	1	Nutrients	24
47.	Independent agency on site to test mills, plants, industry	1	Management	4	Agency	25
48.	Fines	4	Management	4	Fines	26
49.	Loss of water holding and purifying lost through de-forestation	4	Human Use	7	Forestry	27
50.	Test for agriculture waste, runoff	5	Monitor Pollutants	3	Agriculture	28
51.	Test for toxic sub and chemicals in sediment etc.	8	Monitor Pollutants	3	Sediments	29
52.	Stay in touch with recreation users	5	Human Use	7	Ask Users	4
53.	Oppose dam building	2	Management	4	Restrict Dams	30
54.	Pollution from clear cutting	1	Human Use	7	Forestry	27
55.	Reproductivity	1	Ecosystem Health	5	Reproduction	31
56.	Test where rivers run into lakes	2	Monitor Pollutants	3	General	1
57.	Reforestation	1	Human Use	7	Forestry	27
58.	Visual appearance of forests and valleys	2	Human Use	7	Aesthetics	32
59.	River valley environment	3	Ecosystem Health	5	General	1
60.	Heavy metals mercury, PCB's etc.	3	Monitor Pollutants	3	Heavy Metals	33
61.	Effective enforcement of laws	1	Management	4	Enforcement	34
62.	Health of traditional hunters and fishers	1	Human Use	7	Health	3
63.	Erosion	3	Erosion	11	General	1
64.	Everything that can be checked	3	Management	4	General	1
65.	Comprehend historical evidence, written and verbal from elders and compare to present	3	Human Use	7	Traditional Knowledge	35
66.	Use common sense	1	Management	4	General	1
67.	Use your senses	1	Management	4	General	1
68.	Water table	1	Groundwater	12	General	1
69	.Biological status	2	Ecosystem Health	5	General	1
70.	Shutdown	1	Management	4	Enforcement	34
71.	Self reporting	1	Management	4	Reporting	36
72.	Survey users	1	Human Uses	7	Ask Users	4
73.	Test ground water for contamination	1	Groundwater	12	Contamination	2
74.	Establish a base line data	1	Monitor Pollutants	3	General	1
75.	Enforce regulations	2	Management	4		34
76.	Determine what other factors have done to river	1				
77.	Oil in the water	1	Water Quality	1	Oil	37
78.	Test fish for disease	1	Fish	2	Health	3

Recoding Scheme for Recommendations

Code	Recommendation	New Category	New Code
1.	Monitor regularly	Need to monitor industrial activities	1
2.	Clean up water entering rivers, prohibit toxins and chemicals	Need to clean up water	2
3.	Control industrial water entering rivers	Need to clean up water	2
4.	Decrease pollution, water purification	Need to clean up water	2
5.	Monitor industrial use	Need to monitor	1
6.	Stricter waste regulations	Need for stricter regulations	8
7.	Correct water quality/quantity problems	Need to clean up water	2
8.	Make a basin plan and use it	Need for a basin-wide management plan	3
9.	More research	Need more research	4
10.	Stop logging/farming so close to rivers	Stop or reduce development activities	9
11.	Clean up or pay up, heavy fines	Clean up or pay heavy fines	5
12.	Enforce very strict laws on polluters and raise fines for offenders	Enforcement of laws	14
13.	Control municipal/industrial waste	Need to clean up water	2
14.	Quality of water monitoring	Need to monitor	1
15.	Increase legislation to control pollution levels/water	Need for stricter regulations	8
16.	Protection of natural water sources/wetlands	Protect environment	6
17.	More control of water users	Need to clean up water	2
18.	Higher standards for industry using water	Need for stricter regulations	8
19.	Supervision of industrial/municipal dumping	Need to monitor	1
20.	Clean up pulp mill dumping	Need to clean up water	2
21.	Reduce number of road, pipeline crossings	Stop or reduce development activities	9
22.	Industry/agriculture/government work together	Management processes	15
23.	Government becomes more involved in monitoring/measuring river health	Need to monitor	1
24.	Greater control of land users re: development	Need for stricter regulations	8
25.	Management plan	Need for a basin-wide management plan	3
26.	If you don't know what damage it will do say no	Protect environment	6
27.	No more dams	Stop or reduce development activities	9
28.	Control logging to avoid erosion	Stop or reduce development activities	9
29.	Public awareness	Public education	7
30.	Fish levels/health	Need to monitor	1
31.	Monitor hot spots, mill, discharges industry	Need to monitor	1
32.	Stop illegal dumping chemicals toxins sewage from entering river	Need to clean up water	2
33.	Don't mess with nature	Protect environment	6
34.	Agriculture on drainage system chemical by farmers environmentally friendly products	Need to clean up water	2
35.	Identify sources of pollutants	Need more research	4
36.	Agricultural pollutants from entering water ways	Need to clean up water	2
37.	Catch/release fish in all flowing rivers	Control fishing activities	11
38.	1 km boundary on all drainage's for clear cutting monitor forestry close to rivers	Stop or reduce development activities	9
39.	Stop motor boats restrict pleasure boating high power motors	Stop or reduce development activities	9

Code	Recommendation	New Category	New Code
40.	Preserve river systems at any cost take polluters rights to do business away	Protect environment	6
41.	Close ALPAC	Stop or reduce development activities	9
42.	Food chain relationships	Need more research	4
43.	Monitor sediments	Need to monitor industrial activities	1
44.	Reduce clear cutting to maintain water levels	Stop or reduce development activities	9
45.	Health of fish/wildlife	Need to monitor	1
46.	No more mills, plants reduce size of existing ones	Stop or reduce development activities	9
47.	Control of flooding/water levels	Control water flows	12
48.	Air pollutants	Need to clean up air	17
49.	Educate our children make them mad and general public	Public education	7
50.	Household contaminants to be discouraged	Need to clean up water	2
51.	Water controlled by dams allowed to flow more freely	Control water flows	12
52.	Monitor run-off	Need to monitor	1
53.	Stop Swan Hills from pumping into the ground	Need to clean up water	2
54.	Better sewage treatment plants	Need for stricter regulations	8
55.	Regulate agriculture/forestry practices in drainage basin	Need for stricter regulations	8
56.	Stop considering northern rivers as a waste disposal	Stop or reduce development activities	9
57.	Regular survey of wildlife	Need to monitor	1
58.	Water authority to regulate water flow and levels	Control water flows	12
59.	Industrial users should sponsor studies such as this and pay for monitoring	Conduct of NRBS studies	13
60.	Increase pollution standards	Need for stricter regulations	8
61.	Honesty interpret findings and make public	Conduct of NRBS studies	13
62.	Publicize findings offer reasonable solutions	Conduct of NRBS studies	13
63.	We have to be concerned of the environment	Protect environment	6
64.	Enforce regulation of existing laws	Enforcement of laws	14
65.	Pollution of lakes, dumping to stop	Stop or reduce development activities	9
66.	Restock fish to rivers and lakes, improve spawning grounds	Control fishing activities	11
67.	Control fishery, cut down fishing and hunting	Control fishing activities	11
68.	Industries using water should cover cost or big percent of clean up	Need to clean up water	2
69.	Responsibility in hands of local people	Need for local input	10
70.	Independent agency to inspect, water, fish, wildlife	Management processes	15
71.	Protect rivers from straightening	Stop or reduce development activities	9
72.	Check for other things that may effect health of rivers	Conduct of NRBS studies	13
73.	Must consider economic as well as environmental factors	Management processes	15
74.	A reasonable amount of time for change clean up no more pollution damming	Stop or reduce development activities	9
75.	No more development on river	Stop or reduce development activities	9
76.	Overuse from recreational activities	Stop or reduce development activities	9
77.	Encourage development for those who do it responsibility	Management processes	15
78.	Be proactive, get on natures side	Protect environment	6

Code	Recommendation	New Category	New Code
79.	Zero tolerance on second infraction industry should be shut down	Enforcement of laws	14
80.	Everyone has to help, tell people to help, input from everyone	Need for local input	10
81.	Eliminate all forms of chlorine use	Need for stricter regulations	8
82.	Polluters pay for costs of cleanup, industry and municipal	Clean up or pay heavy fines	5
83.	Get general public involved at various points	Need for local input	10
84.	Keeping land for wildlife	Protect environment	6
85.	Less bureaucracy	Management processes	15
86.	No over fishing by any groups	Control fishing activities	11
87.	Control mining procedures	Need for stricter regulations	8
88.	Monitor all industry closer	Need to monitor	1
89.	User fee	Clean up or pay heavy fines	5
90.	Limit logging and oil/gas development	Stop or reduce development activities	9
91.	Use effluent water for oil/gas	Need to clean up water	2
92.	Septic tanks for all gray water at lakes, campgrounds etc. everywhere	Need to clean up water	2
93.	Determine impact of logging before approving more	Need more research	4
94.	Set priorities i.e.: health human/other before profit	Need for a basin-wide management plan	3
95.	Advertise the beauty of NRB for tourism	Management processes	15
96.	To have better quality water	Need to clean up water	2
97.	Effective and empowered inspection, police	Enforcement of laws	14
98.	To prevent the destruction of rivers, streams	Protect environment	6
99.	Open and public chastising of abusers/polluters	Clean up or pay heavy fines	5
100.	less or limited clear cutting	Stop or reduce development activities	9
101.	Pulp mills and industry not near rivers to be tested for seepage	Need to monitor	1
102.	No more clear cutting, enforce select cutting	Stop or reduce development activities	9
103.	No chemical usage by public, or industry spraying, ditch road sides	Stop or reduce development activities	9
104.	Take action	Conduct of NRBS studies	13
105.	When will action be taken	Conduct of NRBS studies	13
106.	How will action be taken	Conduct of NRBS studies	13
107.	Quit draining muskeg	Stop or reduce development activities	9
108.	Determine the health of rivers	Need more research	4
109.	Industry should not come first, economic development shouldn't come first	Protect environment	6
110.	Regulation for oilfield injections	Need for stricter regulations	8
111.	Within 5 years	Management processes	15
112.	Encourage environmental scientists in their practiced research	Need more research	4
113.	Set aside pristine lake and rivers and allow no development	Protect environment	6
114.	Water conservation of some kind	Protect environment	6
115.	Make sure government cleans up too	Stop or reduce development activities	9
116.	Get disposal well checked out	Need to clean up water	2
117.	Clean up as much as possible now	Need to clean up water	2

Code	Recommendation	New Category	New Code
118.	More responsible people	Public education	7
119.	Industry to recycle their own water	Need to clean up water	2
120.	Keep farms/ranches away from river banks	Stop or reduce development activities	9
121.	Amount of trees not being replanted	Mitigate impacts	16
122.	Treatment of municipal water should be maintained and improved	Need to clean up water	2
123.	Preservation of wildlife	Protect environment	6
124.	Reports on river study results and updates on action taken inform basin residents	Conduct of NRBS studies	13
125.	More water treatment plants for drinking water	Water service	18
126.	To find out how bad the water is	Need more research	4
127.	Use common sense	Need for local input	10
128.	Keep costs down	Conduct of NRBS studies	13
129.	Monitoring to be done by clubs	Need to monitor	1
130.	Input from all concerned	Need for local input	10
131.	Locate industry away from water	Stop or reduce development activities	9
132.	No taxpayer money or tax breaks for industry	Enforcement of laws	14
133.	The use of municipal sewage for agriculture	Need to clean up water	2
134.	To be aware that the growth of human population leads to decline in water quality	Need to clean up water	2
135.	In-depth study of all potential threats to water, monitor	Need more research	4
136.	Listen to the elders they are valuable resources and probably have seen changes and could be helpful on deciding what to do	Need for local input	10
137.	Tax on farmers using chemicals	Enforcement of laws	14
138.	Increase levels of oxygen	Need to clean up water	2
139.	Establish baseline data and update regularly	Need more research	4
140.	Effective monitoring	Need to monitor	1
141.	Running water for settlements	Water service	18
142.	No Entry	Stop or reduce development activities	9
143.	Uncontrolled pollution in the groundwater should be monitored	Need to monitor	1
144.	To make our waterways like they were 30 years ago	Protect environment	6
145.	Study should include all of Western Canada	Conduct of NRBS studies	13
146.	Clean up the garbage	Clean up or pay heavy fines	5
147.	Stop the studies	Conduct of NRBS studies	13
148.	Make polluters pay annual fee	Clean up or pay heavy fines	5
149.	Obtain information from fishermen and farmers living in the watershed	Need for local input	10

Appendix IV

Household and Stakeholder Questionnaires

Canada Alberta Northwest Territories

Northern River Basins Study
Household Questionnaire

Part I. Introduction

Your telephone number _____

Thank you for agreeing to answer this questionnaire. One of the objectives of the study is to find out how Northerners use and value the Peace, Athabasca and Slave Rivers. Your household was selected at random to help provide this information. We need your cooperation to answer a series of questions about how you and members of your household make use of the water resources of the region. We are collecting information from about 1,200 households. Individual responses will be kept confidential.

Part II. General Questions

1a. Where are you currently living? *(Circle one answer.)*

A. Town/city (specify) _____ *(Go to question 2.)*
B. Farm
C. Cottage/rural subdivision
D. Native reserve
E. Metis settlement
F. Other (specify) _____

1b. ***(if B to F selected)*** What is the name of the closest city, town, hamlet or village?

_____

2. How long have you been living in this location? *(Circle one answer.)*

A. Less than 1 year
B. Between 1 and 5 years
C. Between 5 and 10 years
D. Between 10 and 15 years
E. Between 15 and 20 years
F. More than 20 years

3. How long have you been living in the Peace, Slave or Athabasca River basins? *(Circle one answer.)*

A. Less than 1 year
B. Between 1 and 5 years
C. Between 5 and 10 years
D. Between 10 and 15 years
E. Between 15 and 20 years
F. More than 20 years

4. Which one of the following major rivers is nearest your current residence? *(Circle only one answer.)*

A. Athabasca River
B. McLeod River
C. Pembina River
D. Peace River
E. Wapiti River
F. Smoky River
G. Little Smoky River
H. Wabasca River
I. Slave River

5. About how far away is this river from your current residence?

_____ Kilometre Or _____ Miles

6. Do you identify yourself as? *(Circle one answer.)*

A. Aboriginal ——> Are you on a registered Tribal roll? Yes ____ No ____
B. Metis
C. Non-native

7. Which of the following categories best describes your household? *(Circle only one answer.)*

A. Single person
B. Couple with no children
C. Couple with children
D. Extended family
E. Single parent family
F. Two or more unrelated adults
G. Two or more related adults
H. Other *(describe below)*

_____

8. Including yourself, how many people are in your household? _____ people

9. Of these, how many are in the following age categories?

A. Under 5 years old _____
B. 5 to 9 years old _____
C. 10 to 14 years old _____
D. 15 to 19 years old _____
E. 20 to 34 years old _____
F. 35 to 44 years old _____
G. 45 to 54 years old _____
H. 55 to 64 years old _____
I. 65 years and older _____

10. How old are you? _____

11. Are you? _____ Male _____ Female

12. In which industries are you and members of your household currently employed? *(Circle all that apply.)*

A. Agriculture
B. Trapping/commercial fishing
C. Oil and gas
D. Forestry (logging)
E. Manufacturing (lumber, paper, etc.)
F. Construction
G. Transportation/communications/utilities
H. Retail or wholesale trade
I. Finance, insurance, other services
J. Government (health, education)
K. Unemployed
L. Other *(describe below)*

_____

Part III. General Use of Water Resources

The next part of this questionnaire asks some general questions about how you and members of your household use the water, fish, plants and wildlife in the river basin.

13. What is the source of your household's everyday drinking water? *(Circle one answer.)*

A. Municipal water plant ——> *(Go to question 15)*
B. Bottled water ——> *(Go to question 15)*
C. Well
D. Lake water Which lake? _____
E. River water Which river? _____
F. Dug out
G. Spring water
H. Other *(describe)* _____

14. Do you treat this water in any way before drinking it?

_____ Yes *(describe)* _____
_____ No

15. Are there any problems with the amount of water available from this source throughout the year?

_____ Yes *(describe)* _____
_____ No

16. Are there any problems with the quality of water available from this source throughout the year?

_____ Yes *(describe)* _____
_____ No

17. **Over the last 10 years,** have there been any noticeable changes in the quality or amount of water available from your usual water supply?

_____ Yes *(describe the changes you have noticed such as amount, smell, colour, taste, clarity)* _____
_____ No

18. Do you agree or disagree with each of the following statements?
(Check only one answer for each question.)

	Totally Agree	Agree	Disagree	Totally Disagree	Unsure
A. Water quality in the Peace, Athabasca and Slave Rivers is not really a major issue at the moment so new restrictions on industrial, agricultural or municipal water use are not required.					
B. Pollution of northern rivers is only a concern in a few locations and more enforcement of existing standards will solve these problems.					
C. Contamination of northern rivers is a major problem and some industries or municipalities should be forced to reduce effluent discharges, even if it means closing some operations.					
D. Existing water management regulations are interfering with economic development in the region and should be reduced or eliminated.					
E. New effluent discharges should not be allowed until a river basin plan has been completed.					

Part IV. Subsistence Use of Water Resources

19. Do you or any members of your household use any water resources for subsistence? By subsistence, we mean harvesting fish or wildlife only for your consumption or as a source of income.

_____ Yes
_____ No ——> *(Go to Yellow Section, Page 11, Question 39.)*

20. How often do you or members of your household participate in the following subsistence activities? *(Check appropriate answer for each activity.)*

	Daily	Weekly	Monthly	Yearly
Fishing				
Trapping				
Hunting				
Other *(specify below)*				

_____

Subsistence fishing

If you or members of your household do <u>not</u> participate in subsistence fishing, go to Question 27.

21a. List the three main species of fish and indicate how many pounds of these fish you and members of your household actually catch in an average year.

Name of species	Average annual catch *(specify pounds or kilograms)*
#1	
#2	
#3	

21b. Of these three species of fish, which would you prefer to catch. *(List in order of preference.)*

Preference	Name of species
#1	
#2	
#3	

22. In which three main bodies of water do you and members of your household usually fish and what proportion of your total catch comes from each? *(List in order of importance.)*

Importance	Name of water body	Percent (%) of annual catch
#1		
#2		
#3		

23. Do you or members of your household fish in the mainstems of the Athabasca, Peace or Slave Rivers or any of their major tributaries?

_____ Yes _____ No

If yes, please indicate the three most important sites along these rivers and indicate the proportion of total catch that comes from each location. *(To help describe the site, use the nearest major landmark that people would know.)*

Importance	Name or Description of Site	Percent (%) of annual catch
#1		
#2		
#3		

24. Over the past 10 years, have you or any members of your household noticed any changes in the number, quality or health of fish you have caught?

_____ Yes _____ No

If yes, describe the types of changes you have noticed.

Number: _____
Quality: _____
Health: _____
Other: _____

25. Of the fish you catch, how much of the total annual catch:

	Percent (%) of annual catch
Is eaten by you and members of your household?	
Is given away or sold to others for their consumption?	
Is fed to dogs or other animals?	

26. How many pounds or kilograms of caught fish does a typical person in your household consume in an average week?

_____ Pounds **OR** _____ Kilograms **OR** _____ Number of fish eaten

Subsistence trapping

If you or members of your household do not participate in subsistence trapping, go to Question 32.

27a . List the three main species of furbearers and indicate how many of these animals you and members of your household actually trap in an average year.

Name of species	Average annual catch *(specify pounds or kilograms)*	Average number of animals trapped per year
#1		
#2		
#3		

27b. Of these three furbearers that you trap, which would you prefer to trap. *(List in order of importance.)*

Preference	Name of species
#1	
#2	
#3	

28. Describe the location of your trapping area or if you are a registered trapper, indicate your registered trapline number. *(To help describe the area, use the nearest major landmark that people would know.)*

_____

_____

_____

29. Do you or members of your household trap within 10 kilometres (6 miles) of the mainstems of the Athabasca, Peace or Slave Rivers or any of their major tributaries?

_____ Yes _____ No

If yes, please indicate the three most important locations along these rivers and indicate the proportion of total catch that comes from each location. *(To help describe the area, use the nearest major landmark that people would know.)*

Importance	Name or Description of Site	Percent (%) of annual catch
#1		
#2		
#3		

30. Over the past 10 years, have you or any members of your household noticed any changes in the number, quality or health of the furbearers you trapped?

_____ Yes _____ No

If yes, describe the types of changes you have noticed.

Number: _____
Quality: _____
Health: _____
Other: _____

31. Do you or members of your household eat any parts of the animals you trap?

_____ Yes _____ No

If yes, please indicate the type of animal you trap, all portions of the animal you eat, and the number of animals that your household eats in an average year.

Type of Animal	Parts eaten	Number eaten per year

Subsistence hunting

If you or members of your household do not participate in subsistence hunting, go to Question 39.

32. In an average year, about how many animals do you or members of your household kill for food (subsistence hunting) each year?

_____ Animals killed

33a. List the three main species of animals and indicate how many of these animals you and members of your household actually hunt and kill in an average year:

Type of animal	Number killed per year
#1	
#2	
#3	

33b. Of these three species of animals, which would you would prefer to hunt? *(List in order of importance.)*

Preference	Type of animal
#1	
#2	
#3	

34. Do you or members of your household hunt within 10 kilometres (6 miles) of the mainstems of the Athabasca, Peace or Slave rivers, or any of their major tributaries?

_____ Yes _____ No

If yes, please indicate the three most important sites along these rivers and indicate the proportion of total kills from each location. *(To help describe the area, use the nearest maior landmark that people would know.)*

Importance	Name or Description of Site	Percent (%) of animals killed
#1		
#2		
#3		

35. Over the past 10 years, have you or any members of your household noticed any changes in the number, quality or health of animals killed for food?

_____ Yes _____ No

If yes, describe the types of changes you have noticed.

Number: _____
Quality: _____
Health: _____
Other: _____

36. Of the animals that you have killed, what proportion of the meat:

	Percent (%) of animals killed
Is eaten by you and members of your household?	
Is given away to others for their consumption?	
Is fed to dogs or other animals?	

37. How many pounds or kilograms of wild game meat does a typical person in your household consume in an average week?

_____ Pounds **OR** _____ Kilograms

General questions

38. While you are subsistence fishing, trapping or hunting, do you ever consume or use river or lake water?

_____ Yes _____ No

If Yes, do you treat this water in any way before drinking it?

_____Yes *(describe how)* _____
_____No _____

Part V. Recreational Activities

39. For each of the following recreational activities, please indicate how often you or members of your household participate in the activities listed below. Also indicate the average length of trips in days and the average number of household residents participating on these trips.

Main Activity	Number of trips in an average year	Average length of trip (days)	Average number of household members on the trip
Fishing			
Boating			
Swimming (lakes/rivers)			
Canoeing			
Camping			
Hunting			
Other			

40. List in order of preference, the sites on rivers and lakes that you and members of your household visit most often for recreational purposes. Also, indicate the usual recreational activity on these trips, the number of trips to each site in an average year, and the main reason for preferring this site. *(To help describe the area, use the nearest major landmark that people would know.)*

	Site #1	Site #2	Site #3
Site name or description			
Usual activity			
Number of trips per year			
Main reason for preferring site			

41. Do you or members of your household use the mainstems of the Athabasca, Peace or Slave Rivers, or any of their major tributaries for recreational purposes?

_____ Yes _____ No *(If No, go to Question 45.)*

If yes, please describe the three locations along these rivers that you use most often, indicate the usual recreational activity at each site, and state the number of trips taken to each site in an average year. *(To help describe the area, use the nearest major landmark that people would know.)*

	Site #1	Site #2	Site #3
Site name or description			
Usual activity			
Number of trips preferring site			

42. List, in order of importance, the three species of fish that you prefer to catch recreationally from themainstems of the Athabasca, Peace or Slave Rivers or any of their major tributaries and indicate how many pounds or kilograms of these fish you and members of your household catch in an average year from these locations. *(Include the numbers of fish you keep and release.)*

Importance	Type of fish	Average annual recreational catch *(specify pounds* **OR** *kilograms)*
#1		
#2		
#3		

43a. On average, about how many pounds or kilograms of fish caught from these locations do you and members of your household consume per year?

_____ Pounds **OR** _____ Kilograms **OR** _____ Number of fish eaten

43b. Which, of these fish species you catch recreationally, do you eat?

44. On average, about how many pounds or kilograms of fish caught from these locations is given away to others?

_____ Pounds **OR** _____ Kilograms **OR** _____ Number given away

45. Over the past 10 years, have you or any members of your household noticed any changes in the water, fish, animals or plants along the mainstems of the Athabasca, Peace or Slave Rivers or any of their major tributaries?

_____ Yes _____ No

If yes, describe the types of changes you have noticed.

Water: _____
Fish: _____
Animals: _____
Plants: _____
Other: _____

46. When involved in water-based recreational activities in the region, do you ever consume river or lake water?

_____ Yes _____ No

If yes, do you treat this water in any way before drinking it?

_____Yes *(describe how)* _____
_____No _____

Part VI. Agricultural Water Use

47. Are you or any members of your household involved in farming of any sort?

_____ Yes
_____ No ———> *(If No, go to White Section, Page 15 Question 57.)*

48. Which of the following terms best describes your farming operation? *(Circle one answer.)*

A. Grains/oilseeds
B. Mixed farming (grain and livestock)
C. Specialty crops *(describe)*_____
D. Livestock only ———> *(Go to question 55.)*

49. How many acres do you plant or harvest in an average year? _____ acres

50. Please list the types of crops you grow.

_____
_____
_____

51a. Do you irrigate any of these crops?

_____ Yes _____ No
If yes, what is the source of this water? *(Name the waterbody.)*_____

51b. Do you have a water license? _____ Yes _____ No

51c. Home many acres of land do you irrigate in an average year? _____ acres

51d. How much water (total volume) do you use in an average year?_____ acres-feet **OR**
_____ inches/acre/year

52. Do you use any herbicides?

_____ Yes _____ No

If yes, please list the types of herbicides you normally use and the amount (by weight or by volume) applied in an average year.

Name or brand of herbicide	Amount applied in an average year *(specify weight or volume)*
1.	
2.	
3.	
4.	
5	
6.	
7	
8.	

53. Do you use any pesticides?

_____ Yes _____ No

If yes, please list the types of pesticides you normally use and the amount (by weight or by volume) applied in an average year.

Name or brand of pesticide	Amount applied in an average year *(specify weight or volume)*
1.	
2.	
3.	
4.	
5	
6.	
7	
8.	

54. Do you use any fertilizers?

_____ Yes _____ No

If yes, please list the types of fertilizers you normally use and the amount (by weight or by volume) applied in an average year.

Name or brand of fertilizers	Amount applied in an average year *(specify weight or volume)*
1.	
2.	
3.	
4.	
5	
6.	
7	
8.	

Farmers without livestock, go to Question 57.

55. How many of each of the following types of livestock do you have?

Type of livestock	Number
1. Cattle	
2. Horses	
3. Pigs/swine	
4. Sheep	
5. Poultry	

Other livestock *(specify)*	Number
6.	
7.	
8.	
9.	
10.	

56. Please describe how you normally dispose of livestock manure.

_____

_____

_____

Part VII Water Management Values and Issues

57. Although this section appears to be lengthy, the answers to these questions are very important. We appreciate you taking the time to complete these questions. In your opinion, what three factors have had the greatest effect on the amount or the quality of water in the major river basin in which you live (Peace, Athabasca or Slave) over the last 20 years?

Factor 1. _____
Factor 2. _____
Factor 3. _____

Thinking about the <u>first factor</u> you mentioned:

58. Describe the ways in which it has affected water quality, fish, wildlife, vegetation or the health of the river.

Factor 1. _____
_____

59. Describe the ways in which it has affected you or members of your household.

Factor 1. _____
_____

60. If no steps are taken to control your Factor 1, describe how you think the health of the rivers will be affected over the next 10 years.

Factor 1. _____
_____

61. If no steps are taken to control your Factor 1, describe how you think the health of members of your household will be affected over the next 10 years.

Factor 1. _____
_____

62. If the Northern River Basins Study were to suggest ways for managing this problem, what actions do you think they should recommend?

Factor 1. _____
_____

Thinking about the <u>second factor</u> you mentioned:

63. Describe the ways in which it has affected water quality, fish, wildlife, vegetation or the health of the river.

Factor 2. _____
_____

64. Describe the ways in which it has affected you or members of your household.

Factor 2. _____
_____

65. If no steps are taken to control your Factor 2, describe how you think the health of the rivers will be affected over the next 10 years.

Factor 2. _____
_____

66. If no steps are taken to control your Factor 2, describe how you think the health of members of your household will be affected over the next 10 years.

Factor 2. _____

_____

67. If the Northern River Basins Study were to suggest ways for managing this problem, what actions do you think they should recommend?

Factor 2. _____

_____

Thinking about the <u>third factor</u> you mentioned:

68. Describe the ways in which it has affected water quality, fish, wildlife, vegetation or the health of the river.

Factor 3. _____

_____

69. Describe the ways in which it has affected you or members of your household.

Factor 3. _____

_____

70. If no steps are taken to control your Factor 3, describe how you think the health of the rivers will be affected over the next 10 years.

Factor 3. _____

_____

71. If no steps are taken to control your Factor 3, describe how you think the health of members of your household will be affected over the next 10 years.

Factor 3. _____

_____

72. If the Northern River Basins Study were to suggest ways for managing this problem, what actions do you think they should recommend?

Factor 3. _____

_____

73. Below are three groups of potential threats to water quality and water quantity in the northern river basins. For each of the three groups, please indicate in the side boxes:

the **one** that you are **most** concerned about **and**
the **one** that you are **least** concerned about.

(Answer each group on its own. Overlap among groups has been done on purpose.)

Group 1:

Most concern *(check only one)*	Threat to water quality/quantity	**Least** concern *(check only one)*
	1. Agricultural run-off (pesticides, herbicides, fertilizers)	
	4. Draining wetlands and muskeg	
	5. Discharges of municipal sewage	
	7. River flows controlled by dams	

Group 2:

Most concern *(check only one)*	Threat to water quality/quantity	**Least** concern *(check only one)*
	1. Agricultural run-off (pesticides, herbicides, fertilizers)	
	2. Groundwater contamination	
	5. Discharges of municipal sewage	
	8. Discharges from pulp mill	
	9. Airborne pollutants	
	11. Industrial wastes/tailing ponds	

Group 3:

Most concern *(check only one)*	Threat to water quality/quantity	**Least** concern *(check only one)*
	4. Draining wetlands and muskeg	
	5. Discharges of municipal sewage	
	6. Seismic exploration/road and pipeline development	
	7. River flows controlled by dams	
	8. Discharges from pulp mills	
	9. Airborne pollutants	
	10. Uranium contamination (e.g. Lake Athabasca)	
	11. Industrial wastes/tailing ponds	

74. For each of the three groups of management actions listed below, please indicate in the side boxes:

the **one** that you think would be the **most** effective in dealing with current problems and
the **one** that you think would be the **least** effective.

(Answer each group on its own. Overlap among groups has been done on purpose.)

Group 1:

Most effective *(check only one)*	Management action	**Least** effective *(check only one)*
	1. Change land use practices (forestry, agriculture) to reduce erosion and pollution	
	4. Protect traditional fishing, hunting & trapping	
	5. Enforce existing pollution laws	
	7. Preserve and maintain ecosystems	

Group 2:

Most effective *(check only one)*	Management action	**Least** effective *(check only one)*
	1. Change land use practices (forestry, agriculture) to reduce erosion and pollution	
	2. Improve municipal wastewater treatment	
	5. Enforce existing pollution laws	
	8. Make polluters pay an annual fee based on the volume they produce	
	9. Improve treatment of municipal drinking water	
	11. Develop a management plan for the entire basin	

Group 3:

Most effective *(check only one)*	Management action	**Least** effective *(check only one)*
	4. Protect traditional fishing, hunting & trapping	
	5. Enforce existing pollution laws	
	6. Reduce industrial effluent loads	
	7. Preserve and maintain ecosystems	
	8. Make polluters pay an annual fee based on the volume they produce	
	9. Improve treatment of municipal drinking water	
	10. Increase monitoring of water quality	
	11. Develop a management plan for the entire basin	

75. One of the responsibilities of the Northern River Basins Study is to assess the health of northern rivers. Describe the three most important ways that you would measure the health of a river. *Please write in your response to the first question in the boxes provided. For the other questions, circle <u>one</u> answer per box.*

Measure 1	Measure 2	Measure 3

76.

	Measure 1	Measure 2	Measure 3
A. How do you think this measure of <u>river health has changed over the last 20 years?</u>			
B. How often do you think this measure of river health should be monitored?	A. Hourly B. Daily C. Weekly D. Monthly E. Yearly F. Every 5 years G. Every 10 years	A. Hourly B. Daily C. Weekly D. Monthly E. Yearly F. Every 5 years G. Every 10 years	A. Hourly B. Daily C. Weekly D. Monthly E. Yearly F. Every 5 years G. Every 10 years
C. Who do you think should be responsible for monitoring this measure of river health?	A. Government B. Industry C. Universities D. Independent agency E. Public F. Other	A. Government B. Industry C. Universities D. Independent agency E. Public F. Other	A. Government B. Industry C. Universities D. Independent agency E. Public F. Other
D. Who do you think should be responsible for paying for monitoring this measure of river health?	A. Government B. All water users C. Industrial water users D. Other	A. Government B. All water users C. Industrial water users D. Other	A. Government B. All water users C. Industrial water users D. Other

77. What are the three most important recommendations you would like the Northern River Basins Study to make?

#1 _____

#2 _____

#3 _____

78. Please list any recreational, environmental, agricultural or professional organizations to which you or any members of your household belong.

_____

_____

_____

79. Do you have any other comments that you would like to make to the Northern River Basins Study?

_____

_____

Thank you for completing this survey. Please return it in the self-addressed stamped envelope provided <u>before February 15th, 1995.</u>

Prepared by Praxis, Inc. and Drobot Data Services

January, 1995.

PART VIII FUTURE RIVER BASIN MANAGEMENT OPTIONS

Currently, the fish, wildlife and water resources of the Peace, Athabasca and Slave river basins are managed separately by the governments of Alberta, the Northwest Territories and Canada, and each government has different management priorities. The Northern River Basins Study would like to determine if some sort of group or committee consisting of representatives of the three governments and various stakeholder groups should be established to help coordinate resource management in the three basins and to provide a way for northern residents to participate in management decisions.

80. Would you or members of your household support the idea of establishing an ongoing, inter-governmental and stakeholder committee responsible for the protection and use of the river basins? *(Check one)*

YES ☐ NO ☐ Don't Know ☐

81. If such a committee were established, should it play the lead role to:
(Check only one answer for each question)

	YES	NO	Don't Know
a. Develop resource regulations in the basins?			
b. Oversee enforcement of existing regulations?			
c. Conduct and coordinate research?			
d. Issue licences and permits?			
e. Prepare resource management plans for the basins?			
f. Provide policy advice to provincial, federal and territorial governments?			
g. Develop education programs for basin residents?			

82. Would you or members of your household be willing to participate on this committee? *(Check one)*

YES ☐ NO ☐ Don't Know ☐

If yes, describe how you or members of your household would be prepared to be involved:

_____

_____

_____

Canada Alberta Northwest Territories

Northern River Basins Study
Stakeholders Questionnaire

PART I: INTRODUCTION

Mailing Address (Please correct if necessary)

Name of Respondent _____ Position in Organization: _____

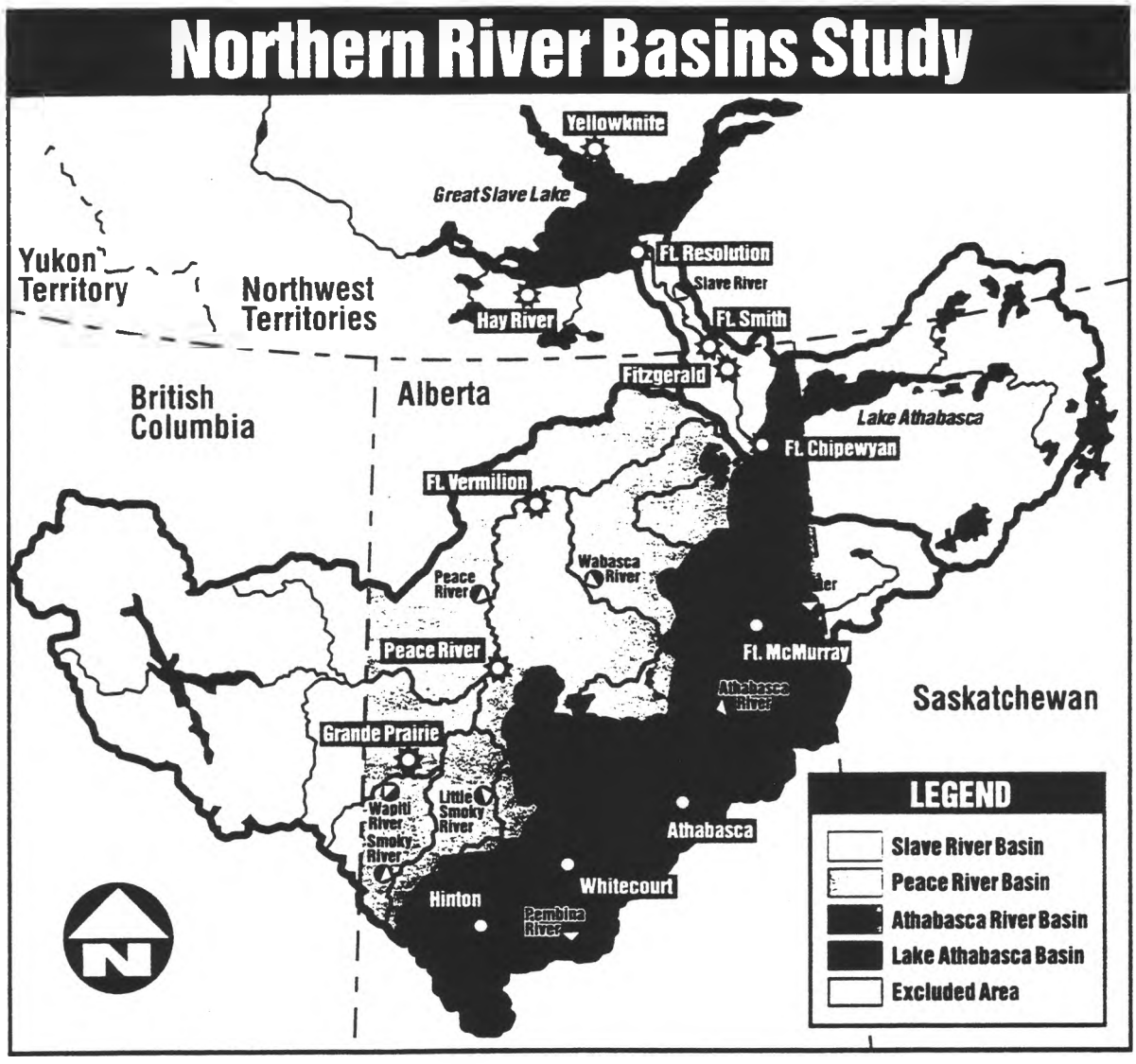
Telephone Number_____

The Northern River Basins Study is a four year study of the effects of development on the aquatic resources of the Peace, Athabasca and Slave river basins (see map on page 2), and is being conducted on behalf of the governments of Alberta, Northwest Territories and Canada.

One of the objectives of the study is to determine how people in environmental, recreation and community associations and organizations, like yours, use and value the Peace, Athabasca and Slave rivers. Please complete this questionnaire on behalf of your organization.

If you need any assistance in completing this questionnaire, you can call us toll-free at 1-800-267-6727.

ALL RESPONSES WILL BE KEPT CONFIDENTIAL.


Northern River Basins Study
Yellowknife
Great Slave Lake
Yukon Territory
Northwest Territories
Ft. Resolution
Slave River
Hay River
Ft. Smith
Fitzgerald
British Columbia
Alberta
Lake Athabasca
Ft. Chipewyan
Ft. Vermilion
Wabasca River
Peace River
Peace River
Ft. McMurray
Athabasca River
Saskatchewan
Grande Prairie
Wapiti River
Smoky River
Little Smoky River
Athabasca
Whitecourt
Hinton
Pembina River
N
LEGEND
Slave River Basin
Peace River Basin
Athabasca River Basin
Lake Athabasca Basin
Excluded Area

PART II GENERAL QUESTIONS

The first part of our survey asks some general questions about your organization.

1. How long has your organization been in existence? *(Circle the appropriate category)*

   a. Less than 1 year
   b. Between 1 and 5 years
   c. Between 5 and 10 years
   d. Between 10 and 15 years
   e. Between 15 and 20 years
   f. Over 20 years

2. How many members does your specific organization have?
   (Circle the appropriate category, do not include members from parent or affiliated organizations)

   a. 0 - 10
   b. 11 - 20
   c. 21 - 30
   d. 31 - 50
   e. 51 - 70
   f. 71 - 100
   g. Over 100

3. What proportion of your members reside within the Peace, Athabasca or Slave river basins, including tributaries? *(Give a percentage)*

   _____ %

4. Do you have a parent organization?

   _____ No _____ Yes *(Name parent organization)*

   _____

5. Are you affiliated with any other organizations?

   _____ No _____ Yes *(Name organization)*

   _____

6. What is the purpose of your organization in terms of its goals, objectives or interests?

   _____

   _____

   _____

   _____

7. Describe a typical member of your organization.

   _____

   _____

8. In which of the following major rivers basins do the majority of the members of your organization reside?
   (Read list. Circle appropriate response.)

   a. Athabasca River Basin
   b. McLeod River Basin
   c. Pembina River Basin
   d. Peace River Basin
   e. Wapiti River Basin
   f Smoky River Basin
   g. Little Smoky River.Basin
   h. Wabasca River Basin
   i. Slave River Basin

PART III RECREATIONAL USE OF WATER RESOURCES

9. How many trips do members of your organization take in an average year anywhere in the Northern River Basins for the following outdoor recreation activities?

Please indicate the average length of trips in days and the average number of members participating on these trips. *(Read list. Enter appropriate response for each activity)*

Primary Activity on Trip	Number of Trips in an Average Year	Average Length of trip (Days)	Average Number of Members Participating
Fishing			
Boating			
Swimming (lakes/rivers)			
Canoeing			
Camping			
Skiing (water or snow)			
Snowmobiling			
Horseback riding			
Rafting			
Kayaking			
Hunting			
Other			
Other			

10. List in order of importance, the five sites on rivers and lakes that members of your organization most frequently use for recreational purposes.

Also, indicate the usual recreational activity on these trips, the number of trips to each site in an average year, and the main reason for preferring this site.

	Site #1	Site #2	Site #3	Site #4	Site #5
Site Name					
Usual Activity					
Number of Trips per year					
Main Reason for Choosing Site					

11. Do members of your organization use the mainstems of the Athabasca, Peace or Slave rivers, or any of their major tributaries for recreational purposes?

_____ No *(Go to Question 12)* _____ Yes

If yes, please indicate the three locations along these rivers that members of your organization most frequently and indicate the usual recreational activity at each site and the number of trips taken to each site in an average year.

	Site #1	Site #2	Site #3
Site Description			
Usual Activity			
Number of Trips per year			

12. When involved in subsistence fishing, trapping or hunting do members of your organization ever consume or use river or lake water? *(Check appropriate response.)*

_____ No *(Go to Question 14)* _____ Yes *(Go to Question 13)*

13. Do members of your organization treat this water in any way before drinking it? *(Check appropriate response.)*

_____ No _____ Yes *(Describe Treatment)* _____

14. Over the last 10 years, have members of your organization noticed any changes in the water, fish, wildlife or plants along the mainstems of the Athabasca, Peace or Slave rivers or any of their major tributaries?

_____ No (*Go to Question 15*) _____ Yes

If yes, describe the types of changes that you members of your organization have noticed.

Water: _____
Fish: _____
Wildlife _____
Plants: _____
Other: _____

15. Do members of your organization foresee any changes in the next ten years that may affect water resources in your area?

_____ No (*Go to Question 16*) _____ Yes

If yes, describe the types of changes that may affect water resources in your area.

_____
_____
_____
_____

16. Do members of your organizations have specific concerns with the way northern rivers are managed?

_____ No (*Go to Question 17*) _____ Yes

If yes, describe the specific concerns of your organization:

_____

_____

_____

_____

_____

_____

_____

_____

_____

17. How much do members of your organization agree with each of the following statements? (Please check correct answer.)

	Agree Completely	Partly Agree	Disagree	Unsure
1. Water quality in the Peace, Athabasca and Slave rivers is not really a major issue at the moment so no new restrictions on industrial or municipal water use are required.				
2. Pollution of northern rivers is only a concern in a few locations and more enforcement of existing standards will solve these problems.				
3. Contamination of northern rivers is a major problem and some industries or municipalities should be forced to reduce effluent discharges, even if it means closing some operations.				
4. Existing water management regulations are interfering with economic development in the region and should be reduced or eliminated.				
5. No new effluent discharges should be allowed until a river basin plan has been completed.				

PART IV WATER MANAGEMENT VALUES AND ISSUES

18. In the opinion of members of your organization, over the last 20 years what three factors have had the greatest effect on water quality or quantity in the major river basin (Peace, Athabasca or Slave) in which most of your operations are located ?

Factor 1. _____

Factor 2. _____

Factor 3. _____

Thinking about the first factor you mentioned:

19. Describe the ways in which this factor has affected water quality, fish, wildlife, vegetation or the health of the river

Factor 1: _____

_____

20. Describe the ways in which this factor has affected members of your organization.

Factor 1: _____

_____

21. If no steps are taken to control your Factor 1, describe how you think the health of the rivers will be affected over the next 10 years

Factor 1: _____

_____

22. If no steps are taken to control your Factor 1, describe how you think members of your organization will be affected over the next 10 years

Factor 1: _____

_____

23. If the Northern River Basins Study were to suggest ways for managing this problem, what actions do you think they should recommend.

Factor 1: _____

_____

Thinking about the second factor you mentioned:

24. Describe the ways in which this factor has affected water quality, fish, wildlife, vegetation or the health of the river

Factor 2: _____

_____

25. Describe the ways in which this factor has affected members of your organization.

Factor 2: _____

_____

26. If no steps are taken to control your Factor 2, describe how you think the health of the rivers will be affected over the next 10 years

Factor 2: _____

_____

27. If no steps are taken to control your Factor 2, describe how you think members of your organization will be affected over the next 10 years

Factor 2: _____

_____

28. If the Northern River Basins Study were to suggest ways for managing this problem, what actions do you think they should recommend.

Factor 2: _____

_____

Thinking about the third factor you mentioned:

29. Describe the ways in which this factor has affected water quality, fish, wildlife, vegetation or the health of the river

Factor 3: _____

_____

30. Describe the ways in which this factor has affected members of your organization.

Factor 3: _____

_____

31. If no steps are taken to control your Factor 3, describe how you think the health of the rivers will be affected over the next 10 years

Factor 3: _____

_____

32. If no steps are taken to control your Factor 3, describe how you think members of your organization will be affected over the next 10 years

Factor 3: _____

_____

33. If the Northern River Basins Study were to suggest ways for managing this problem, what actions do you think they should recommend.

Factor 3: _____

_____

34. Below are three groups of things that are a potential threat to water quality and water quantity in the northern river basins. For each of the three groups, please indicate in the side boxes:

- the one that is of most concern to members of your organization, and.
- the one that is of least concern to members of your organization.

(Answer each group on its own. Overlap among groups has been done on purpose)

GROUP 1:

Most Concern *(Check only one)*	Threat to Water Quality/Quantity	Least Concern *(Check only one)*
	2. Groundwater contamination	
	6. Seismic exploration/road and pipeline development	
	7. Regulation of river flows by dams	
	9. Airborne pollutants	

GROUP 2:

Most Concern *(Check only one)*	Threat to Water Quality/Quantity	Least Concern *(Check only one)*
	1. Agricultural run-off (pesticides, herbicides, fertilizers)	
	6. Seismic exploration/road and pipeline development	
	10 Uranium contamination (Lake Athabasca)	
	11. Industrial wastes/tailing ponds	

GROUP 3:

Most Concern *(Check only one)*	Threat to Water Quality/Quantity	Least Concern *(Check only one)*
	1. Agricultural run-off (pesticides, herbicides, fertilizers)	
	2. Groundwater contamination	
	3. Forestry harvesting practices	
	5. Discharges of municipal sewage effluent	
	6. Seismic exploration/road and pipeline development	
	7. Regulation of river flows by dams	
	8. Discharges of pulp mill effluent	
	10. Uranium contamination (Lake Athabasca)	

35. For each of the three groups of management actions listed below, please indicate in the side boxes:

- the one that members of your organization think would be the most effective in dealing with current problems, and.
- the one that members of your organization think would be the least effective.

(Answer each group on its own. Overlap among groups has been done on purpose)

GROUP 1:

Most Effective *(Check only one)*	Management Action	Least Effective *(Check only one)*
	2. Improve municipal wastewater treatment.	
	6. Reduce industrial effluent loads.	
	7. Preserve and maintain ecosystems	
	9. Improve treatment of municipal drinking water	

GROUP 2:

Most Effective *(Check only one)*	Management Action	Least Effective *(Check only one)*
	1. Change land use practices (forestry, agriculture) to reduce erosion and non-point pollution.	
	6. Reduce industrial effluent loads.	
	10. Increase monitoring of water quality	
	11. Develop management plan for entire basin.	

GROUP 3:

Most Effective *(Check only one)*	Management Action	Least Effective *(Check only one)*
	1. Change land use practices (forestry, agriculture) to reduce erosion and non-point pollution.	
	2. Improve municipal wastewater treatment.	
	3. Provide more flood protection.	
	5. More enforcement of existing pollution laws.	
	6. Reduce industrial effluent loads.	
	7. Preserve and maintain ecosystems	
	8. Make polluters pay an annual fee based on the volume of effluent they produce.	
	10. Increase monitoring of water quality	

36. One of the responsibilities of the Northern River Basins Study is to assess the health of northern rivers. Describe the three most important ways that members of your organization would like to see used to measure the health of these rivers.

Measure #1	Measure #2	Measure #3

37.

	Measure #1	Measure #2	Measure #3
• How do you think this measure of river health has changed over the last 20 years?			
• How often do you think this measure of river health should be monitored?	a. hourly b. daily c. weekly d. monthly e. yearly f. every 5 years g. every 10 years	a. hourly b. daily c. weekly d. monthly e. yearly f. every 5 years g. every 10 years	a. hourly b. daily c. weekly d. monthly e. yearly f. every 5 years g. every 10 years
• Who do you think should be responsible for monitoring this measure of river health?	a. government b. industry c. universities d. independent agency e. public f. other	a. government b. industry c. universities d. independent agency e. public f. other	a. government b. industry c. universities d. independent agency e. public f. other
• Who do you think should be responsible for paying for monitoring this measure of river health?	a. government b. all water users c. industrial water users d. other	a. government b. all water users c. industrial water users d. other	a. government b. all water users c. industrial water users d. other

PART V FUTURE RIVER BASIN MANAGEMENT OPTIONS

Currently, the fish, wildlife and water resources of the Peace, Athabasca and Slave river basins are managed separately by the governments of Alberta, the Northwest Territories and Canada, and each government has different management priorities. The Northern River Basins Study would like to determine if some sort of group or committee consisting of representatives of the three governments and various stakeholder groups should be established to help coordinate resource management in the three basins and to provide a way for northern residents to participate in management decisions.

38. Do members of your organization support the idea of establishing an ongoing, inter-governmental and stakeholder committee responsible for the protection and use of the river basins? *(Check one)*

YES ☐ NO ☐ Don't Know ☐

39. If such a committee were established, should it play the lead role to:
(Check only one answer for each question)

	YES	NO	Don't Know
a. Develop resource regulations in the basins?			
b. Oversee enforcement of existing regulations?			
c. Conduct and coordinate research?			
d. Issue licences and permits?			
e. Prepare resource management plans for the basins?			
f. Provide policy advice to provincial, federal and territorial governments?			
g. Develop education programs for basin residents?			

40. Would members of your organization be willing to participate on this committee?
(Check one)

YES ☐ NO ☐ Don't Know ☐

If yes, describe how members of your organization would be prepared to be involved:

_____

_____

_____

PART VI GENERAL COMMENTS

41. What do members of your organization foresee to be the most significant water-related issues in the Northern River Basins in the next ten years?

42. From the viewpoint of members of your organization, what are the three most important recommendations that the Northern River Basins Study should make?

#1

#2

#3

43. Do you have any other comments that you would like to make on behalf of members of your organization that would be of interest to the Northern River Basins Study?

Thank you for completing this survey. Please return it in the self-addressed postage paid envelope provided before March 10, 1995.

Appendix V: Responses Data Files

This Appendix is provided on the disk bound as the last page of this report; it contains data files for responses to the household and stakeholders surveys. Data entry and coding of responses to the household survey is described in NRBS Project Report No. 70. Data entry and coding of responses to the stakeholders surveys is described in NRBS Project Report No. 75.

The disk comprising this Appendix contains three files, using 601,007 bytes.

1. INSTALL.BAT; being 80 bytes in size.
2. NRBSUSES.EXE; being 600,431 bytes in size.
3. DISCLAIM.TXT; being 496 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 15 files totalling 3,653,307 bytes. To use the files with extension .SYS requires SPSS/PC+, version 3.1. To use the files with extension .DOC requires MS WORD for Windows, version 2.0.

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.

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