Characterization of Aquatic Uses Within The Peace, Athabasca and Slave River Basins

7

Synthesis Report

Canada Alberta Northwest Territories

Northern River Basins Study

NORTHERN RIVER BASINS STUDY
SYNTHESIS REPORT NO. 7

CHARACTERIZATION OF AQUATIC USES WITHIN THE PEACE, ATHABASCA AND SLAVE RIVERS

by

R. Bruce MacLock
Leader, Other Uses Component
Northern River Basins Study

and

John P. Thompson
Co-Leader, Other Uses Component
Northern River Basins Study and
Strategic and Regional Support Division
Corporate Management Service
Alberta Environmental Protection

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If you would like:

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Alberta Environmental Protection
Information Centre
9920 - 108 Street
Edmonton, Alberta T5K 2M4

Telephone: 403 - 422-2079 Fax: 403 - 427-4407

EXECUTIVE SUMMARY

This study was undertaken on behalf of the Northern River Basins Study (NRBS) to answer the question: 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 answers this question and also describes some of the water management issues and concerns of most importance to basin residents and stakeholders. The information contained in this report is based mainly on completed questionnaires from 718 basin households and from 183 of 602 stakeholder groups. 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, including 3,000 people living in the NWT. The main consumptive use of water for this group is drinking water. The majority of basin residents (55 percent) obtain their drinking water supplies from municipal water systems and 31 percent of households use groundwater from wells. Most of the remaining households draw their 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. Over 11 percent of households using river water have complaints about a chlorine taste in their water 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 report that the mainstems of the rivers 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 described various changes in fish populations over the last 10 years. These people have complaints about fish populations (lower in number and smaller in size), fish health (more disfigurations), and fish taste.

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 the purpose of domestic consumption This use accounts for nine percent of licenced water withdrawals from the Athabasca River and 15 percent of withdrawals from the Peace River. Only three percent of governments believe that their treated drinking water does not meet drinking water standards. The quality of raw water supplies is listed by 36 percent of water plant operators as 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 releasing it to surface water sources, and 54 percent of these use only primary sewage treatment. About 31 percent of households that use

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 21,600 farms in the study area. Mixed farms account for 41 percent of farm operations in the basin. About 26 percent raise livestock only, and 29 percent produce grains or oilseeds. The remainder are specialty farms. Farms in the NRBS area account for about 17 percent of Alberta cattle production. The main uses of water are livestock watering and irrigation. In total, 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 farms spread their manure onto their land.

Industrial Water Users

Industry is the biggest consumer of water in the region. Licences allocating 430,600 acre-feet of water for industrial purposes have been issued in the Alberta portion of the basin. About 52 percent of these allocations are for water from the Athabasca River mainstem and eight percent are 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 observed any changes in water quality or quantity in the last 10 years. Companies in the oil and gas sector expect their needs for water to decline in the next 10 years. On the other hand, 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 other types of operations don't directly use the rivers, any change in the water quality or quantity can affect the reputation of the region and affect visitation. Commercial operations are used by about 50,000 people per year. This number includes one-quarter of all non-resident visitors to the basins.

Lakes in the NRBS area account for 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 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, river mainstems account for less than 10 percent of animals trapped. In contrast, more than 50 percent of the harvest in the Peace-Athabasca Delta comes from river mainstems. Only 40 percent of trappers have

reported a decline in furbearers in recent years, and this may be 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.

Ecological Uses

Fish and other aquatic life is dependent upon minimum streamflows, various temporal variations in flow, and natural levels of water quality. The riparian ecosystem is also dependent on floods and ice regimes. Human uses of water, such as impoundment for electric power generation and discharges of effluents, have impacted the natural equilibria of ecological uses in both the Peace and Athabasca rivers.

Stakeholder Issues and Concerns

Basin residents generally believe that water quality is a problem in the basin. Only 16 percent agree completely or partially with the questionnaire statement that water quality is not a problem. In contrast, 38 percent agree with the statement that water quality issues are limited to a few locations, while 75 percent agree that contamination of northern rivers is a major problem.

Pulp mills are considered the most important factor affecting water quality by nearly 40 percent of households throughout the basin. Most stakeholder groups also identify pulp mills as the prime factor affecting the health of the river. 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. Of households concerned about pulp mills, two-thirds believe that they have been directly affected by emissions from the mills. While impacts on drinking water and human health are of concern to some households, a larger proportion are concerned 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 are affecting water quality and quantity. About 75 percent of households and 66 percent of basin stakeholders disagree with the statement that current water management regulations are interfering with economic development in the basin.

Nearly 55 percent of households throughout the northern river basins want water quality to be measured as the prime indicator of river health, with measurements being taken on a monthly basis. In the future, 40 percent of households prefer that the government be responsible for monitoring water quality, while 30 percent suggest than an independent agency should do the job. Only three percent feel that industry should be responsible for monitoring. However, nearly half of households think that industry should pay for water quality monitoring.

Households and stakeholders were give an opportunity to provide three recommendations that they feel should be made by the NRBS Board, and 60 percent responded to this question. In the opinion of northern residents, the NRBS Board should recommend that:

- effluent loads be reduced (23 percent of households);
- industrial activities be better monitored (21 percent); and,
- pollution laws be better enforced (17 percent).

In addition, 12 percent of households want certain activities, such as logging and the operation of dams, be stopped or better controlled. While only four percent of households want the NRBS Board to

recommend that a basin management plan be prepared, 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.

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1.0 INTRODUCTION

The Northern River Basins Study (NRBS) is a joint project between the governments of Canada, Alberta and the Northwest Territories. The study 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 basins and boundaries of the study area are shown in Figure 1.

The Study Board developed a vision statement to provide overall guidance for the various technical activities being conducted in support of the study and identified 16 key questions that serve to focus study activities. Eight scientific component groups were established to address these 16 questions. The Other Uses Component was given responsibility for 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?

In formulating a work plan to answer this question, two primary objectives were identified by the Other Uses Component. These objectives were:

1. to identify all types of consumptive and non-consumptive water users (stakeholders), including ecosystem (instream) uses of water; and,
2. to describe how each stakeholder uses the water resources of the basin, especially the mainstems of the Peace, Athabasca and Slave rivers.

As the work evolved, two other objectives were added. First, the Study Board requested that some work be done to determine the issues, needs and expectations of stakeholders in regard to management of the Athabasca, Peace and Slave rivers. This information was required to support the Board in developing effective recommendations that address stakeholder concerns. Second, the Strategic Planning Subcommittee of the Board requested that stakeholders be questioned about the potential structure and function of a possible future basin management committee. This information was needed to assist the Subcommittee in answering Question #16:

#16 What kind of interjurisdictional body can be established, ensuring stakeholder participation, for the ongoing protection and use of the river basins?

This document provides a summary of the research undertaken by the Other Uses Component. It also integrates relevant information from work completed by three other components of the Study. The Drinking Water Component provides information on the quality of water produced from drinking water treatment facilities in the NRBS area (Armstrong et al, 1995). The Traditional Knowledge Component describes water use by and the attitudes and concerns of people who live in nine native communities and who live or have lived off the land (Flett and Bill, 1995). There has also been close collaboration with the Hydrology Component in assessing ecosystem (instream) uses of the basin, especially in regard to the effects of regulating the Peace River. While a brief discussion of these ecosystem uses is provided in this document, a more complete discussion can be found in Synthesis Report No. 1 (Prowse, 1996).

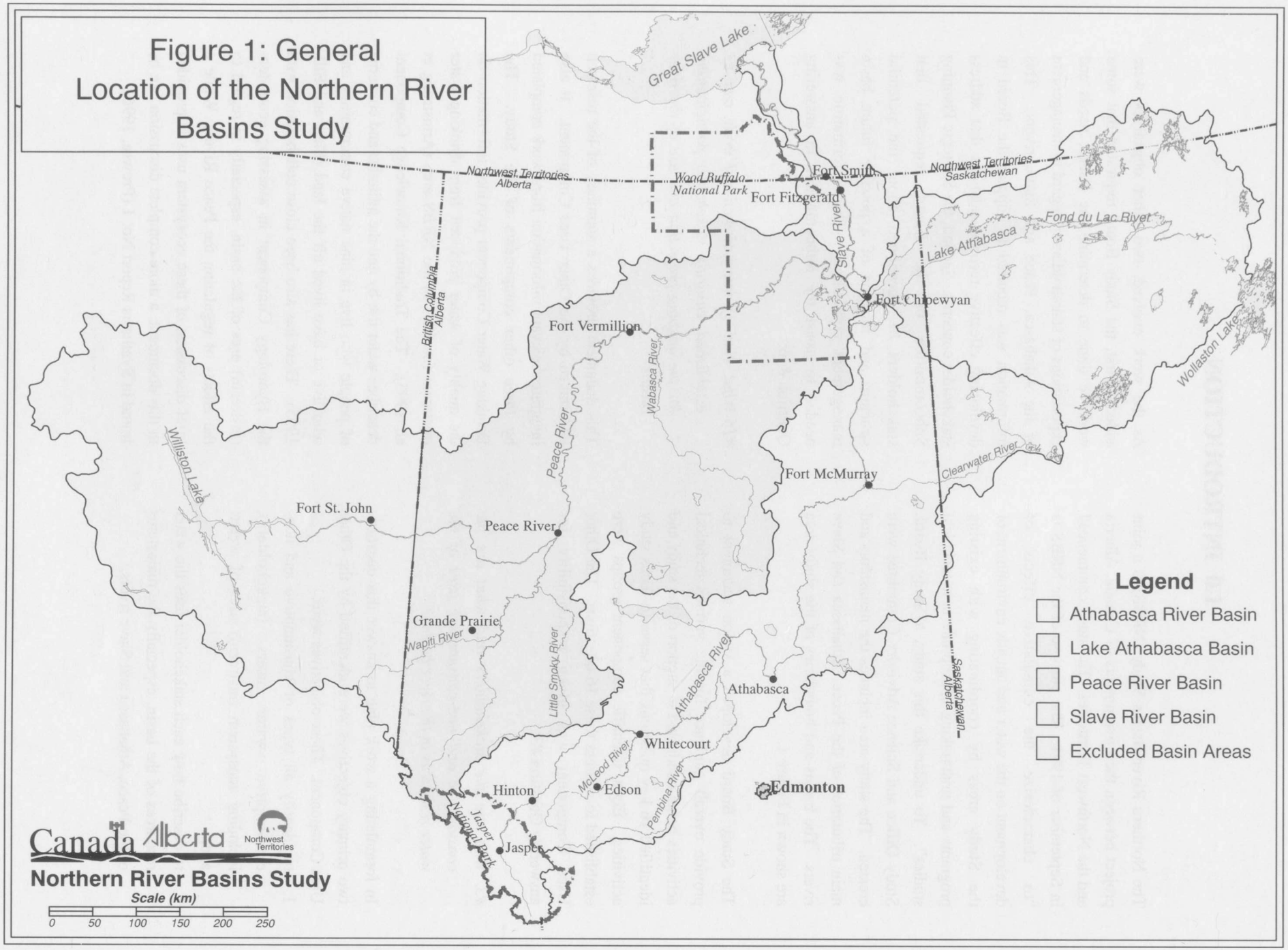


Figure 1: General Location of the Northern River Basins Study
Great Slave Lake
Northwest Territories
Alberta
Wood Buffalo National Park
Fort Smith
Fort Fitzgerald
Northwest Territories
Saskatchewan
Slave River
Fond du Lac River
Lake Athabasca
Fort Chipewyan
British Columbia
Alberta
Fort Vermillion
Wabasca River
Wollaston Lake
Peace River
Williston Lake
Fort McMurray
Clearwater River
Fort St. John
Peace River
Grande Prairie
Wapiti River
Little Smoky River
Athabasca River
Athabasca
Saskatchewan
Alberta
Whitecourt
McLeod River
Pembina River
Hinton
Edson
Edmonton
Jasper
Jasper National Park
Legend
Athabasca River Basin
Lake Athabasca Basin
Peace River Basin
Slave River Basin
Excluded Basin Areas
Canada
Alberta
Northwest Territories
Northern River Basins Study
Scale (km)
0
50
100
150
200
250

2.0 METHODOLOGY AND DATA SOURCES

A six-step work program was used to identify stakeholders and to determine their use of aquatic resources in the river basins. As shown in Figure 2, these six steps were undertaken by consultants under nine different contracts. A summary of the six steps in the work program is provided below.

2.1 Stakeholder Identification

An initial outline of the work program was developed as part of Project 4101-B1 (Praxis, 1994). This project completed a review of recent publications and newspapers to identify water management issues and concerns in the basins. It also determined that there was very little information on how aquatic resources are used, and proposed that surveys should be used to collect the required information. The study also recommended that the general public living in the basin be recognized as a stakeholder. In addition, this study produced a partial list of known regional, provincial and national stakeholder groups (about 290) that have members in the region.

This list of stakeholders was further developed as part of Project 4121-D1 (South Slave Research Centre, 1995). A telephone survey of stakeholder organizations was conducted to determine their interest in participating in the study and to identify groups that may have been missed by the initial study.

These initial stakeholder lists focused on environmental and recreational organizations. However, in a subsequent study (Project 4121-D4, Reicher, 1996), the list of stakeholders was 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. A total of 602 stakeholder groups were ultimately included in the survey.

2.2 Information Collection Strategy

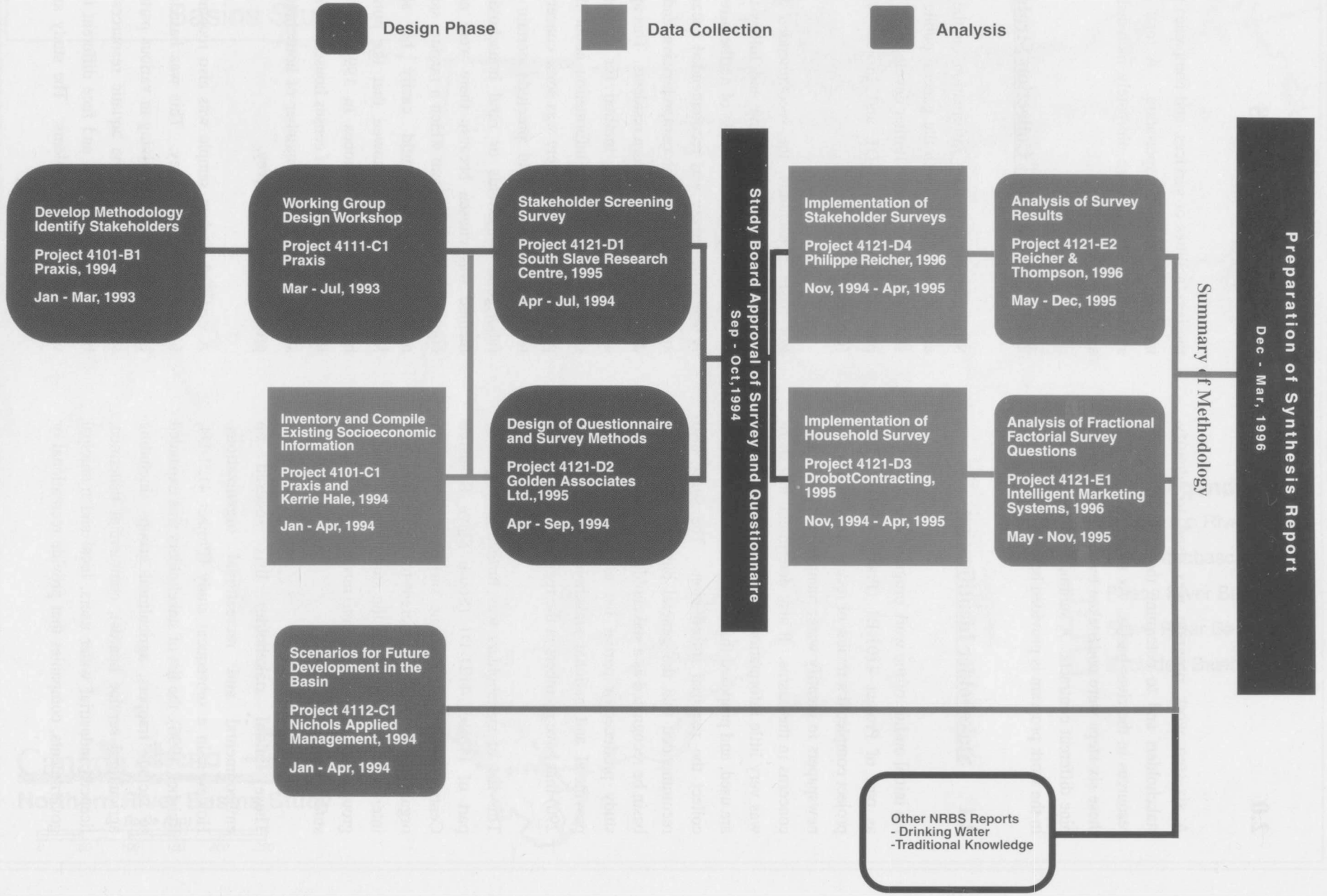
Strategies for collecting information on the use of aquatic resources by both the general public and by stakeholder groups were further developed in 1994 as part of Project 4121-D1 and Project 4121-D2 (Golder, 1995).

For basin households, the recommended strategy involved conducting telephone and follow-up mail surveys with a random sample of northern residents. A telephone survey was recommended because this approach uses the most comprehensive and up-to-date listing of most northern residents. This approach also provides an easy method for extrapolating survey data 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 were no other comprehensive lists from which a random sample of northern residents could easily be selected. Subsequent analysis showed that the number of households with telephones in 1994 was almost identical to the number of census households in 1991, so that only a minimal number of households were precluded from the survey.

A stratified random sample was also recommended for the household survey. This was based on the expectation that people living in various parts of the study area likely use the aquatic resources of the basins in different ways and face different types of water management problems. The study area was

Figure 2

Summary of the Methodology Used by the Other Uses Component



divided into 12 regions which matched 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 3.

Sample size was a third design factor. 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 accuracy. As the study proceeded and costs proved lower than expected, these numbers were increased slightly to 100 and 200 per region, respectively.

The recommended approach for collecting water use information from stakeholders changed as the study proceeded. An initial suggestion was that stakeholders could participate in a series of regional workshops where they could provide detailed information on their use of the basin: what locations they visit and what they do there. However, given the high level of interest and available resources, it was later decided that all stakeholder groups be contacted though a mail survey that would coincide with the household survey. This approach guaranteed that survey results were directly comparable between households and stakeholders, and that all stakeholders would have the opportunity to participate in the study.

2.3 Questionnaire Design

A draft questionnaire was generated as part of Project 4121-D2 (Golder, 1995). This initial design was eventually adopted for both the stakeholder and householder surveys to allow survey results to be directly comparable among the various groups.

The first half of each questionnaire was designed to determine how households or stakeholders use aquatic resources in the study area. Respondents were asked to describe where in the basins they went, what they did, which aquatic resources were used, and their frequency of use. Questions were tailored to 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 past 10 years. Each respondent was also asked to describe their use of the mainstems of the Athabasca, Peace or Slave rivers.

The second half of the questionnaire was exactly the same for both the stakeholder and household surveys. Respondents were asked to identify the key factors that have caused changes in the aquatic resources of the basins over the past 20 years, describe which aspects of river health ought to be monitored in the future, and list the recommendations the NRBS Board ought to make. The majority of questions were open-ended, allowing respondents to describe things in their own words.

An innovative approach was suggested for determining which water management issues and possible management actions were of most importance to basin households and stakeholders. This approach used best-worst scaling with a fractional factorial survey design and was nearly identical to a recent study of public concerns related to food safety (Finn and Louviere, 1992).

In the survey, respondents were asked to select the most important (best) and least important (worst) of 11 water management issues. These issues were

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

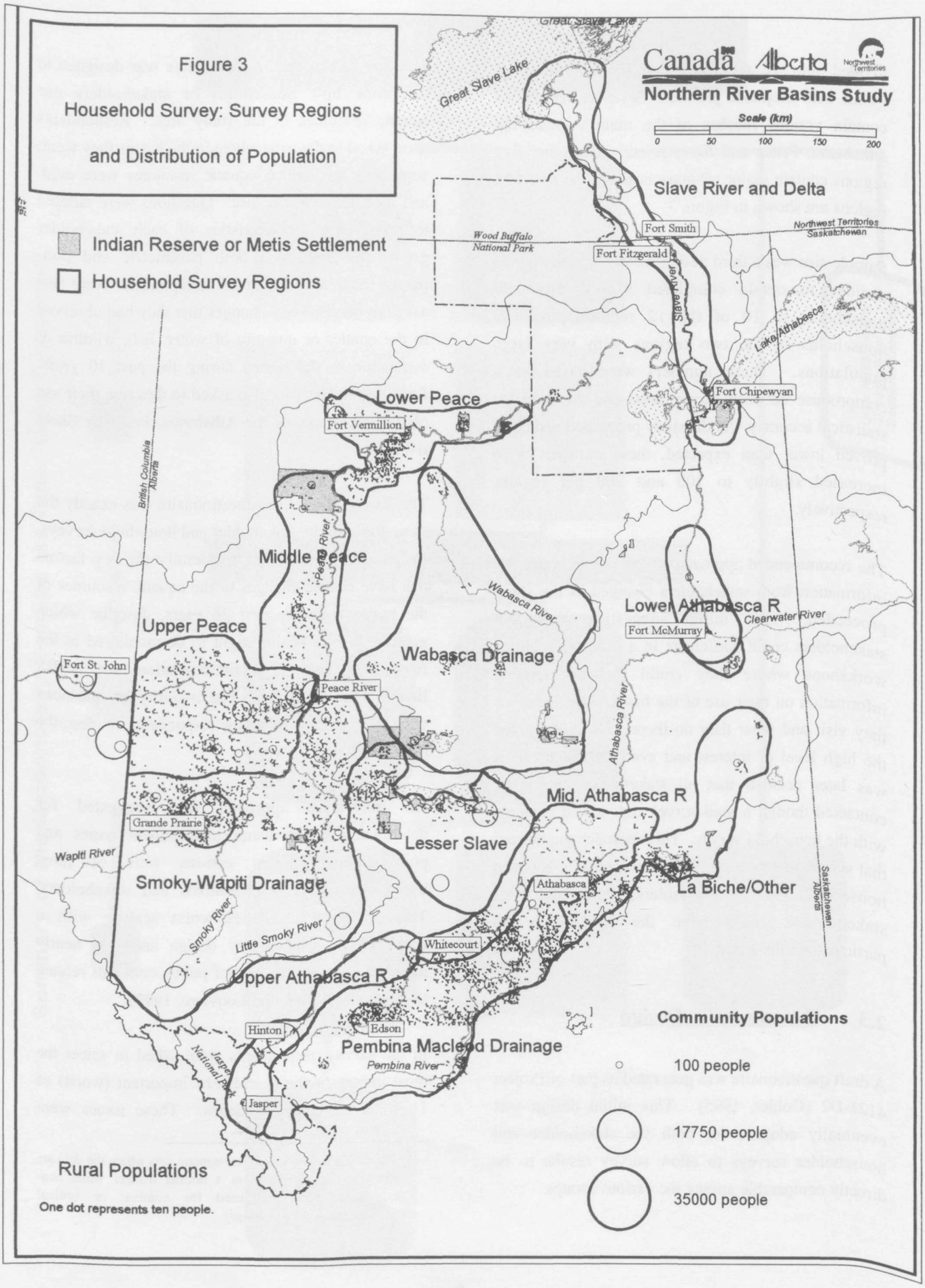


Figure 3
Household Survey: Survey Regions
and Distribution of Population
Indian Reserve or Metis Settlement
Household Survey Regions
Canada Alberta Northwest Territories
Northern River Basins Study
Scale (km)
0 50 100 150 200
Great Slave Lake
Slave River and Delta
Fort Smith
Northwest Territories
Saskatchewan
Wood Buffalo
National Park
Fort Fitzgerald
Slave River
Lake Athabasca
Fort Chipewyan
Lower Peace
Fort Vermillion
British Columbia
Alberta
Peace River
Middle Peace
Wabasca River
Lower Athabasca R
Clearwater River
Fort McMurray
Upper Peace
Wabasca Drainage
Fort St. John
Peace River
Athabasca River
Mid. Athabasca R
Grande Prairie
Lesser Slave
Wapiti River
Smoky-Wapiti Drainage
Athabasca
La Biche/Other
Saskatchewan
Alberta
Smoky River
Little Smoky River
Whitecourt
Upper Athabasca R
Hinton
Edson
Pembina Macleod Drainage
Pembina River
Jasper National Park
Jasper
Rural Populations
One dot represents ten people.
Community Populations
100 people
17750 people
35000 people

presented in terms of 12 lists, each consisting of four, six or eight of the 11 issues. The issues were selected from comments at community gatherings held by the NRBS and summarized in the Community Response Database. To prevent respondents from having to make selections from all 12 lists, four versions of the questionnaire were devised with each having three of the 12 lists. Survey responses allowed the 11 issues to be ranked and scaled in order of importance. This approach generated results that have more statistical reliability than those based on conventional approaches to measuring public opinion.

A draft copy of the household survey and the proposed sample design were developed in the fall of 1994. This information was provided to the NRBS Board and the Science Advisory Committee for review. After some minor modifications to the questionnaire, the Study Board gave formal approval to implement the survey.

2.4 Survey Implementation

The household and stakeholders surveys were administered separately, but at the same time. The household survey was pre-tested in December 1994 and full implementation started in January 1995 (Project 4121-D3, Drobot Contracting, 1996). Randomly-selected households were contacted by telephone, briefed about the study, and asked to complete the questionnaire which was sent out by mail. This initial screening ended when the desired number of households from each region (1,400 in total) had agreed to complete the survey. This required calls to 2,621 households, and means that 53 percent of households contacted by telephone agreed to participate in the survey.

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 51 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. Thus, the survey was conducted with an average of 0.8 percent of households in the study area.

Not everyone contacted by telephone agreed to do the survey, and only a 513 percent of households actually completed their questionnaire. In summarizing the survey results, the consultant noted that there appeared to be no strategic or systematic reasons for non-response (Drobot Contracting, 1996).

Implementation of the stakeholder surveys commenced in January of 1995 and was completed by mid-April. As part of Project 4121-D4 (Reicher, 1996), nine different types of surveys were developed for specific categories of stakeholders within the basin. Questionnaires were ultimately mailed to 602 different groups and associations which were later contacted by telephone and reminded to complete the survey. In total, 185 stakeholder surveys were completed, returned, coded and entered into a statistical data base. Response rates varied between 21 and 46 percent for the various stakeholder groups.

Both households and stakeholders gave the same general reasons for not completing the survey. The main reasons were lack of time or interest. Some households decided not to complete the questionnaire because the questionnaire seemed too complicated. For some stakeholder groups, water management was not an issue. Other stakeholders indicated that they needed input from the membership of their group before a response could be prepared.

Since non-response can introduce some degree of bias into the survey results, it was recommended that demographic information from the household survey be checked against 1991 Census data. Such a

Table 1

Household Survey Response Rates and Sampling Fraction, by Region

Region	Total Households		Sample Households		Sample
	Number	Percent	Number	Percent	Fraction
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

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%

comparison might indicate whether the survey population represented an accurate cross-section of northern residents (Drobot Contracting, 1996). The results of this comparison are provided in Section 2.7.

2.5 Other Data Sources

Project 4101-C1 (Praxis, 1994) was undertaken to identify and compile existing socio-economic data for the study area. Demographic information was drawn from the 1991 Census. This information was used to prepare a demographic profile of the residents of the northern river basins and was also used to test the validity of the household survey.

Information on a variety of types of economic activities was also collected. This included data on agriculture, forestry, recreation and tourism, oil and gas development and transportation. Much of this information was tied to specific geographical areas and was used to develop GIS maps of the basin.

An assessment of the potential future economic development in the study areas was also completed (Project 4111-C1, Nichols, 1996). This study involved a review of the economic factors that determine regional development in the agriculture, energy, forestry and manufacturing sectors.

2.6 Analysis of Survey Data

Data from the household and stakeholder surveys were analyzed during the summer and fall of 1995. The majority of the analysis was completed as part of Project 4121-E2 (Reicher and Thompson, 1996). However, analysis of the results of the best-worst fractional factorial design question was undertaken separately (Williams, 1996).

Both analyses followed normal statistical conventions:

- The accuracy and reliability of estimates for key population characteristics were described in terms of 95 percent confidence intervals (CI). This means that there is a 95 percent probability that the true measure falls within a given confidence interval (i.e., 19 times out of 20).
- Chi-square (χ^2) tests were used to test for significant differences in the pattern (distribution) of responses among stakeholders or among households in different regions.
- Scheffé multiple comparison tests were used to test for significant differences among sample means for the various stakeholder groups or regions, based on pairwise comparisons.

In all cases, tests were performed using a 95 percent level of significance.

2.7 Validity of Survey Data

Several types of analyses were undertaken to determine whether the results of the survey provide a completely accurate representation of all the characteristics, attitudes and concerns of residents of the northern river basins. These analyses were conducted by comparing survey results with other published data sources, especially Census data.

Demographic information from the household survey was a close match to known Census information for the overall basin:

- the average household size was nearly identical; and
- the estimated population of the basins in 1994 (278,680 ± 10,750) was close to the 1991 Census estimate of 268,960). The higher estimate reflects some population growth in the basin since 1991.

There were some noticeable differences between the sample and the population:

- households with people aged 20 to 34 and children under 10 were slightly under-represented in the sample. Households with people aged 45 to 64 age were over-represented;
- the survey over-estimated the percentage of people employed in the primary resource sector; and,
- the number of farm households was overstated probably due to higher survey response rates from farm households.

Based on these comparisons, it was concluded (Reicher and Thompson, 1996) that the survey results can be considered reasonably reliable at the basin level, mainly due to the large sample size. Survey estimates were determined to be less accurate at a regional level because of smaller sample size (48 to 97). However, demographic profiles of the 12 regions based on survey data generally match what is known about each region, and there do not appear to be any surprises in the survey results. Thus, the results of the survey appear to provide a realistic and valid assessment of socio-economic conditions in the northern basins.

In terms of the stakeholder surveys, the reliability of survey results was tested using known information about each stakeholder group. For example, the 31 percent of local and municipal governments that responded to the survey represent 32 percent of the population. However, no responses were received from either of the two cities (Fort McMurray and Grande Prairie) which account for 23 percent of the population. Thus, survey responses reflect the views of the administrations of towns, villages and rural areas, but not the cities.

Although 46 percent of licenced industrial water users responded to the survey, they accounted for only 32 percent of all water licences and 56 percent of total licenced water volume. This means that survey results reflect information from the larger surface water users rather than a representative sample of all industrial water users.

The accuracy of the household survey information on agriculture is variable. Survey results suggest much higher levels of cultivated land and livestock production than those reported in agriculture census data. This is due to higher response rates from farm households than for non-farm households. However, survey estimates of average farm size, and the proportion of farms raising cattle, hogs and sheep were nearly identical to agricultural census data. Thus, the agricultural information is considered to be representative of farming operations in the northern river basins.

In terms of commercial fishing, questionnaire responses were received from fishermen in only two of the six zones in the basin. Most of the responses came from people fishing on Lesser Slave Lake which is the most important lake for commercial fishing in the NRBS region. Thus, survey responses are not representative of people fishing commercially in the smaller lakes in the region .

Very few completed responses were received from trappers contacted by the stakeholder survey. However, a large number of people who responded to the household survey were trappers. Extrapolation of household survey data produced estimates of the total number of trappers that were quite consistent with the actual number of active trappers in the Alberta portion of the basin. The assessment of trapping in the basin is based primarily on the household survey data, supplemented with information from the trapper stakeholder survey, where necessary.

Over 30 percent of commercial recreation operations responded to the survey. It is not possible to determine whether the information received is completely reliable because there is no other information on the nature of these operations. River

transportation companies and subsistence users of fish and wildlife responded in insufficient numbers to be able to provide an accurate assessment of water use for these stakeholders.

These types of problems are found with any questionnaire survey where only a portion of the survey population actually responds. Without any other information that would allow correction of these biases, the survey data have been used as reported.

3.0 WHO ARE THE STAKEHOLDERS?

Although a broad range of Albertans and other Canadians may have some sort of interest in water quality and quantity in the Peace, Athabasca and Slave River basins, the emphasis of the studies was on residents of the basins. Basin residents are more likely to be directly and regularly affected by changes in the basins, so they warranted specific attention. This section of the report provides an socio-economic description of basin residents

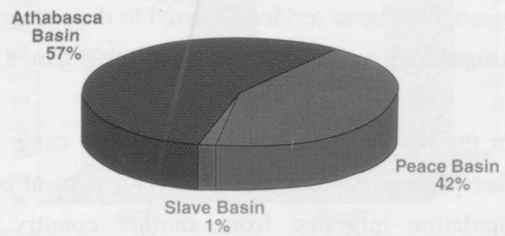
Logistically, it was found to be too costly to survey random samples of all other people or parties having an interest in the basins. As an alternative, it was decided to survey a wide variety of stakeholder groups, including those with members who live outside the basins. Thus, the stakeholder survey was used to capture some information on water use and management issues from people living outside the basin.

3.1 Demographic Characteristics

The population of the Northern River Basins Study area in 1991 was 268,690 people, including about 3,000 people living in the Northwest Territories portion of the basin. In Alberta, residents of the NRBS area accounted for 10.4 percent of the provincial population in 1991.

Figure 4

Regional Population Distribution,1991



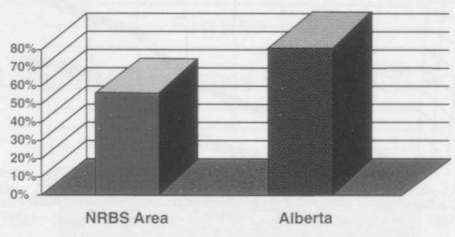
Source: 1991 Census

The majority of the NRBS population (57 percent) resides in the Athabasca drainage basin, including tributaries, while 42 percent live in the Peace basin and the remainder (1.2 percent) live in the Peace-Athabasca Delta and Slave River basin (Figure 4). Just over 23 percent of the population resides in one of the two cities in the region: Fort McMurray or Grande Prairie

The population of the NRBS area is more rural than the province as a whole. Figure 5 shows that in 1991 about 147,500 people, or 55.5 percent of the basin population, lived in communities of greater than 1,000 people. In comparison, nearly 80 percent of Albertans lived in communities larger than 1,000 people.

Figure 5

Population Living in Communities of More Than 1,000



Source: 1991 Census

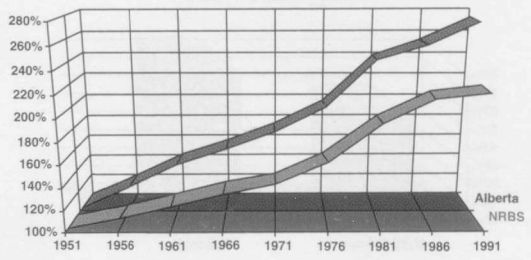
Survey data show similar results: about 60 percent of households live in urban areas, 30 percent live on farms, nine percent live in rural or cottage subdivisions, while the remaining one percent live in Métis settlements or Indian reserves. The greatest urban concentrations are found in the Lower Athabasca (Fort McMurray), Slave River/Delta (Fort Chipewyan, Fort Smith, Fort Resolution), and Upper Athabasca (Jasper, Hinton, Whitecourt) regions. The largest percentages of farm households are found in the Middle Athabasca and Upper Peace regions. The

Wabasca region has the highest proportion of households in Métis settlements and Indian reserves. Nearly 25 percent of households in the Lac la Biche region live in cottage or rural subdivisions.

The rate of population growth in the NRBS area since 1951 has averaged just under 2.0 percent per year (see Figure 6). In comparison, the Alberta population has been growing at an average rate of 2.5 percent per year. The most rapid rate of population growth in the NRBS area occurred between 1976 and 1981, as a result of oil sands development. However, the rate of population growth in the NRBS area between 1986 and 1991 basin was considerably below the provincial average. Since 1971, population growth rates have been more affected by migration patterns than natural population growth (births minus deaths).

Figure 6

Population Growth, 1951 to 1991

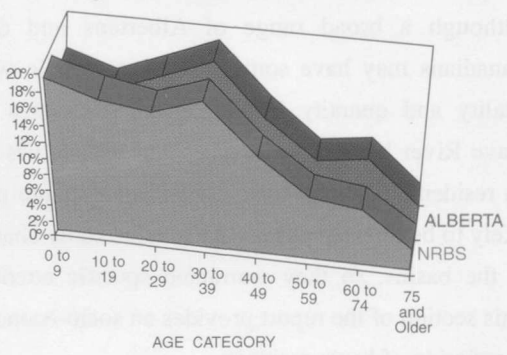


Source: 1991 Census

According to 1991 Census data, the population of the NRBS area is younger than that of Alberta as a whole. Figure 7 shows that, although the proportion of people aged 20 to 59 is the same for both the NRBS area and Alberta, there are more people under the age of 20 in the NRBS area. There are also proportionately fewer people over the age of 60 in the NRBS area. The NRBS area has a higher birth rate and lower death rate than does Alberta as a whole.

Figure 7

Age Characteristics,1991



Source: 1991 Census

There is a greater imbalance between males and females in the NRBS population than in Alberta. In the NRBS area there are 107 males for every 100 females. In Alberta there are 101 males for every 100 females.

The average household in the basin consists of 3.1 people. In this respect, the survey results are identical to 1991 Census data. Furthermore, survey data show that about 50 percent of households consist of couples with children, while nine percent are single people. Another 25 percent are couples without children. Single parent families, extended families, and groups of adults each account for about four percent of basin households.

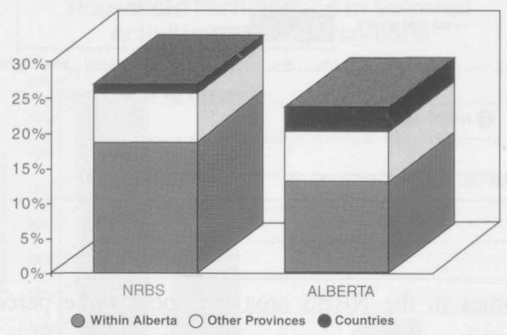
The population of the NRBS area tends to be more mobile than the Alberta population. Census data shows that about 27 percent of NRBS residents moved to the basin between 1986 and 1991, while 24 percent of Alberta residents moved to the province or changed regions during this period (see Figure 8).

For the NRBS area, most new residents came from other parts of Alberta, while only 1.1 percent of the population migrated from another country. In comparison, 3.3 percent of Albertans migrated from other counties and only 13 percent changed regions.

The proportion of new residents arriving from other provinces was the same in both cases, at just over 7.2 percent.

Figure 8

Proportion of the Population that Migrated Between 1986 and 1991

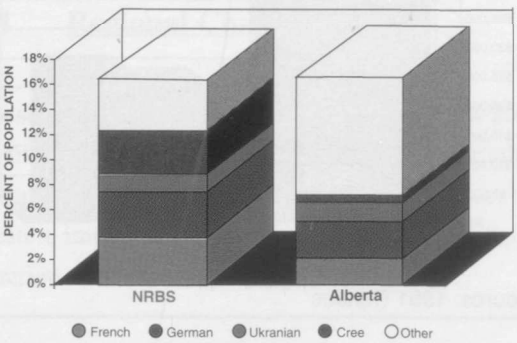


Source: 1991 Census

Within the NRBS region there is less ethnic diversity than in Alberta as a whole, although the proportion of English-speaking residents is the same in both areas. Within the NRBS area there is a higher proportion of French and German speaking peoples and a much higher proportion of aboriginal peoples whose first language is Cree (Figure 9).

Figure 9

Languages of Non-English Speaking Residents



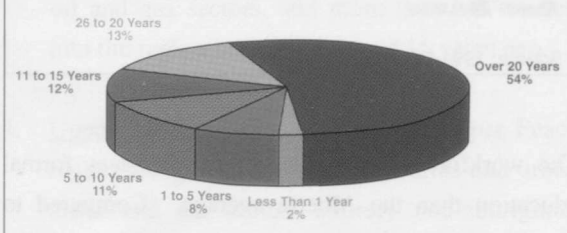
Source: 1991 Census

The survey data in Figure 10 show that the majority of northern residents have lived in the NRBS area for an extended period of time. About 54 percent of household residents have lived somewhere in the basin for more than 20 years. Less than three percent of them have lived in the region for less than one year, and only eight percent have resided in the basin for between one and five years. The remainder have been living in the basin for between five and 20 years.

According to survey information the average household resident in the basin lives an average of 17.4 kilometres (± 2.4 km) from the mainstem of one of the major rivers in the basin. Major rivers include the mainstems of the Athabasca, Peace and Slave rivers, plus the major tributaries like the Macleod, Pembina, Wapiti, Smoky, Little Smoky and Wabasca rivers. Within the NRBS area, households in the Upper Athabasca, Lower Athabasca and Slave River/Delta are typically located within five kilometres of a major river.

Figure 10

Length of Residency in the NRBS Area



Source: Household Survey

3.2 Labour Force and Employment

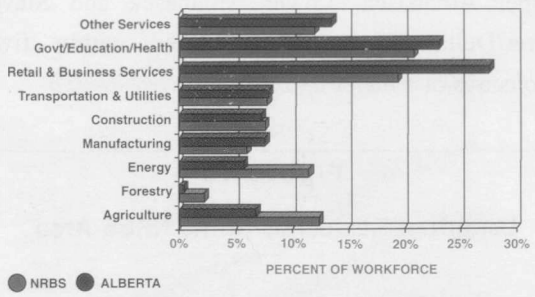
In 1991, 75 percent of the regional population 15 years of age or older were in the workforce. Of these, 92 percent were employed. These statistics are nearly identical to the corresponding information for Alberta as a whole.

The economy of the NRBS area is based largely on natural resource development. Employment data for the area shows much higher participation in the agriculture, energy and forestry sectors than for Alberta as a whole (Figure 11). Overall, over 26 percent of employment in the NRBS area is in these primary, resource-based sectors, compared to only 13 percent for the province.

The service sector in the region is comparatively less developed. Employment in the retail, wholesale and business service sectors is considerably below the Alberta average. There is also less employment in the government, education and health sectors, as well as in the manufacturing sector.

Figure 11

Employment by Sector, 1991

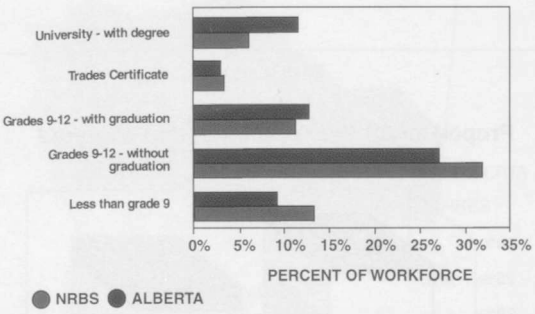


Source: 1991 Census

The workforce in the NRBS area has less formal education than the Alberta average. Compared to provincial statistics, a greater proportion of the workforce in the NRBS area aged 15 or older has less than a Grade 9 education or a Grade 9 to 12 education without having graduated from high school (Figure 12). Similarly, there are fewer university-trained people in the NRBS area. However, a higher than average proportion of the NRBS area workforce has a trade certificate, and this may reflect above average employment in the primary resource sector.

Figure 12

Education of the Work Force

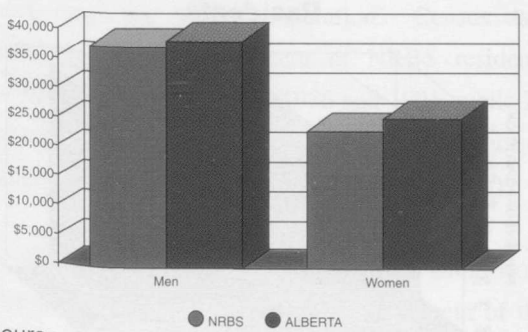


Source: 1991 Census

Incomes in the NRBS area are about three percent lower than the provincial average for men and about nine percent lower for women. As shown in Figure 13, average incomes in 1991 were $37,313 for men and $22,944 for women. In the NRBS area, employment accounts for 76 percent of total income with 17 percent coming from transfer payments, such as pensions, unemployment insurance and welfare payments. In comparison, Albertans earn 81 percent of their annual incomes and transfer payments account for nine percent.

Figure 13

Average Incomes, 1991



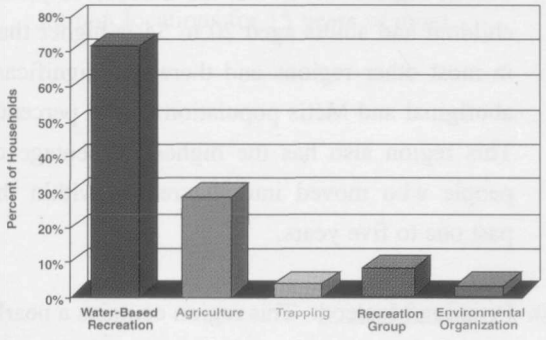
Source: 1991 Census

3.3 Other Characteristics

Survey data provide some additional information about the people living in the NRBS area (see Figure 14).

Figure 14

Household Participation in Selected Activities and Organizations



Source: Household Survey

In terms of how northern residents might use or value water, other than as drinking water, the survey determined that:

- 72 percent of households participate in water-based recreation;
- 29 percent are involved in farming;
- three percent are trappers;
- eight percent are members of recreation groups; and,
- two percent are members of environmental organizations.

3.4 Regional Characteristics

Households in the 12 regions in the basin show some significant differences in their use of water, their attitudes, and the water management issues of greatest importance (see Figure 3). A demographic description of each region is provided below:

1. Upper Athabasca: Households in this region are predominantly urban (96 percent) and non-aboriginal. There is a higher-than-average number of people living in single person households and a larger number of people 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 is a higher proportion of persons over the age of 55 than elsewhere in the basin.

3. Lower Athabasca: This is a very urbanized region (96 percent) that 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 proportion of households that have resided 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 reaches of the Peace, although there is a higher proportion of families with young children and a higher aboriginal population. A fairly even split exists 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. This region has 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 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 tend to be quite similar in size and composition to households in the basin as a whole. The majority of households are 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 the 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. They account for 62 percent of the population and most live in Métis settlements or Indian Reserves. Households tend to be larger than average, and there are more single-parent families and extended families than elsewhere in the NRBS area. The proportion of children under five and young parents (aged 20 to 34) is also very high. Important economic sectors include mining, 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. A high proportion of families with no children and above average proportions of people aged 45 to 64 reside in this region. 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 locations for 15 years or more.

4.0 CONSUMPTIVE USES OF WATER

Many stakeholders in the basins use water for consumptive purposes. Such uses include water used for drinking and other domestic purposes, as well as water used for municipal, agriculture and industrial purposes. For these uses, water is withdrawn from a water body and may then be returned to the water body in diminished quantity or quality.

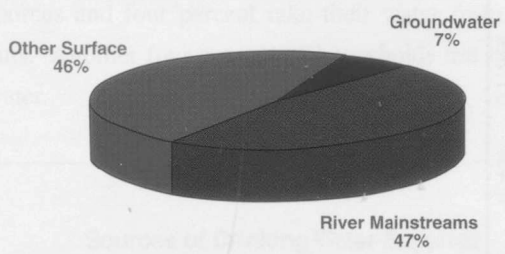
4.1 Licenced Water Use

In Alberta, two percent of water licences issued to users in the NRBS area allow them to use water from the mainstems of the Peace, Athabasca or Slave rivers. These 82 licences allow withdrawals of up to 291,200 acre-feet of water per year. This represents nearly half (47 percent) of the total volume of licenced water use in the basins (Figure 15).

The vast majority of licences for water from the river mainstems (88 percent) have been issued for industrial purposes, and most (86 percent) are from the Athabasca River.

Figure 15

Volume of Licenses by Water Source

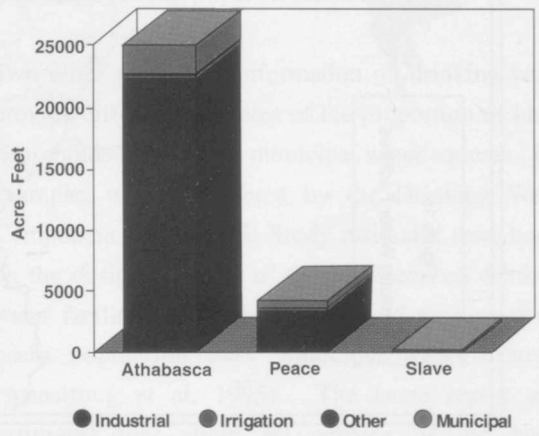


Source: Alberta Water Rights Files

Licences issued for water from the mainstem of the Athabasca River account for 63 percent, by volume, of all water licences issued in the Athabasca basin (Figure 16). Of the licences issued for the mainstem, 90 percent are for industrial purposes with nine percent for municipal purposes. Small amounts have been allocated for agriculture, irrigation, and storage.

Figure 16

Licensed Water Uses From River Mainstems



Source: Alberta Water Rights Files

In the Peace basin, 18 percent of licenced water use is from the Peace River. The majority of this (83 percent) is for industrial use with 15 percent for municipal use and two percent for irrigation.

All of the water licences issued for the Alberta portion of the Slave River are for municipal purposes. These amounts account for 12 percent of all water licences issued for the Slave River basin.

Prior to 1950, few licences were issued for relatively small amounts of water in the Alberta portion of the basin. However, major allocations for industrial purposes commenced in the 1950s. Since then, there has been a steady increase in licenced water use for industrial and municipal purposes, with the largest growth occurring during the 1970s.

Table 3

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%
La Biche/Other	36.2%	4.3%	46.8%	12.8%	0.0%	0.0%
Total	55.3%	4.4%	31.0%	2.0%	2.8%	4.4%

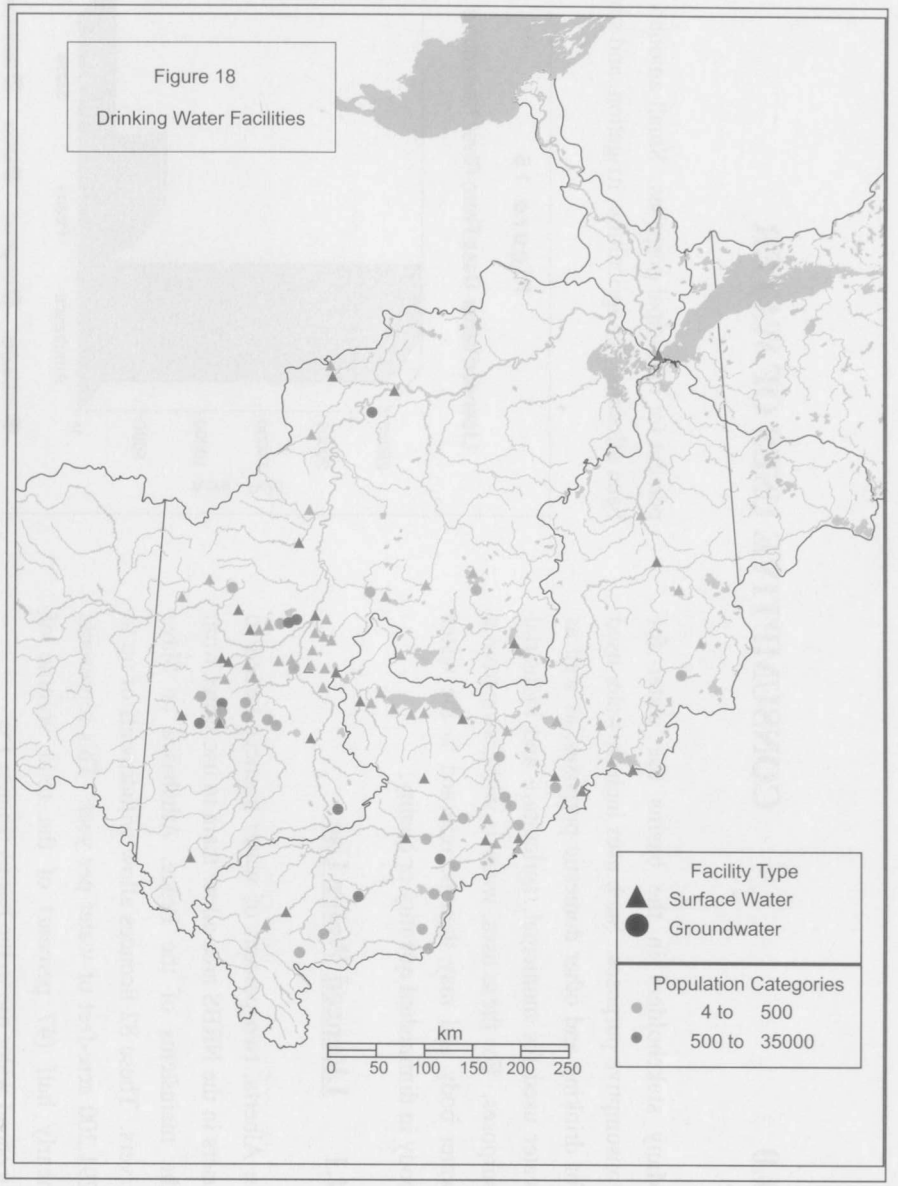
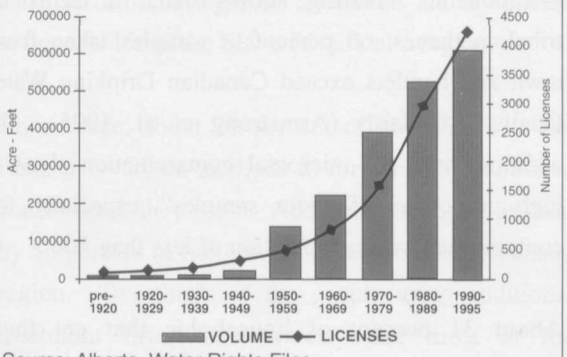


Figure 17

Historical Allocation of Water in the Alberta Portion of the NRBS Area



Source: Alberta Water Rights Files

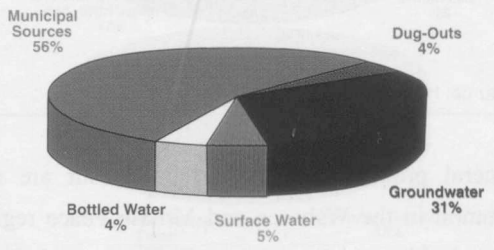
During the last five years, there has been an increase in the number of licences issued but these have been for smaller amounts of water, mostly for agricultural and domestic purposes.

4.2 Drinking Water

The majority of people living in the NRBS area obtain their drinking water from municipal water sources. Survey data suggest that 55 percent of households use municipal sources while 31 percent, especially farm households, take their water from wells or springs (Figure 19). About five percent of households use water from various surface water sources and four percent take their water from dug-outs. Another four percent of households use bottled water.

Figure 19

Sources of Drinking Water Supplies



Source: Household Survey

As shown in Table 3, there is considerable variation among regions in terms of the source of drinking water. In regions with very large farm populations, such as the Lower Athabasca region, very few households rely on municipal water systems. Use of dug-outs is a common practice in the Peace River basin, but unusual elsewhere. Use of river water occurs throughout much of the basin but is of greatest importance in the Upper Athabasca region.

Two other sources of information on drinking water provide different estimates of the proportion of basin households that rely on municipal water sources. For example, work completed by the Drinking Water Component of the NRB Study estimates that, based on the design capacity of the 214 licenced drinking water facilities in the basin, about 75 percent of the basin population uses municipal water systems (Armstrong et al, 1995). The same report also estimates that about 60 percent of the basin population may actually be served by these drinking water facilities. In contrast, data from the Traditional Knowledge Component of the NRB Study found that only five percent of the 221 traditional resource users from nine native communities use municipal water supplies (Flett and Bill, 1995).

Based on the inconsistencies among data sources, it is estimated that between 55 and 75 percent of basin residents draw their water from municipal water systems. The remainder use other water sources.

4.2.1 Municipal Water Sources

Within the Alberta portion of the NRBS area, some 321 municipal water licences for 28,800 acre-feet of water have been issued. Nearly half of these licences have been issued since 1980. There are 214 licenced drinking water treatment facilities in the basin[2]. The location of these facilities is shown in Figure 18.

[2] Details of these facilities can be found in Appendix D of the report by Armstrong, et al. 1995.

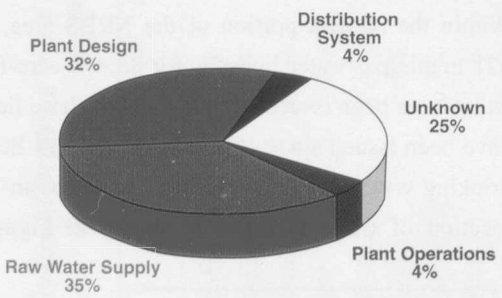
Multiple licences to withdraw water have been issued for several of the water treatment facilities.

Surveys of municipal and local governments suggest that water for households accounts for 78 percent of municipal water use. The balance is used for commercial purposes (12 percent), industries (four percent) or government buildings, including hospitals and schools (four percent). System leakage is estimated to be about two percent of municipal water use. As noted earlier, these results are representative of towns and small communities and do not reflect water use patterns for the two cities (Fort McMurray and Grande Prairie) and some rural parts of the region.

According to survey results, the vast majority of municipalities believe that their treatment facilities are producing water that meets drinking water standards. Only three percent say they are not meeting these standards and another three percent not sure whether standards are being met. For plant operators, Figure 20 shows that the most important factors affecting drinking water quality are raw water quality (36 percent of operations), plant design (32 percent) or unknown factors (25 percent). More than half of the municipalities (58 percent) expect to upgrade or construct new water treatment facilities in the near future, either by adding chlorination or improving filtration.

Figure 20

Factors Affecting Water Plant Operations



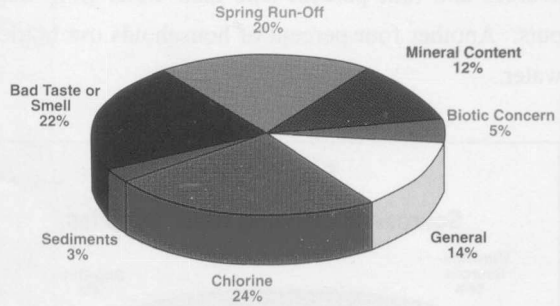
Source: Surveys Of Local and Municipal Governments

The perception that water treatment plants are meeting drinking water standards is inconsistent with the results of assessments by the Drinking Water Component. Testing shows that, in terms of trihalomethanes, 60 percent of samples taken from town and hamlets exceed Canadian Drinking Water Quality Standards (Armstrong et al, 1995). In addition, tests for microbial contamination show a high proportion of "poor samples", especially for communities with a population of less than 500.

About 31 percent of households that get their drinking water from a municipal treatment facility have concerns about the quality of this water. The most common complaint is that water has a strong chlorine taste (Figure 21). This is reported by 25 percent of households that have water quality concerns. Another 22 percent have general complaints about a bad taste or smell, while 20 percent report a bad taste to the water during periods of spring run-off. Other concerns about drinking water include sediments, biotic concerns (such as algae or microbial contamination), and mineral content.

Figure 21

Water Quality Concerns for Municipal Drinking Water Sources



Source: Household Survey

General problems with taste and odour are most common in the Wabasca and Middle Peace regions. Households in the Lower Athabasca, Pembina/Macleod, Slave River/Delta and Lesser

Slave regions report taste and odour problems mostly in the spring. Microbial and other biotic concerns are most prevalent among households in the Lesser Slave and Lac la Biche regions. Sediments are of concern to households in the Slave River/Delta region.

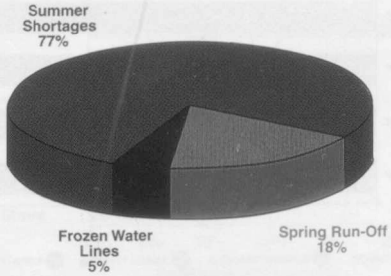
On average, about 28 percent of households in the basin use various methods to further treat municipal water before they use it. Additional treatment is used by 50 percent of households in the Pembina/Macleod region. Two-thirds of the people using additional treatment filter their water while most of the remainder either boil or distill their water first.

About 14 percent of basin households using municipal water supplies report that the quality of their drinking water has improved over the last 10 years. At the same time, half of all water treatment plant operators (52 percent) believe that there has been a decline in the quality or quantity of raw water supplies during the last 10 years.

About 10 percent of households using municipal water sources experience water quantity problems (Figure 22). In most cases (77 percent), the problem is water shortages during the summer months. Others households (18 percent) note that high flows during spring run-off cause changes in water colour. The remainder periodically experience frozen water lines.

Figure 22

Water Quantity Concerns for Municipal Drinking Water Sources



Source: Household Survey

About 80 percent of municipal and local governments in the NRBS area treat waste water before discharging it into surface water bodies. Of these, 54 percent use primary or mechanical treatment processes to remove solids, while 45 percent use secondary treatment. However, 20 percent of local and municipal governments discharge waste water without any form of treatment. Larger population centres have sewage facilities that treat and discharge effluent continuously, while small centres treat sewage and hold it in lagoons which are emptied only once or twice a year.

4.2.2 Unconventional Water Sources

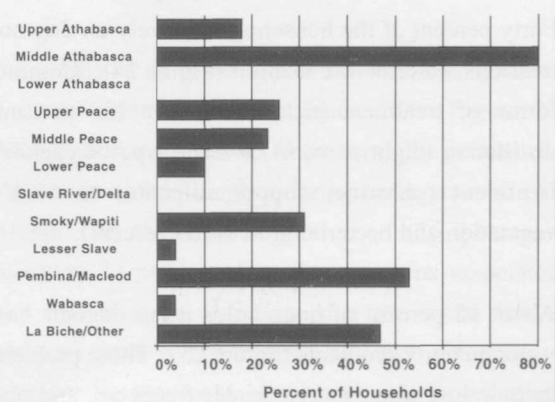
As noted earlier, between 25 and 45 percent of the population in the basin use water from sources other than a municipal water supply. The treatment methods and problems faced by these people vary according to the source of water used.

Groundwater Wells

About 31 percent of households in the NRBS area use groundwater from wells.

Figure 23

Regional Distribution of Households Using Groundwater



Source: Household Survey

Groundwater use is especially important in areas with a high agricultural population. The highest use of groundwater is reported in the Middle Athabasca, Pembina/Macleod and Wabasca regions.

About 30 percent of households that rely on groundwater use some form of treatment (Figure 24). The most common treatments for groundwater consist of distillation (29 percent), filtering (26 percent), mineral removal (23 percent) or chlorination (10 percent).

Only six percent of households using groundwater are concerned about water quantity (Figure 25), mostly in terms of a long-term reduction in the groundwater table (Figure 26).

About 27 percent of well users have complaints about water quality (Figure 27). Many of these people have problems with high mineral content (68 percent) while others (16 percent) say that the water tastes or smells bad (Figure 28).

Dug-Outs

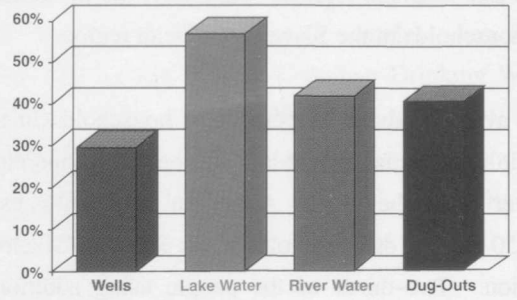
Just over four percent of households in the NRBS area get their drinking water from dug-outs. Dug-outs are used in six of the 12 regions and are the usual source of drinking water for between 10 and 30 percent of households in the Peace River basin (Figure 29).

Forty percent of the households that rely on dug-outs treat this water before using it (Figure 24). Common forms of treatment include filtration (33 percent), distillation (eight percent) or some type of chemical treatment (chlorine, copper sulphate) to control vegetation and bacterial growth (59 percent).

About 15 percent of households using dugouts have water quantity problems (Figure 25). These problems include low water levels, winter freeze-up, and poor water during spring run-off.

Figure 24

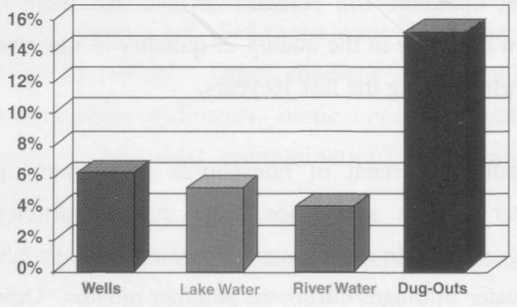
Proportion of Households Treating Water From Unconventional Sources



Source: Household Survey

Figure 25

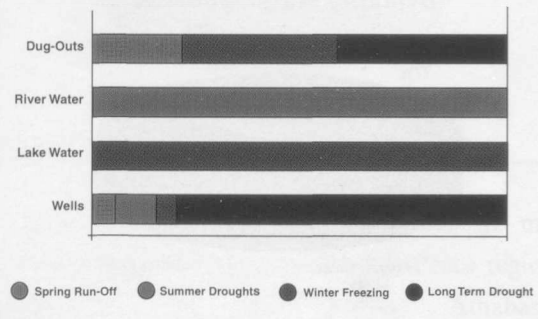
Incidence of Water Quantity Problems by Households Using Conventional Sources



Source: Household Survey

Figure 26

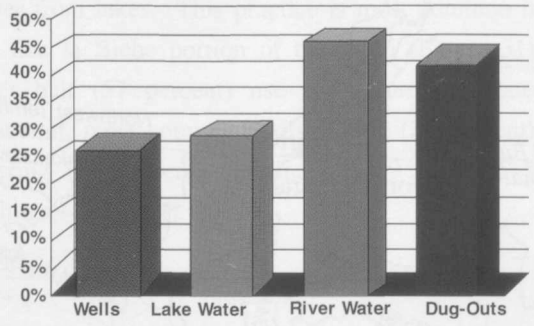
Types of Water Quantity Problems



Source: Household Survey

Figure 27

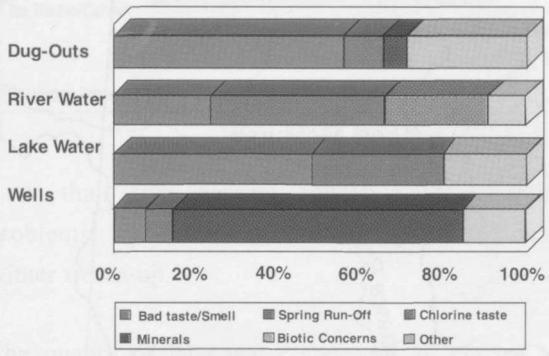
Incidence of Water Quality Problems



Source: Household Survey

Figure 28

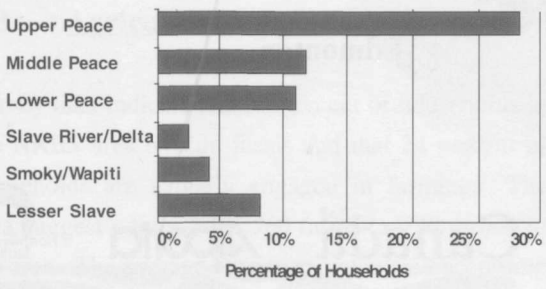
Types of Water Quality Problems



Source: Household Survey

Figure 29

Regional Distribution of Households Using Dug-Outs



Source: Household Survey

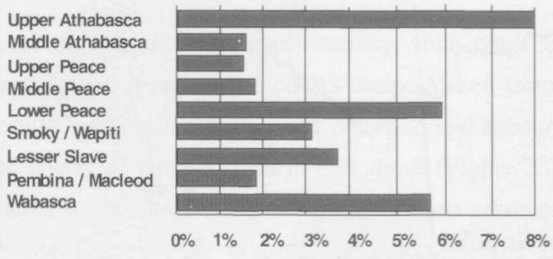
Of households that use dug-outs, nearly 44 percent are concerned about water quality (Figure 27). Problems with bad taste or smell are common (65 percent of concerns), as they are for people using other unconventional water sources, Problems associated with vegetation and bacteria in dug-outs are also fairly common (29 percent of concerns).

River Water

Nearly three percent of households in the NRBS area draw their drinking water directly from rivers. This practice occurs throughout the basins (Figure 30).

Figure 30

Regional Distribution of Households Using River Water



Source: Household Survey

River water is treated by 42 percent of households (Figure 24). This treatment involves either filtration (55 percent) or boiling (45 percent). Only four percent of households using river water have water quantity problems. The problems are related mostly to summer droughts.

The quality of river water is of concern to 47 percent of households that use it (Figure 27). Figure 28 shows that in many cases (41 percent), the problem is a bad taste or smell, either during spring run-off (41 percent) or the rest of the year (26 percent). However, 24 percent of quality concerns associated with use of river water are that the water has a chlorine taste. The source of this chlorine is unknown because none of these people report using chlorine to treat their water.

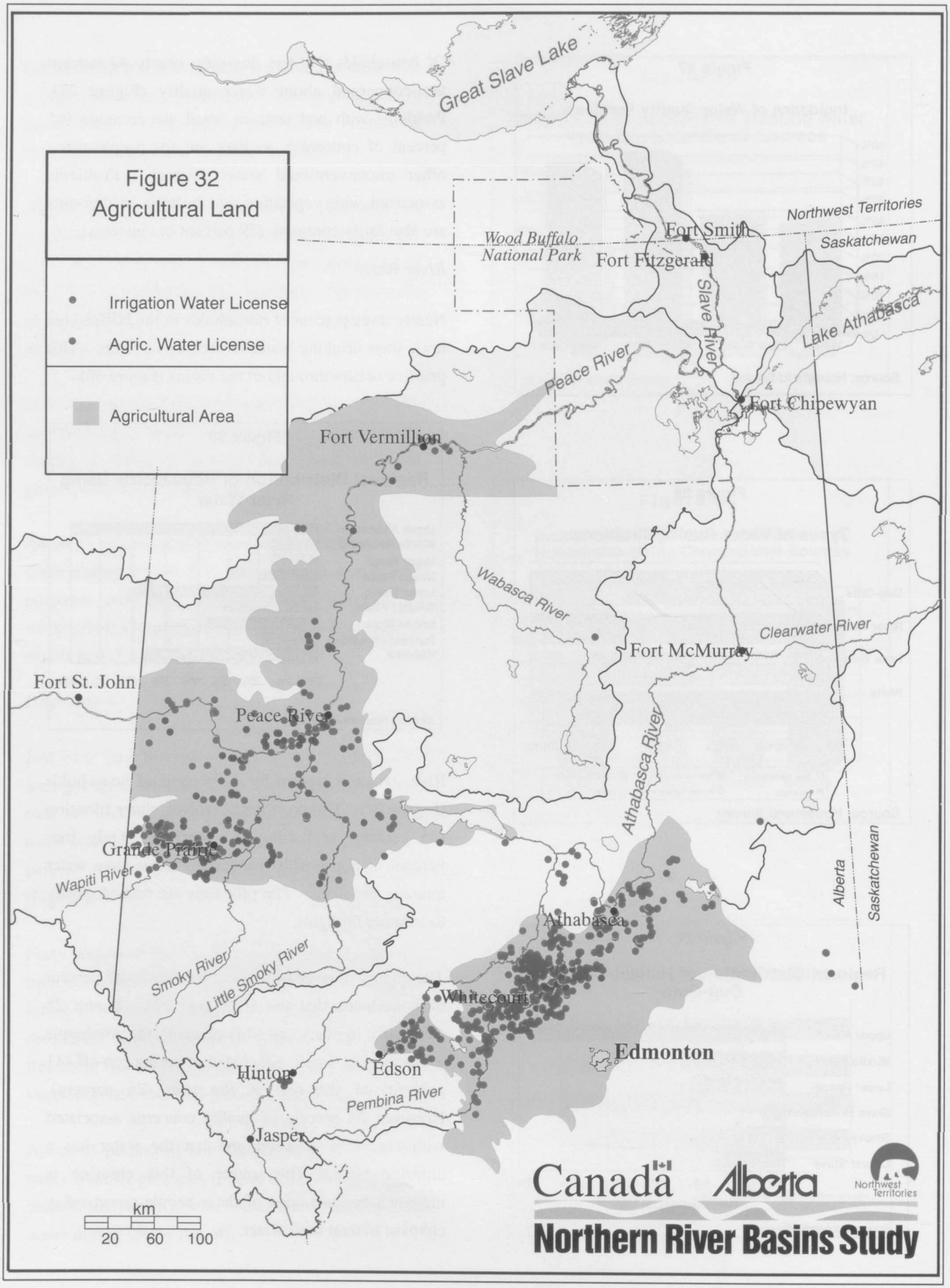


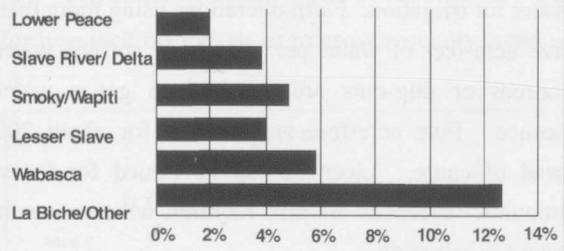
Figure 32
Agricultural Land
Irrigation Water License
Agric. Water License
Agricultural Area
Great Slave Lake
Wood Buffalo
National Park
Fort Smith
Fort Fitzgerald
Northwest Territories
Saskatchewan
Slave River
Lake Athabasca
Peace River
Fort Chipewyan
Fort Vermillion
Wabasca River
Clearwater River
Fort McMurray
Fort St. John
Peace River
Athabasca River
Grande Prairie
Wapiti River
Athabasca
Alberta
Saskatchewan
Smoky River
Little Smoky River
Whitecourt
Edmonton
Hinton
Edson
Pembina River
Jasper
km
20 60 100
Canada
Alberta
Northwest Territories
Northern River Basins Study

Lake Water

Only two percent of basin households draw their water from lakes. This practice is most common in the Lac la Biche portion of the basin (Figure 31). Over half (57 percent) use some form of water treatment, most commonly distillation (37 percent), filtering (31 percent) chlorination (19 percent) or boiling (17 percent).

Figure 31

Regional Distribution of Households Using Lake Water



Source: Household Survey

Less than five percent report water quantity problems, and these are usually associated with winter freeze-up.

The quality of lake water concerns 29 percent of households that use it (Figure 27). They are concerned about the taste or smell of the water (49 percent), especially in the spring (31 percent). About 20 percent are concerned about algae growth or microbial or bacterial contamination of lake water (Figure 28).

4.3 Agriculture

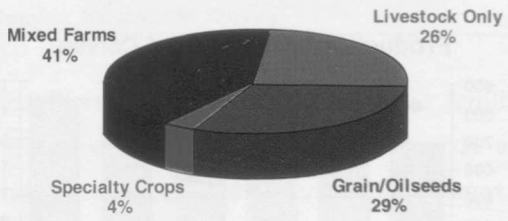
Survey data indicate that 30 percent of households in the NRBS area live on farms and that 24 percent of households are actually engaged in farming. The data suggest a total of 21,560 farms (± 720 farms) in the area. The average farm size, calculated according to the land area being used to grow crops, is 462 acres. Extrapolation of survey data indicates that about 8.7 million acres of crops are planted in the NRBS area each year.

Information from the 1991 Alberta Census of Agriculture, when adjusted to river basin boundaries, suggests there are actually 13,870 operating farms within the NRBS area. Total farm size amounts to 10.6 million acres, of which 6.4 million acres are used for crops. The average farm size, based on land used for crops is 465 acres. The difference between Census and survey data indicates that, although a disproportionate number of farms households responded to the household survey, they appear to be representative of farming operations in the northern river basins.

According to the household survey, four types of farming are found in the NRBS area. Mixed farms (crops and livestock) are most common and account for nearly 41 percent of farm operations (Figure 33). Farms raising grains and oilseeds are most common in the Peace River drainage and account for 29 percent of farm operations in the NRBS area. Another 26 percent of farms raise livestock only. The remaining four percent are specialty farms and include apiaries (beekeeping), greenhouses, market gardens and saskatoon berries.

Figure 33

Types of Farming Operations



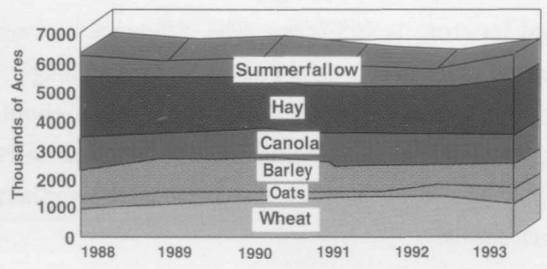
Source: Household Survey

Agricultural census data show that, based on land area, hay is the most common crop. Nearly two million of acres of hay are cut each year in support of

livestock production. Wheat and canola are the next two most important crops; each accounts for about 20 percent of crop areas. Oats and barley are of less importance, with some production being used to feed livestock.

Figure 34

Crop Production by Land Area

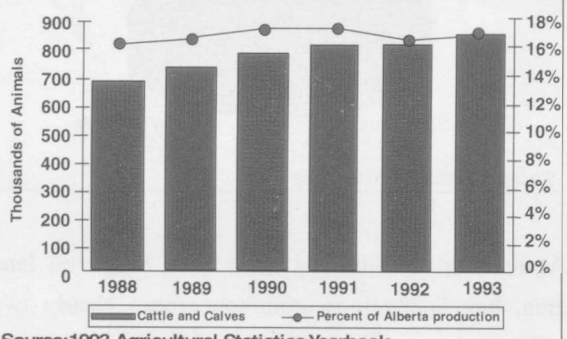


Source: Agricultural Statistics Yearbook

According to the survey results, two-thirds of the farms raise some type of livestock and 55 percent raise cattle. Agricultural statistics for Alberta report that about 800,000 cattle and calves are raised on about 50 percent of farms in the basin. Cattle production in the NRBS area accounts for about 17 percent of Alberta cattle production. This percentage has remained relatively constant in recent years (Figure 35).

Figure 35

Production of Cattle and Calves



Source: 1993 Agricultural Statistics Yearbook

Survey data also show that small numbers of horses are raised on about 24 percent of farms in the NRBS area. Pigs are raised on 16 percent of livestock farms while five percent of farms raise sheep and 17 percent raise poultry.

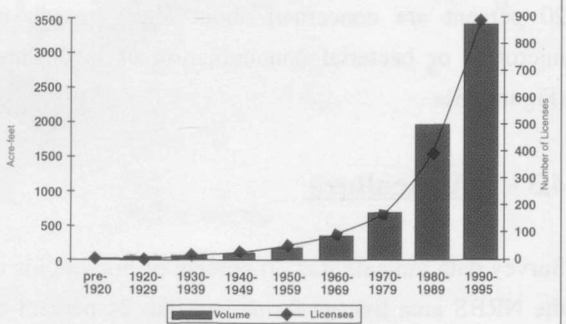
4.3.1 Agricultural Water Use

Agricultural water use varies according to the type of farm operation. Small amounts of water are used on grain and oilseed farms. Livestock and mixed farms require water for livestock. Specialty farms may use water for irrigation. Farm operations using more than five acre-feet of water per year from surface water sources or dug-outs are required to get a water licence. Five acre-feet is sufficient for about 200 head of cattle. Licences can be issued for lesser amounts. Licences are also required where water is used for irrigation.

At the present time, 887 agricultural water licences have been issued for a total of 3397 acre-feet of water from both surface and groundwater sources in the NRBS area. The average licence is for about 3.8 acre-feet of water. Agricultural water licences are held by about three percent of farms in the basin.

Figure 36

Agricultural Water Licenses



Source: Alberta Water Rights Files

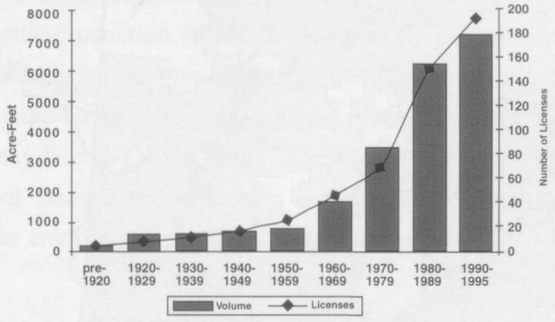
There has been rapid growth in the number of agricultural water licences issued in recent years

(Figure 36). This does not represent a change in water use but reflects a move by farmers towards establishing and protecting their water rights.

There are currently 194 irrigation water licences. They allocate 7144 acre-feet of water for irrigation purposes, with an average of 36.8 acre-feet per licence. Irrigation accounts for about two percent of water drawn from the mainstem of the Peace River. There has also been considerable growth in the amounts of water being used for irrigation (Figure 36). Typically, irrigation water is used to grow hay for livestock operations or to grow specialty crops.

Figure 37

Irrigation Water Licenses



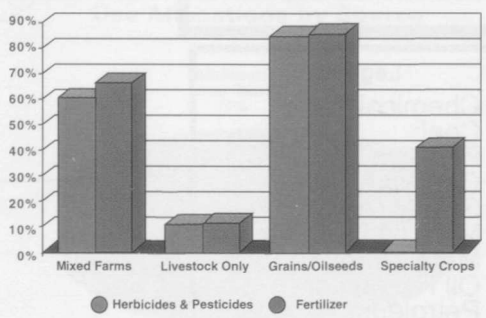
Source: Alberta Rights Files

4.3.2 Use of Agricultural Chemicals

Farm use of herbicides and pesticides varies by farm type. As shown in Figure 38, about 85 percent of grain/oilseed farms use herbicides and pesticides. These chemicals are also used by 60 percent of mixed farms. Round-Up, MCPA Amine, Poast, Lontrel and 2,4-D are the most common brands of herbicides used. According to Alberta Agriculture, Food and Rural Development, farmers in the region apply these herbicides at rates equal to or just below the recommended rates (Lussier, pers. comm.).

Figure 38

Farm Use of Farm Chemicals, By Farm Type

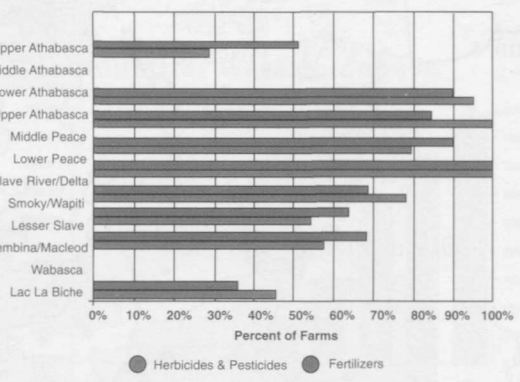


Source: Household Survey

Figure 39 shows how the use of farm chemicals varies from region to region. As expected, use of herbicides and pesticides is greatest in those regions where grain/oilseed farms are predominant, such as the Upper and Middle Peace regions.

Figure 39

Farm Use of Farm Chemicals, by Region



Source: Household Survey

The majority of farms (56 percent) use fertilizers. The highest use of fertilizer is reported in the upper Peace River region and on grain/oilseed farms. In nearly half of the cases, farmers report using a general nitrogen-based fertilizer. Survey respondents also identified 27 different types of fertilizers, with the most common being combinations of nitrogen, phosphorous, potassium and sulphur in blends (based

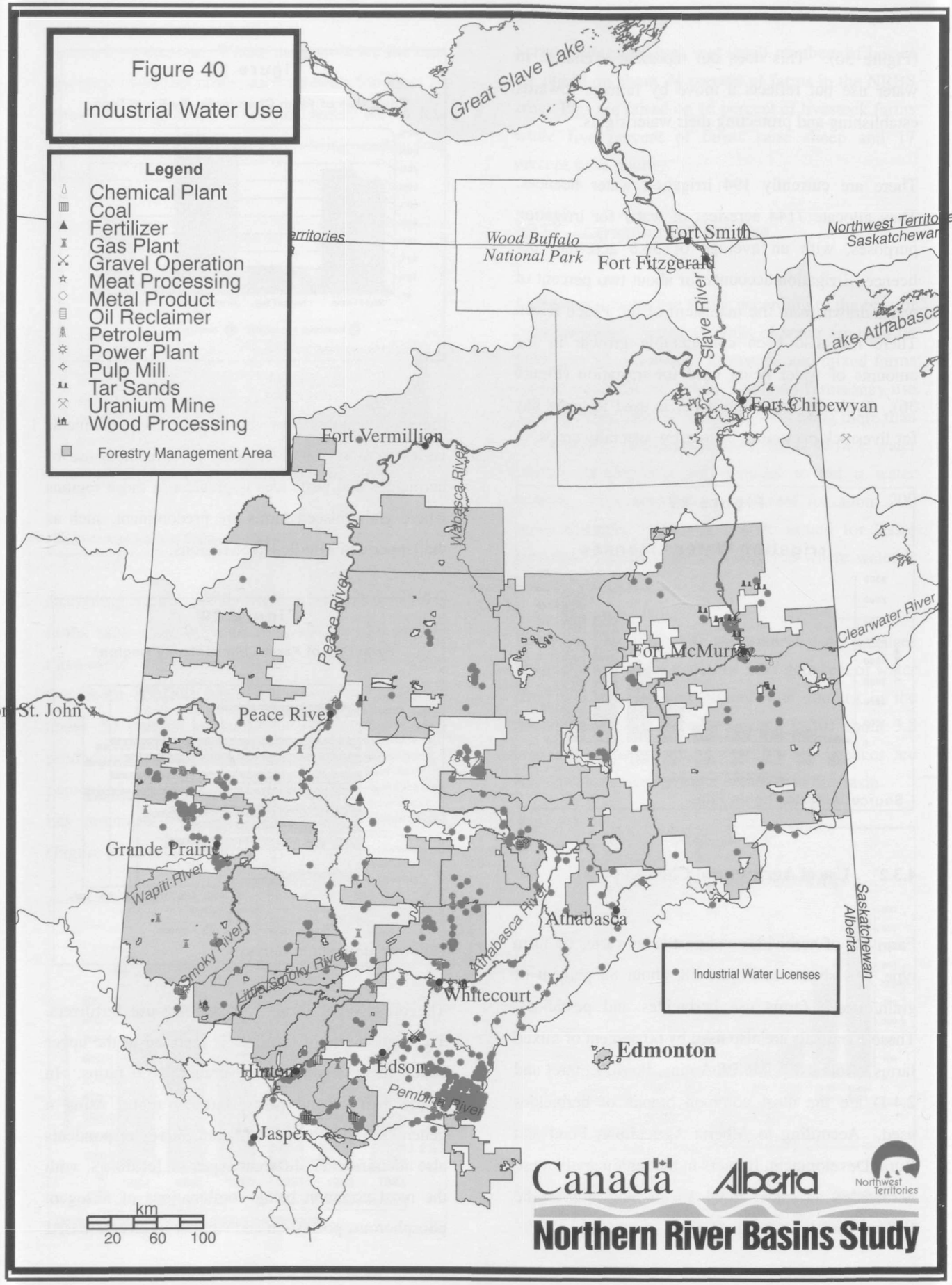


Figure 40
Industrial Water Use
Legend
Chemical Plant
Coal
Fertilizer
Gas Plant
Gravel Operation
Meat Processing
Metal Product
Oil Reclaimer
Petroleum
Power Plant
Pulp Mill
Tar Sands
Uranium Mine
Wood Processing
Forestry Management Area
Great Slave Lake
Wood Buffalo National Park
Fort Smith
Fort Fitzgerald
Slave River
Lake Athabasca
Fort Chipewyan
Fort Vermillion
Peace River
Wabasca River
Clearwater River
Fort McMurray
Fort St. John
Peace River
Grande Prairie
Wapiti River
Smoky River
Little Smoky River
Athabasca River
Athabasca
Whitecourt
Edmonton
Hinton
Edson
Pembina River
Jasper
Saskatchewan
Alberta
Industrial Water Licenses
km
20 60 100
Canada
Alberta
Northwest Territories
Northern River Basins Study

on proportions) of 27-14-0-0, 11-52-0-0 and 82-0-0-0 (anhydrous ammonia).

Livestock farms use three different methods for disposing of manure. About 85 percent of mixed and livestock farms spread their manure back on to their fields. Composting of manure is the most popular manure disposal practice on grain/oilseed farms, but is relatively unusual on other types of farms. The third method of manure disposal is to sell it. This is reported by only two to three percent of mixed and livestock farms.

Over the next decade, the status of agriculture in the northern river basins is not expected to change dramatically. A review of recent trends suggests that the amount of farmland in the basins is not expected to grow by more than five percent (Nichols, 1996). Furthermore, there may be a shift toward increased cattle production, due to changing world markets and changes in grain transportation subsidies (elimination of the Crow Rate). It is expected that fertilizer use may increase in the future, depending on grain prices, but farmers are becoming increasingly sensitive to the environmental effects of their activities.

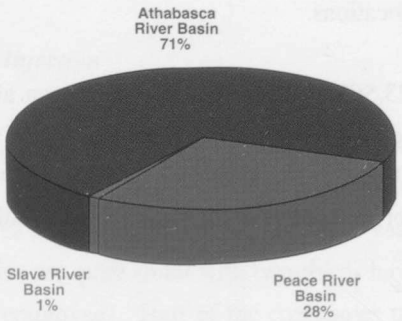
4.4 Industrial Water Use

Some 95 companies hold 896 water licences issued for industrial purposes in Alberta. The location of these licences is shown in Figure 40. The water allocated under these licences amounts to 430,618 acre-feet.

The majority of this water (92 percent) is taken from surface water sources, while eight percent comes from groundwater sources. About 71 percent of licenced industrial water use comes from the Athabasca River basin, while 28 percent is from the Peace River basin (Figure 41). Only one percent of licenced industrial water use comes from the Slave River basin.

Figure 41

Allocations of Surface Water For Industrial Use Allocations by Source

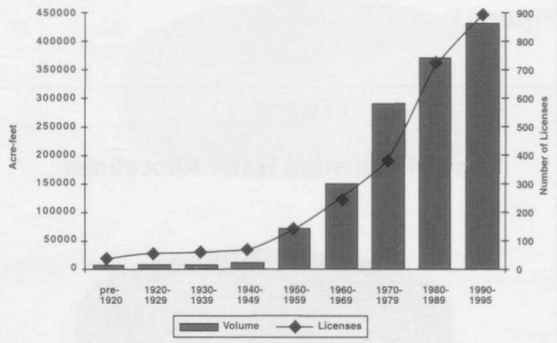


Source: Alberta Water Rights Files

There was a major increase in the amount of water allocated to industrial uses during the 1950s. Since then, volumes have increased by a factor of ten. Figure 42 shows that much of the growth in industrial water demand occurred during the 1980s, when licenced industrial water use almost doubled.

Figure 42

Industrial Water Licenses



Source: Alberta Water Rights Files

The vast majority of industrial water allocations (62 percent of licenced volume) are issued for the purposes of processing. This includes pulp mills and gas plants. The second most important use (16 percent) is for cooling purposes, including the oil sands plants and a thermal power facility. Another 14 percent is allocated for the purposes of oilfield

injection purposes. Water used for other purposes, including gravel washing, steam processing for oil and gas operations and various other activities, accounts for the remaining seven percent of industrial water allocations.

Some 223,560 acre-feet of water has been allocated from the mainstem of the Athabasca River for industrial purposes. These 17 licences represent 73 percent of all industrial allocations in the Athabasca basin.

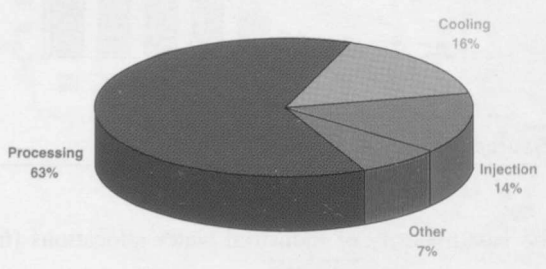
Water allocations from the mainstem of the Peace River amount to only 33,850 acre-feet, which represents 28 percent of allocations for the Peace basin. There are no industrial water licences for the mainstem of the Slave River.

4.4.1 Survey Results

Of the 95 companies that hold industrial water licences in the basins, 44 responded to the survey. These 44 companies account for 32 percent of industrial water licences and hold 56 percent of industrial water allocations (by volume) in the basin (Figure 43).

Figure 43

Use of Industrial Water Allocations



Source: Alberta Water Rights Files

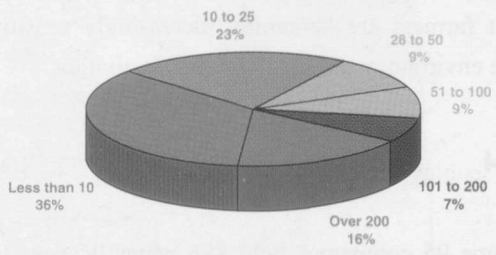
Figures 44 to 48 summarize survey results related to industry size, and use of water. However, analysis of survey responses shows that water use patterns vary considerably from company to company, so the results were grouped into five major industrial sectors. Survey results for each of these five sectors are summarized below.

Forest Sector

Industries in the forest sector produce pulp and paper, lumber and oriented strand board. Survey responses were received from a few companies that have more than 100 employees and are located mainly in the Athabasca basin. Two-thirds of companies have been operating there 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. More than 40 percent of water is recycled, and more than 60 percent is returned to surface water sources after being treated.

Figure 44

Size of Industrial Water Users Based on Number of Employees



Source: Survey of Industrial Water Users

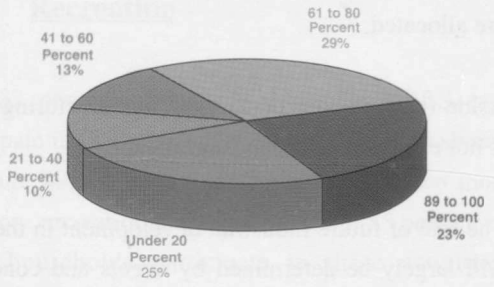
Mineral Extraction

The mineral extraction sector includes coal mines, oil sands plants, and sand and gravel companies. Companies in this sector are located in both the Peace and Athabasca basins. Three-quarters of the operations have less than 25 employees while the remainder have more than 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 prior to release.

Figure 45

Proportion of Industrial Water Allocations Being Used



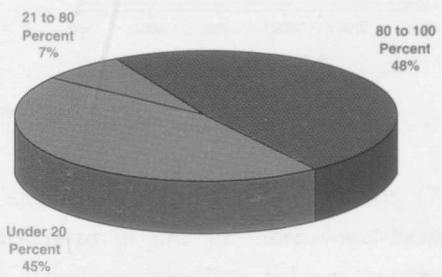
Source: Survey of Industrial Water Users

Oil and Gas

Oil and gas companies are located mainly in the Athabasca basin. The majority have been operating for more than 10 years and they employ 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.

Figure 46

Proportion of Industrial Water Allocations Being Recycled



Source: Survey of Industrial Water Users

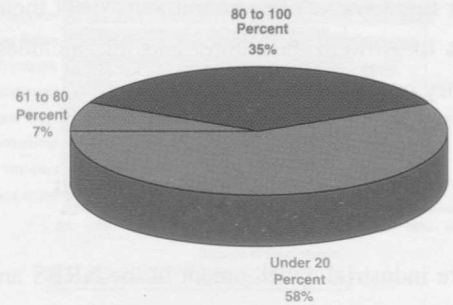
Two-thirds of the companies recycle less than 40 percent of their water, and less than 20 percent of the water is returned to surface water bodies, with about half of it being treated first.

Oilfield Injection

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

Figure 47

Proportion of Industrial Water Returned to Surface Water Bodies After Use



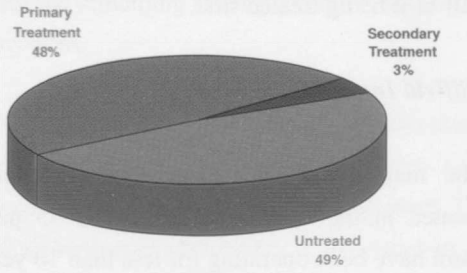
Source: Survey of Industrial Water Users

Thermal Power

One thermal power plant is located in the Peace basin. It has been generating electricity for more than 20 years. The 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.

Figure 48

Treatment of Industrial Water Being Returned to Surface Water Bodies



Source: Survey of Industrial Water Users

Very few industrial water users that responded to the survey (seven percent) have seen any changes in the quality or quantity of their raw water supplies during the last 10 years. The nature of these changes was not specified.

About 25 percent of companies expect their water requirements to change in the next 10 years. The majority of these companies (60 percent) are in the oil and gas sector, and they expect their needs for water to decrease. The remainder expect their water needs to grow in the future, and this includes some forestry operations.

4.4.2 Future Industrial Development

Future industrial development in the NRBS area will have the greatest impact on consumptive water use in the Peace, Athabasca and Slave river basins. The sectors with the greatest potential for economic growth over the next two decades are the conventional and non-conventional oil and gas industry and the forest industry (Nichols, 1996).

Additional development of the oil sands is predicted to be the single most-important area of potential economic growth in the NRBS area. New investment in oil sands projects could range between $20 to $25 billion, with production doubling or tripling. In comparison, coal production and hydroelectric development in the region are not expected to change in the foreseeable future.

For the forest industry, the greatest potential for growth lies in the development of additional value-added, wood processing industries. This includes more oriented strand board plants, paper-making operations and various wood products manufacturing companies. Other opportunities for forest sector growth will occur as the remaining hardwood forests are allocated.

Aside from wood products, the manufacturing sector is not expected to expand significantly.

The rate of future industrial development in the basin will largely be determined by events and conditions outside the region. Most of the products created in the NRBS area are exported. This means that world supply-demand conditions will have considerable influence on economic activity within the northern basins.

5.0 NON-CONSUMPTIVE USES OF WATER

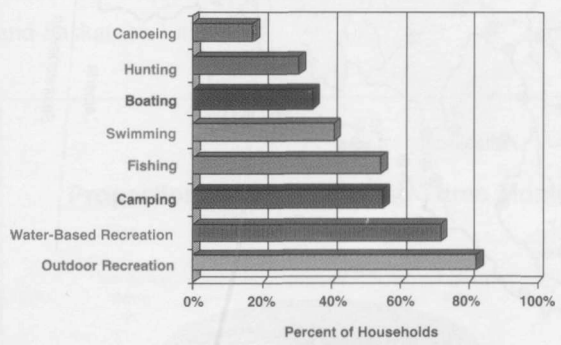
Various activities involve non-consumptive uses of water. Recreation, tourism, commercial fishing, trapping, and river transportation are all activities that depend on the water resources of the basin, even though no actual consumption of water may occur. This section of the report summarizes the extent of these activities in the NRBS area.

5.1 Recreation

Over 82 percent of households in the NRBS area participate in outdoor recreation activities. As shown in Figure 49, camping and fishing are the two most common recreational activities. About 55 percent of basin households participate in these activities. Nearly 42 percent of households also participate in swimming at lakes and rivers, while 35 percent of households go boating. About 31 percent of households participate in hunting, while only 17 percent go canoeing.

Figure 49

Household Participation in Recreational Activities



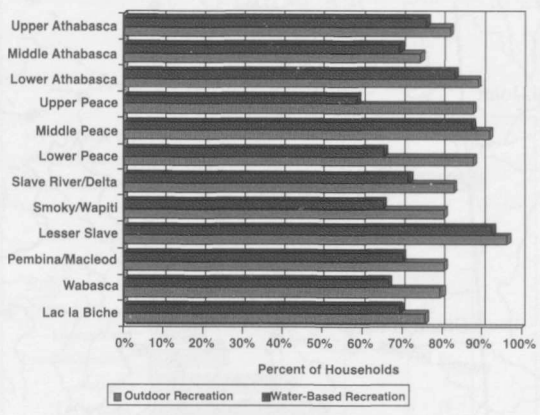
Source: Household Survey

A slightly smaller proportion of households (72 percent) participate in one or more water-based recreational activities, including fishing, boating, canoeing and swimming. Studies undertaken as part of the Traditional Knowledge Component of the NRBS also determined that 68 percent of traditional users in nine communities in the basin use rivers and lakes for recreation (Flett and Bill, 1995).

Household participation in water-based recreation ranges from a low of 59 percent for the Upper Peace region to a high of 93 percent for the Lesser Slave region (see Figure 50). This variability is likely due to the availability of recreational facilities on rivers and lakes and the age composition of populations within each region.

Figure 50

Household Participation in Outdoor Recreation, By Region



Source: Household Survey

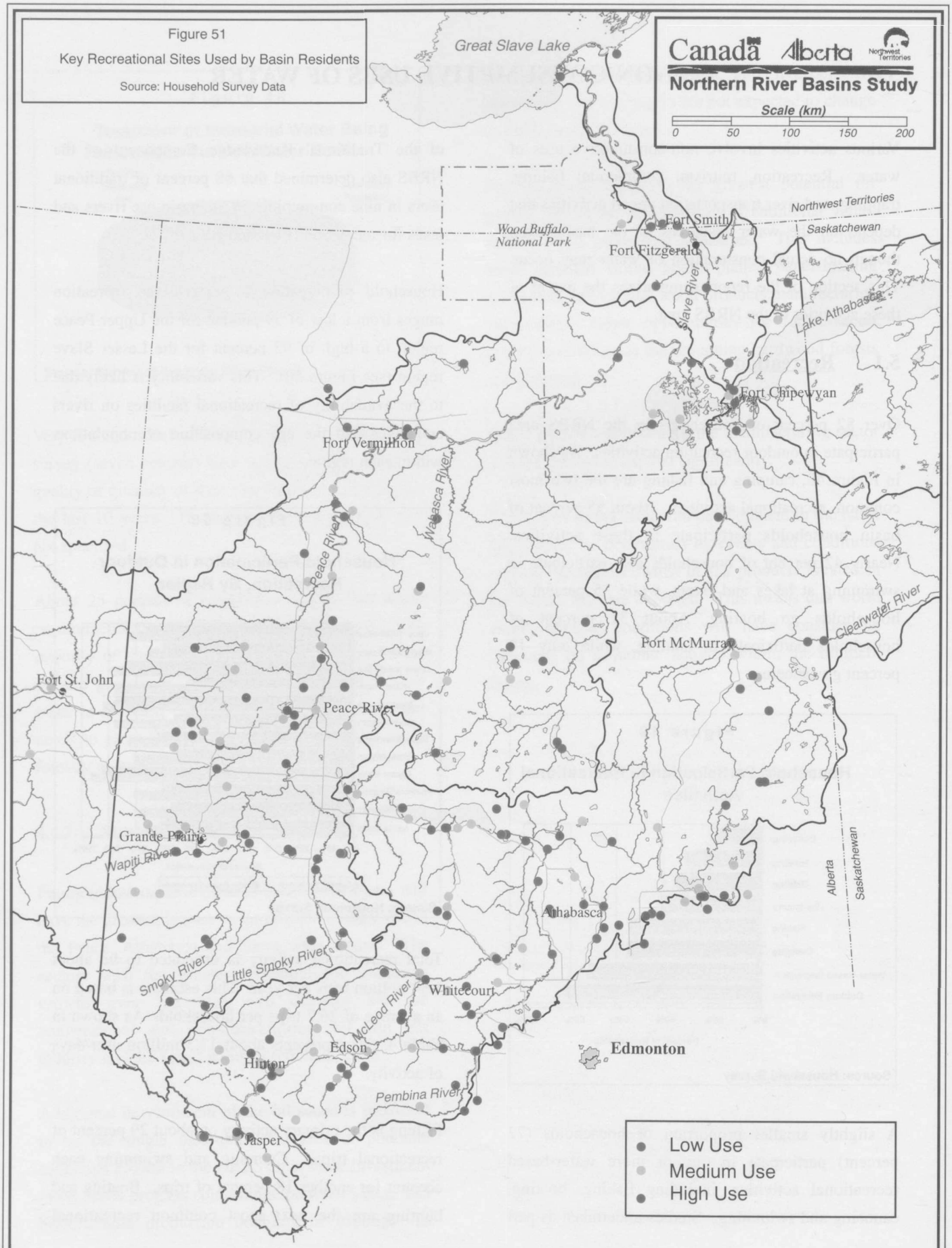
Total recreational activity is estimated to be about 1.84 million trips per year. This estimate is based on an average of 26.7 trips per household. As shown in Table 4, this represents about 13.3 million user-days of activity.

Fishing is the primary activity on about 29 percent of recreational trips. Camping and swimming each account for another 18 percent of trips. Boating and hunting are the next most common recreational

Figure 51

Key Recreational Sites Used by Basin Residents

Source: Household Survey Data



activities accounting for 16 and 15 percent of trips, respectively. Only four percent of trips are for canoeing.

Table 4

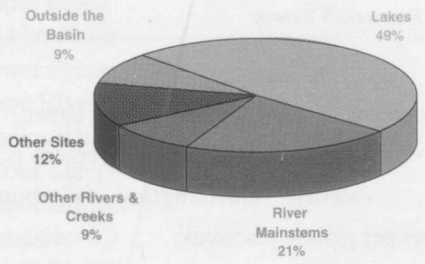
Estimated Recreational Activity by Households in the Northern River Basins

Activity	Percent of Households	Estimated Total Trips	Estimated Total User Days
Camping	55.0%	334,000	4,278,500
Swimming	40.7%	336,700	2,720,600
Boating	34.6%	292,000	1,841,900
Canoeing	17.2%	71,200	497,000
Hunting	30.6%	280,300	1,496,600
Fishing	54.2%	525,800	2,458,900
Total	82.3%	1,840,000	13,293,500

Residents of the NRBS area visit a wide variety of recreational sites both inside and outside the basin. Over 400 locations were identified as being one of the three most used recreational sites. These locations are shown in Figure 51. Of total trips to the most heavily used sites, nine percent are to locations outside the basin. Lakes in the basin are very heavily used and account for nearly half (49 percent) of trips to the most frequently used sites (Figure 52). Important recreational lakes include Gregoire Lake, Lesser Slave Lake, Pierre Grey Lakes, Sturgeon Lake and Saskatoon Lake.

Figure 52

Proportion of Trips Taken to Three Most Used Sites



Source: Household Survey

River mainstems are also commonly used. About 21 percent of trips to the most heavily-used sites are to locations along the mainstems of the major rivers. The Athabasca, Lesser Slave, Peace, Clearwater and Wapiti rivers are the most important recreational rivers in the basin. River mainstems are used by about 34 percent of households that participate in water-based recreation.

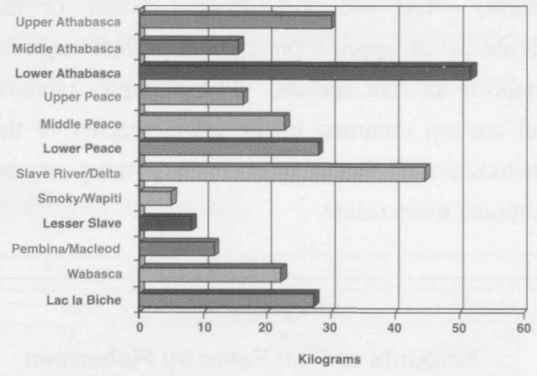
5.1.1 Fishing

About 54 percent of basin households participate in fishing. They take an average of 10.8 trips per year and fishing trips last about 2.0 days per trip.

On average, fishermen catch 23.3 kilograms of fish per year. Figure 53 shows that average catch varies considerably within the basin, with the lowest catch rates being reported in the Smoky/Wapiti region.

Figure 53

Average Fish Catch, by Region



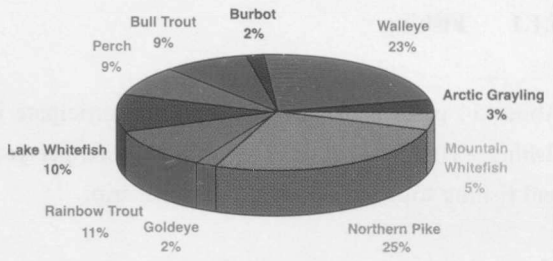
Source: Household Survey

The composition of the sport fish harvest is shown in Figure 54. The two major recreational fish species in most parts of the basin are walleye and northern pike. Each of these species accounts for about 25 percent of the total catch. Eleven percent of the sport fish caught in the basin are rainbow trout, but this species accounts for a much higher portion of the catch for fishermen in the Upper Athabasca, Smoky and

Wapiti river basins. Other important fish species are lake whitefish, perch and bull trout. Four other species each account for less than five percent of the total catch. These include mountain whitefish, goldeye, Arctic grayling, and burbot.

Figure 54

Composition of Sport Fish Harvest

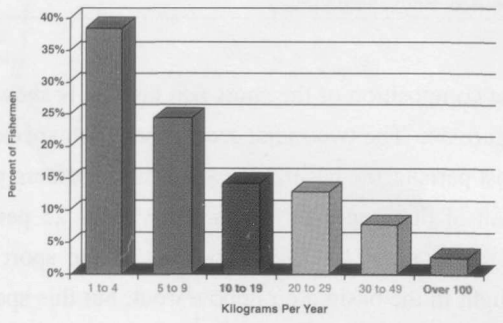


Source: Household Survey

This catch information is quite similar to fish harvests reported by traditional users (people who live off the land). The five species of fish used most often by traditional users include northern pike (47 percent of users), walleye (42 percent), lake whitefish (41 percent), goldeye (35 percent) and lake trout (29 percent) (Flett and Bill, 1995). Some of the differences in species preferences reflect regional variability in fish species. For example, rainbow trout are not common in the lower reaches of the Athabasca and Peace rivers where most of the traditional users reside.

Figure 55

Amounts of Fish Eaten by Fishermen



Source: Household Survey

Just over one-third of fishermen (36 percent) eat part of their catch. Average consumption is 13.6 kilograms of fish per year, although this varies considerably. Figure 55 shows that nearly two-thirds of these fishermen eat less than 10 kilograms while three percent consume more than 100 kilograms of fish per year.

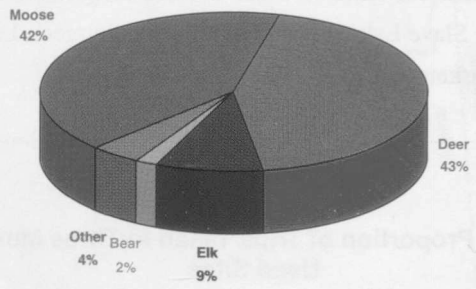
5.1.2 Hunting

Just over 30 percent of households in the NRBS area participate in hunting. They take an average of 10.3 hunting trips per year. These trips last an average of 3.5 days per trip. Hunters kill an average of one big game animal per year, although this ranges from 0.6 to 1.6 animals per year in various parts of the basin.

Deer and moose are the two most-frequently killed big game species. Each of these species accounts for over 40 percent of the total big game harvest (Figure 56). Elk is an important game species in certain parts of the basin, but represents less than 10 percent of the overall harvest.

Figure 56

Composition of Big Game Harvest



Source: Household Survey

Ninety percent of wild game meat is eaten. About nine percent is given away and one percent is fed to animals. Average consumption is about 1.6 kilograms per person per week.

Northern residents who live off the land or used to live off the land consider moose to be the most important animal species. Sixty-three percent of traditional users kill moose for food. Black bear and caribou are also big game species important to traditional users. The traditional patterns of wildlife use differ from those of recreational hunters. This difference is partly due to the mix of big game species available in the lower reaches of the Peace and Athabasca rivers.

5.1.3 Drinking Water

About 22 percent of households consume river or lake water while on recreational trips. This proportion ranges from 14 percent of recreational users in the Pembina/Macleod region to 47 percent in the Slave River/Delta region.

Over half of the users treat the water in some way before drinking it. The usual type of treatment is to boil the water (93 percent of cases). According to Health and Welfare Canada and Environment Canada (1991), "heat is the oldest and most effective method of purifying water." Boiling kills microorganisms and can also remove chlorine and volatile organic compounds (Armstrong et al, 1995). Other treatments used by recreational users include filtration or the addition of iodine or bleach. People living in the lower reaches of the Athabasca and Peace basins are more likely to treat their drinking water than people living in the upstream reaches.

5.1.4 Observed Changes in River Mainstems

Just over 41 percent of households that participate in recreation have seen some sort of change in the water, fish, animals or plants along the mainstems of the Athabasca, Peace and Slave rivers during the last 10 years. Such changes are reported by a greater percentage of households in the Middle Peace and Lesser Slave regions than elsewhere in the basin.

Of these households, 65 percent have seen changes in water quality or quantity. The changes are reported most frequently by households in the Lower Peace and Wabasca regions. As shown in Figure 57, the most common observation (37 percent) is that river water is dirtier now. Another 13 percent, especially from areas bordering the mainstems of the Peace and

Table 5

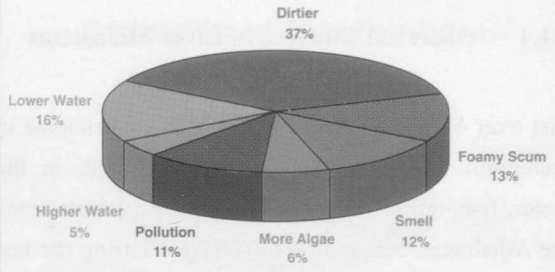
Observed Changes in Water, Fish, Animals or Plants Along River Mainstems in Past 10 Years
(Percent of Households That Participate in Recreation)

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%

Athabasca rivers, report seeing a foamy scum on the rivers.

Figure 57

Observed Changes in Water Along River Mainstems by Recreational Users
(Percent of Responses)



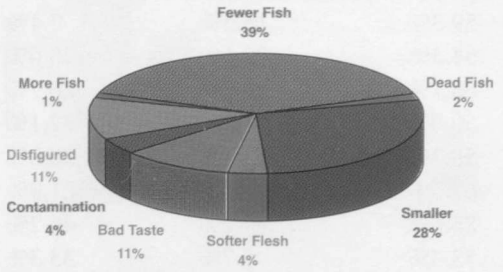
Source: Household Survey

Other comments are that the rivers now smell worse, have more algae and vegetation, and are more polluted than they were. About 16 percent of comments made by recreational users are that water levels are lower now. However, five percent feel that water levels have increased during the past 10 years.

About 57 percent of households have concerns about changes in fish populations. These concerns are most prevalent among households in the Wabasca and Middle and Upper Athabasca regions.

Figure 58

Observed Changes in Fish Along River Mainstems by Recreational Users
(Percent of Responses)



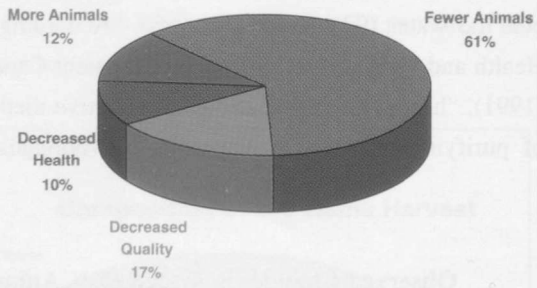
Source: Household Survey

The major concerns are that there seem to be fewer fish now (39 percent), or that fish are smaller than they used to be (28 percent) (Figure 58). Other complaints are that the fish taste bad, are contaminated, are softer, and are more frequently disfigured. A small proportion of households report that fish populations have increased.

About one-quarter (24 percent) of recreational households have seen some sort of change in wildlife along river mainstems during the last 10 years. Changes in wildlife are described most frequently by households in the Wabasca and Slave River/Delta regions. Similarly, 52 percent of hunters have also seen changes in wildlife populations.

Figure 59

Observed Changes in Wildlife Along River Mainstems by Recreational Users
(Percent of Responses)



Source: Household Survey

The most common observation (61 percent of comments) is that wildlife populations, especially deer and moose have declined (Figure 59). However, 12 percent of comments are that animal populations are increasing. Some households feel that wildlife populations are not as healthy now because there are more sick and diseased animals. Other households report that the quality of animals, in terms of their size and quality of meat, has deteriorated.

One-quarter of recreational households reporting changes in river conditions mention changes in vegetation. The main concern (31 percent of

comments) is that there are fewer trees or less vegetation along rivers. Logging is usually cited as the cause. Increased numbers of dead or diseased trees account for another 29 percent of comments related to vegetation. Another comment is that there are now more weeds than there used to be.

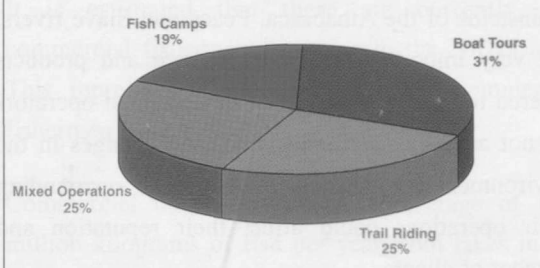
5.2 Commercial Recreation Operations

A review of available tourist information from northern Alberta and the NWT identified 51 companies that offer commercial recreation services and facilities in the NRBS area. Sixteen of these companies responded to the survey, yielding a response rate of 31 percent.

Analysis of survey responses indicated that there are four types of commercial recreation operations. They include fish camps, companies that offer river tours and boat trips, companies that conduct trail rides, and mixed operations that offer accommodation as well as a variety of summer and winter recreational activities. Survey responses were fairly evenly split among these four types of operations (Figure 60).

Figure 60

Types of Commercial Recreation Operations

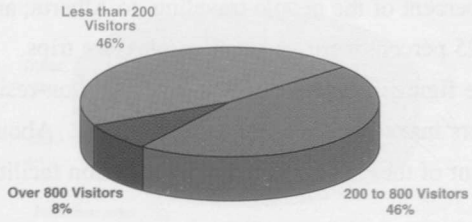


Source: Survey of Commercial Recreation Operations

The majority of the businesses (87 percent) are quite small, with fewer than 10 employees during the peak season of their operations. Only one operation has more than 20 employees. Slightly more than half of the commercial recreation companies (56 percent) have been operating for more than 10 years. However, 12 percent of companies were in their first year of operation at the time of the survey.

Figure 61

Size of Commercial Recreation Operations

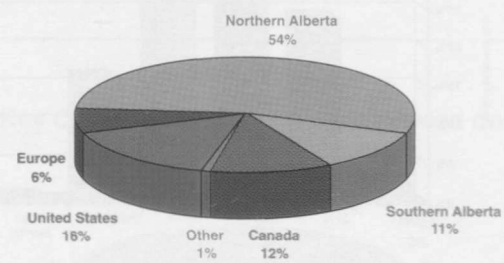


Source: Survey of Commercial Recreation Operations

Nearly half of the commercial recreation operations (46 percent) have less than 200 clients per year, and a similar percentage have between 200 and 800 clients (Figure 61). Assuming that the sample is representative of all commercial recreation operations in the basin, it is estimated that about 50,000 people use these types of facilities each year.

Figure 62

Origin of Clients Using Commercial Recreation Operations



Source: Survey of Commercial Recreation Operations

Commercial recreation operations in the basin attract clients from throughout the world. The majority (55 percent) are residents of the NRBS area. Figure 62 shows that another 11 percent come from the rest of Alberta. The other 33 percent are tourists from outside the province.

These facilities draw a considerable percentage of visitors to the NRBS areas. According to recent Alberta tourism statistics (AEDT, 1990):

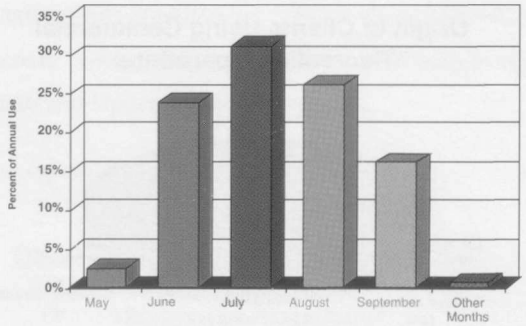
- 444,700 people from outside the province visited one of the five Alberta tourism zones (Lakeland, Evergreen, Mighty Peace, Game Country, Midnight Sun) in 1990;
- these zones were the main destination for 55 percent of the people traveling to Alberta; and
- 25 percent were on vacation/pleasure trips.

These figures suggest that about 61,000 non-resident visitors make pleasure visits to the region. About 27 percent of these use commercial recreation facilities.

July is the peak month for commercial recreation companies, with 31 percent of visitors using the facilities (Figure 63). August and June are also important, with 26 and 24 percent of customers, respectively. Only some of the mixed operations stay open during the winter months, so that very little use occurs between October and May.

Figure 63

Seasonal Use of Commercial Recreation Operations



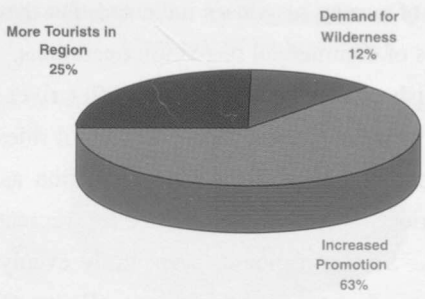
Source: Survey of Commercial Recreation Operations

The mainstems of the Peace and Athabasca rivers are important sites for the tour boat companies. The Clearwater River is also heavily used for boating. Fish camps are located on various lakes in the basin and most activity occurs near these lakes. Trail riding occurs throughout the basin, but key areas include Willmore Wilderness Park, the Kakwa River and Jasper National Park. Mixed operations offer various recreational activities at their sites in the Upper Athabasca region, the Peace River valley, and in the Slave River basin.

More than 83 percent of operations report an increase in business during the past 10 years. These increases are due to business promotion efforts (63 percent), increasing numbers of tourists in the region (25 percent) and growing demands for wilderness-based recreation (12 percent) (Figure 64). Most operators expect that business will continue to increase over the next 10 years.

Figure 64

Reasons for Increased Business in Last 10 Years



Source: Survey of Commercial Recreation Operations

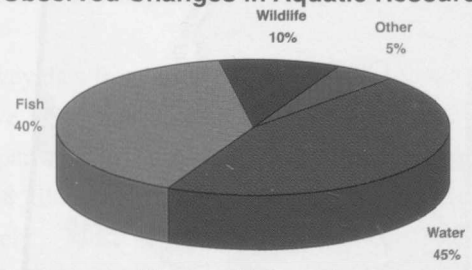
Nearly all of the commercial recreation operators (94 percent) believe that water resources, including the mainstems of the Athabasca, Peace and Slave rivers, are very important to the experience and products offered to their clients. Even though most operators do not actually use these rivers, any changes in the environmental conditions in the areas surrounding their operations could affect their reputation and number of clients.

Over 70 percent of operators report that they or their clients have observed changes in the aquatic resources of the basins over the past 10 years. About 45 percent of the comments relate to changes in

water conditions, while 40 percent relate to fish and 10 percent to wildlife (Figure 65).

Figure 65

Observed Changes in Aquatic Resources



Source: Survey of Commercial Recreation Operations

Their key observation is lower river levels. This is a major concern of tour boat operators on the Peace River. Others complain that river water is dirtier than it used to be and that it can no longer be consumed.

In terms of fish, the greatest concern is that, because of contamination, fish can no longer be eaten or eaten in the same amounts. Some operators report seeing more dead fish, more deformed fish, fewer fish, or no fish at all.

Comments related to wildlife are that there seem to be fewer species of wildlife now and that wildlife seem to be leaving their traditional areas.

5.3 Commercial Fishing

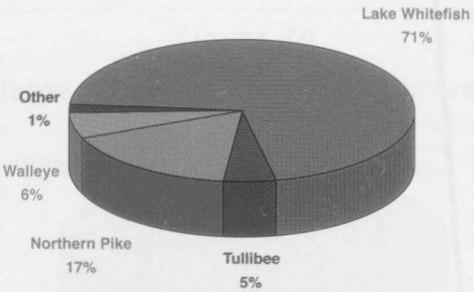
It is estimated that there are currently 400 commercial fishermen operating in the NRBS area. This represents a reduction of 200 commercial fishermen since 1990/91.

Commercial fishermen caught an average of 1.37 million kilograms of fish per year from lakes in the NRBS area over the past five years. This represents about two-thirds of the total Alberta commercial fish harvest.

As shown in Figure 66, lake whitefish account for 70 percent of the commercial harvest, while northern pike account for 17 percent. Much of the remainder of the catch consists of walleye and tullibee. Other commercial species include burbot, perch, suckers and trout.

Figure 66

Composition of Commercial Fish Harvest

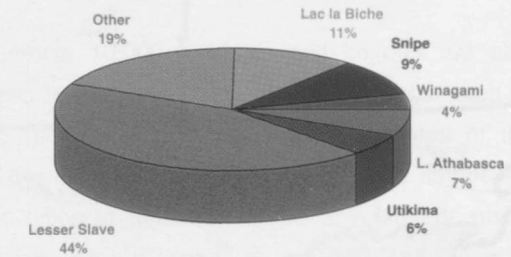


Source: Alberta Commercial Fishing Statistics

More than 25 lakes in the NRBS area are used for commercial fishing. The most important lakes include Lesser Slave Lake, Lac la Biche, Snipe Lake, Lake Athabasca, Utikuma Lake, and Winagami Lake. These six lakes account for 81 percent of the total harvest in the NRBS area. Commercial fishing also occurs on Sturgeon Lake, Peerless Lake, North Wabasca Lake and Lake Nipisi. The relative importance of key commercial fishing lakes is shown in Figure 67. No commercial fishing occurs in the mainstems of the Peace, Athabasca or Slave rivers.

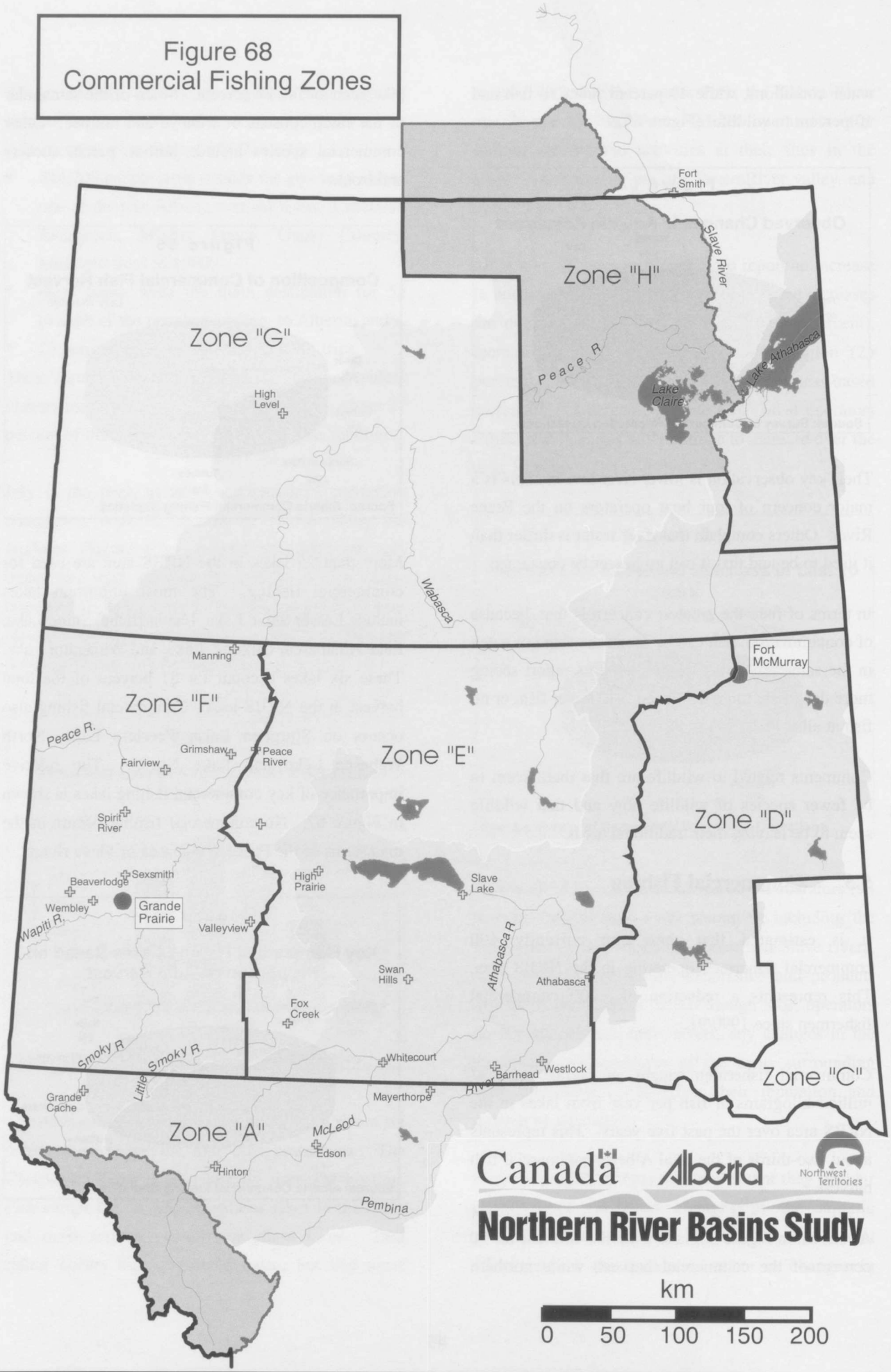
Figure 67

Key Commercial Fishing Lakes Based on Proportion of Total Harvest



Source: Alberta Commercial Fishing Statistics

Figure 68
Commercial Fishing Zones

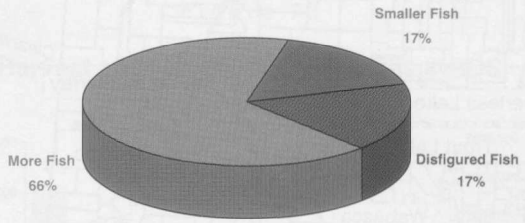


Surveys were completed by commercial fishermen in only two of the commercial fishing zones in the region: Zone E and Zone F. A map of these zones is provided in Figure 68. However, these two zones account for the majority of the commercial fish harvest in the northern river basin.

Survey data from a sample of fishermen in the Lesser Slave Lake area (Zone E) indicates that all of them eat part of their catch. Average consumption amounts to 48 kilograms of fish per year, although this varies widely. Most fishermen also consume lake water while fishing, but only a few (22 percent) treat this water first, usually by boiling.

Figure 69

Observed Changes in Fish Populations, by Commercial Fishermen in the Lesser Slave Lake Area



Source: Survey of Commercial Fishermen

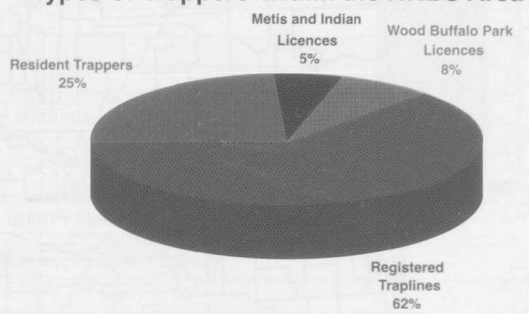
Two-thirds of commercial fishermen surveyed report that fish populations have changed during the past 10 years. As shown in Figure 69, the majority of the respondents feel that fish populations in the Lesser Slave Lake area have increased (67 percent). They also believe that fish are smaller than they used to be (17 percent of comments) and more frequently disfigured (17 percent).

5.4 Trapping

Trapping statistics for Alberta suggest that there were about 3,470 trappers in the NRBS area in 1994/95. The majority of them (62 percent) are trappers with registered traplines. The remainder include trappers on private lands, licenced Métis and Indian trappers, as well as people licenced to trap within Wood Buffalo National Park (Figure 70). Survey data also indicate that there are about 10 active trappers in the Fort Smith area of the Northwest Territories. A map of traplines and trapping areas in the NRBS area is provided in Figure 71.

Figure 70

Types of Trappers Within the NRBS Area



Source: Alberta Trapping Statistics

Only about 2,400 trappers are estimated to be active, as not all registered traplines are used each year. This estimate is very similar to the results of the household survey which shows that 3.0 percent of households (about 2,680) participate in trapping.

Beaver is the key species for trappers. Trappers in the NRBS area are estimated to have harvested 25,600 beaver in 1993/94. This represents about 47 percent of all the animals trapped in the region and accounts for nearly 74 percent of all the beaver trapped in Alberta.

More than 10,000 muskrats and coyotes are also trapped in the region. Figure 72 shows that each of these species accounts for about 20 percent of the total fur harvest in the NRBS area. The number of other types of animals trapped is relatively small. However, the NRBS area accounts for more than 80 percent of the provincial harvests of weasel, fisher and otter.

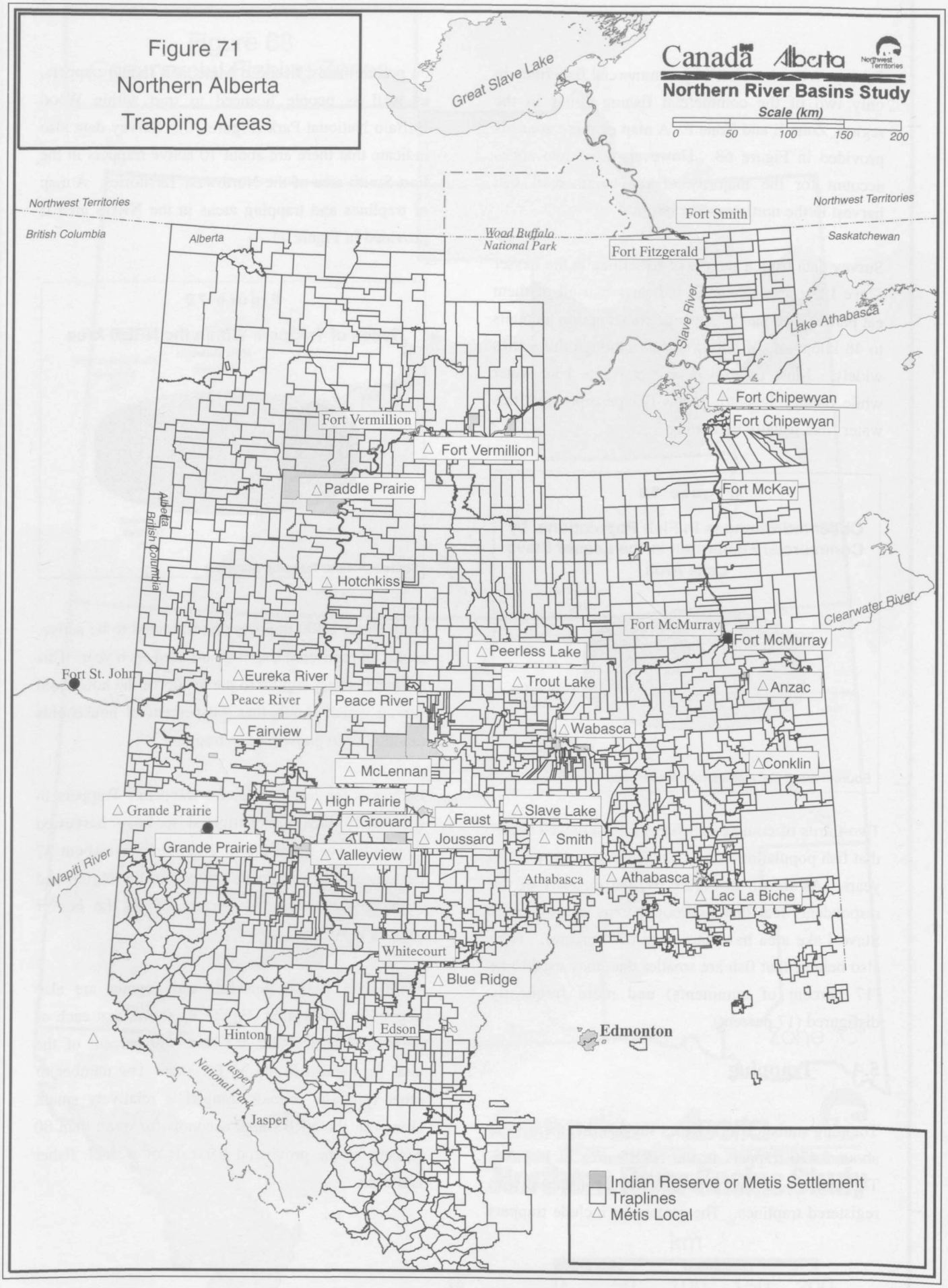
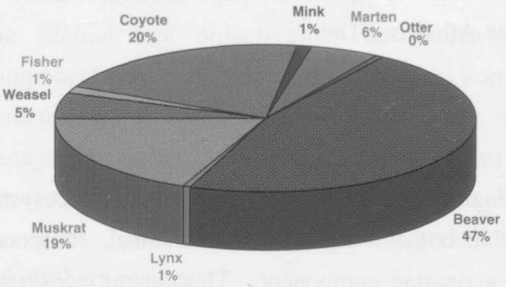


Figure 71
Northern Alberta
Trapping Areas
Canada
Alberta
Northwest Territories
Northern River Basins Study
Scale (km)
0
50
100
150
200
Great Slave Lake
Northwest Territories
British Columbia
Alberta
Wood Buffalo National Park
Fort Smith
Fort Fitzgerald
Northwest Territories
Saskatchewan
Slave River
Lake Athabasca
△ Fort Chipewyan
Fort Chipewyan
Fort Vermillion
△ Fort Vermillion
△ Paddle Prairie
Fort McKay
Alberta
British Columbia
△ Hotchkiss
Clearwater River
Fort McMurray
Fort McMurray
△ Peerless Lake
Fort St. John
△ Eureka River
△ Trout Lake
△ Anzac
△ Peace River
Peace River
△ Fairview
△ Wabasca
△ Conklin
△ McLennan
△ High Prairie
△ Grande Prairie
△ Grouard
△ Faust
△ Slave Lake
Grande Prairie
△ Joussard
△ Smith
△ Valleyview
Wapiti River
Athabasca
△ Athabasca
△ Lac La Biche
Whitecourt
△ Blue Ridge
Edson
Hinton
Edmonton
Jasper National Park
Jasper
Indian Reserve or Metis Settlement
Traplines
△ Métis Local

Figure 72

Estimated Fur Harvest

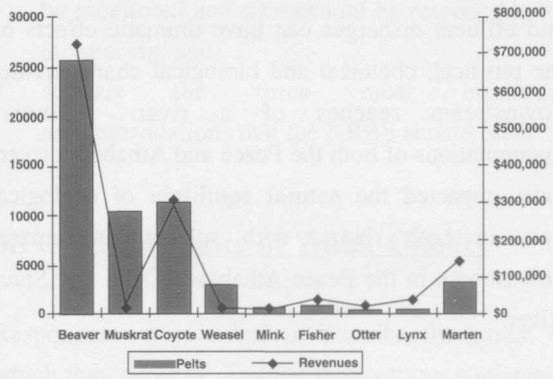


Source: Alberta Fur Harvest Statistics

The total value of the fur harvested from the NRBS area in 1993/94 was $1.3 million. Figure 73 shows the value of the harvest by species. Thus, trapping represents a major source of revenue for the NRBS area, especially for residents of the lower Peace and Athabasca basins.

Figure 73

Harvest and Revenues by Species, NRBS Area

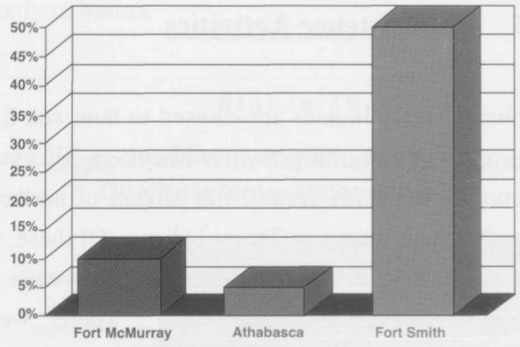


Source: Alberta Fur Harvest Statistics

Data from the household survey suggest that 24 percent of trappers have their traplines within 10 kilometres of the mainstems of the Athabasca, Peace or Slave rivers. In general, few animals are trapped at locations along the mainstems. In the Fort McMurray area, about 10 percent of animals are trapped along the Athabasca River (Figure 74). Trappers in the Athabasca area also report that only about five percent of the harvest is taken from locations along the river. However, in the Peace-Athabasca Delta, where there are numerous river channels, 50 percent of the fur harvest comes from river mainstems.

Figure 74

Proportion of Harvest Taken From River Mainstems in Key Parts of the Basin

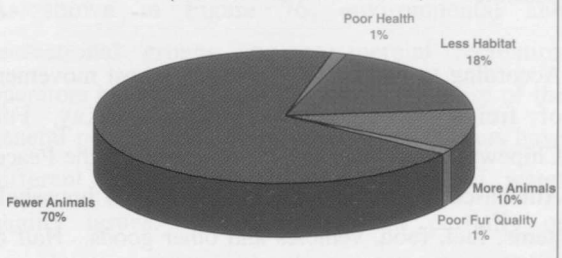


Source: Trappers Survey

Few trappers consume parts of the animals they trap. The key species for consumption are beaver, muskrat and lynx. Nearly one quarter (24 percent) of trappers in the NRBS areas consume water from rivers and lakes while they trap. Of these, 62 percent treat the water first. Boiling is the usual method of treatment.

Figure 75

Observed Changes in Furbearers
(Percent of Comments)



Source: Trappers Survey

Less than half of the trappers (40 percent) have observed changes in furbearer populations during the past 10 years. Of the comments received, the most frequent suggestion (70 percent) is that furbearer populations have dropped (Figure 75). However,

some trappers feel that this is just part of normal variability. Another 10 percent of the comments are that animal populations have increased. Few trappers feel that the health or fur quality of trapped animals has declined. However, there are some concerns about losses of furbearer habitat.

5.5 Subsistence Activities

Status or Treaty Indians are allowed to hunt and fish for subsistence purposes without a licence. According to survey results, 0.6 percent of northern households are Status or Treaty Indians. Of these, 45 percent participate in subsistence activities such as fishing, hunting and trapping. There were insufficient survey responses to provide a detailed description of subsistence activities in the NRBS area.

5.6 River Transportation

The mainstem of the Athabasca River is still used as a transportation route for hauling goods in the NRBS area. Although three river transportation companies were contacted during the survey, only one completed response was received. Therefore, a statistically valid assessment of river transportation is not possible.

According to limited survey results, most movement of freight occurs between Fort McKay, Fort Chipewyan and other small settlements in the Peace-Athabasca Delta. This freight consists of household items, fuel, food, vehicles and other goods. Half of this freight is moved in September just prior to freeze-up.

The amount of freight moved by boat has declined in recent years. Freight volumes are related to the amount of new construction that occurs in Fort Chipewyan and surrounding settlements. These volumes are not expected to increase in the future unless there is significant population growth in the Peace-Athabasca Delta.

5.7 Ecological (Instream) Uses

Ecological uses of water in a riverine ecosystem involve both an aquatic, or in-channel, component and a riparian component. The aquatic ecosystem, which includes fish and other aquatic life, is dependent upon not only minimum stream flows and various temporal stream flow characteristics, but also upon natural levels of water quality. The riparian ecosystem, which includes vegetation communities and wildlife on river floodplains, is also dependent upon certain streamflow characteristics, such as floods and ice regimes.

Human uses of water may directly affect the quantity and quality of water available for ecological uses. Dams and reservoirs, diversions for consumptive uses and effluent disharges can have dramatic effects on the physical, chemical and biological characteristics downstream reaches of a river. Human manipulations of both the Peace and Athabasca rivers have impacted the natural equilibria of ecological uses in both rivers, with subsequent impacts downstream in the Peace-Athabasca Delta and Slave River.

Due primarily to time and resource constraints, the bulk of the NRBS work on ecological uses of water has been concentrated on the Peace River. This work has been a collaborative effort with Hydrology Component of the study. A detailed summary of the key findings of the work on ecological uses of water is provided in NRBS Synthesis Report No.1, General Hydrology and Effects of Flow Regulation on the Peace, Athabasca and Slave Rivers.

6.0 STAKEHOLDER ISSUES AND CONCERNS

The second key objective of the Other Uses Component was to gather information about northern residents and their attitudes and opinions on water management issues in the study area. Thus the surveys included a series of questions that explored the values, needs and expectations of stakeholders and northern residents.

Five sets of questions were used. Respondents were asked to:

- describe the range and significance of water quality issues in the northern basins;
- identify the three factors that had most affected the basins in the last twenty years;
- rank the significance of various factors affecting water quality/quantity in the basins and also rank the effectiveness of selected management actions dealing with these factors;
- identify how the health of northern river should be monitored and who should be responsible for monitoring; and,
- suggest the three most important recommendations that the NRBS should make.

6.1 Importance of Water Quality

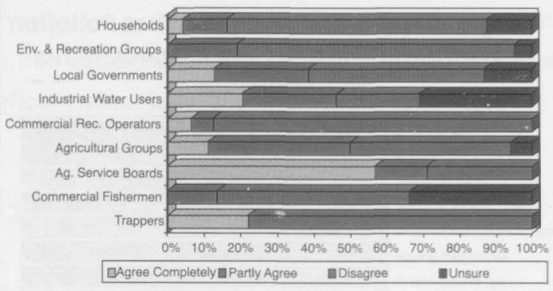
Respondents were asked to describe the extent to which they agree or disagree with various statements about the range and severity of water quality problems in the northern basins.

6.1.1 Statement: Water Quality is Not a Major Issue

The majority of households (72 percent) disagree with the statement that "water quality in the Peace, Athabasca and Slave rivers is not really an issue at the moment so new restrictions on industrial, agricultural or municipal water use are not required". Only 16 percent agree, in whole or in part, with this statement. This suggests that the public clearly believes there is a water quality problem in the northern basins.

Figure 76

Agreement With Statement That Water Quality is Not a Major Issue



Source: Household and Stakeholder Surveys

From a regional perspective, a higher than average proportion of households in the Lower Athabasca and Slave River/Delta regions disagree with the statement that water quality is not an issue.

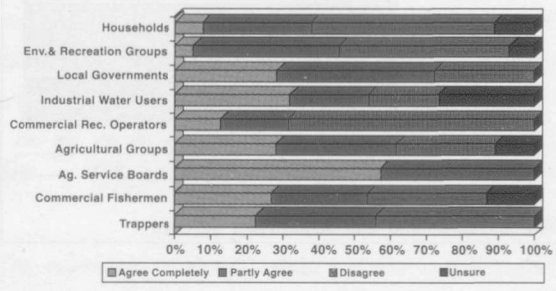
As shown in Figure 76, environmental and recreational groups and commercial recreation operators have views that are similar to those of the general public. However, industrial water users have different beliefs about the importance of water quality issues. Over 46 percent partially or completely agree with the statement. Other stakeholder groups that show high levels of agreement with the statement that water quality is not an issue include municipal and local governments, agricultural service boards and other agricultural groups.

6.1.2 Statement: Water Quality Issues Are Limited to a Few Locations

About 38 percent of northern households 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 Figure 77, 51 percent of households disagree with this statement. This view is consistent throughout the basin.

Figure 77

Agreement With Statement That Pollution of Northern Rivers Is Only a Concern in a Few Locations



Source: Household and Stakeholder Surveys

The majority of environmental and recreational groups and commercial recreation operators also disagree with this statement. However, over 70 percent of the agricultural service boards and local governments agree that pollution of northern rivers is only a concern in a few locations. This shows an important difference in views between the general public and some stakeholder groups, such as local government officials.

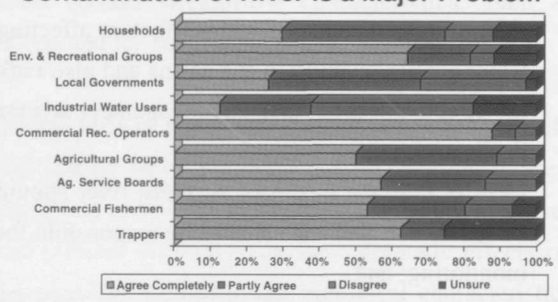
6.1.3 Statement: Water Contamination is a Major Problem

Nearly 75 percent of households throughout the basin agree, in whole or in part, with the 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". Thus, contamination of water quality appears to be an important and pervasive concern for basin residents.

The public concern for water contamination is shared by most stakeholder groups (Figure 78). However, 45 percent of industrial water users disagree with the notion that the water contamination issue was serious enough to warrant closure of some operations.

Figure 78

Agreement With Statement That Contamination of River is a Major Problem



Source: Household and Stakeholder Surveys

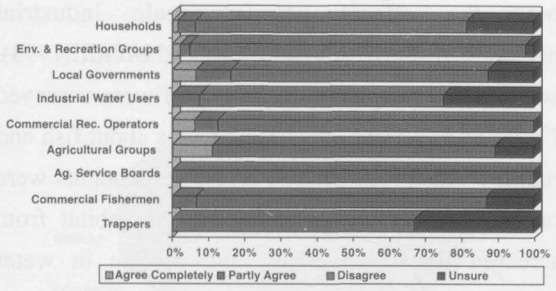
6.1.4 Statement: Current Water Management Regulations Interfere With Economic Development

Survey participants were also asked to respond to the statement: "Existing water management regulations are interfering with economic development in the region and should be reduced or eliminated".

With the exception of one part of the basin (the Wabasca region), less than 10 percent of households believe that regulations are interfering with economic development. As shown in Figure 79, this perception is shared by the majority of respondents from each stakeholder group, including industrial water users.

Figure 79

Agreement With Statement That Existing Water Management Regulations Interfere With Economic Development



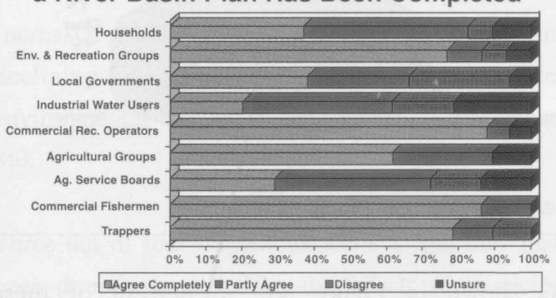
Source: Household and Stakeholder Surveys

6.1.5 Statement: No Further Effluent Discharges Should be Allowed Until a River Basin Plan Has Been Completed

More than 80 percent of most stakeholder groups, including households, agree in whole or in part, with the statement: "New effluent discharges should not be allowed until a river basin plan has been completed." Household agreement with this statement was consistent throughout the basin.

FIGURE 80

Agreement With Statement That No New Effluent Discharges Should Be Allowed Until a River Basin Plan Has Been Completed



Source: Household and Stakeholder Surveys

However, there is less support for a river basin plan among industrial water users, local governments and agricultural service boards (Figure 80). At least 14 percent of each group disagree with the idea of limiting effluent discharges until a river basin plan has been completed.

6.2 Key Factors Affecting Water Quality and Quantity

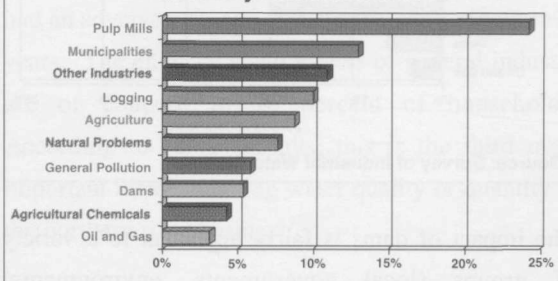
In both the household and stakeholder surveys, respondents were asked to identify the three factors that have had the greatest effect on the amount or quality of water in the Peace, Athabasca and Slave river basins over the last 20 years. Survey responses to this questions are grouped into 14 categories that reflect various industrial or water use classifications.

6.2.1 General Results

Basin households and most stakeholder groups identify pulp mills as the key factor affecting water quality and quantity in the basins over the past 20 years (Figure 81). Local governments are an exception in that they perceive agricultural practices as the key factor affecting water quality and quantity (Figure 82). The factors of most importance to industry are summarized in Figure 83. All stakeholder groups see logging as one of the top four factors affecting water quality and quantity.

Figure 81

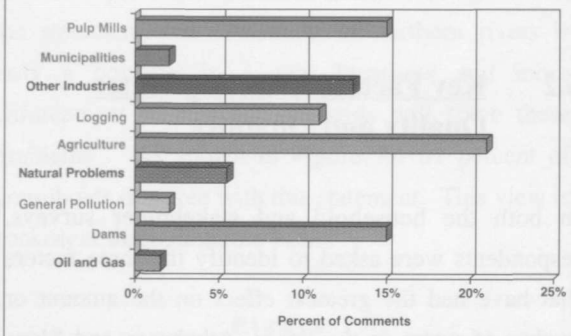
10 Key Factors Affecting Water Quality or Quantity: Households



Source: Household Survey

Figure 82

Key Factors Affecting Water Quality/Quantity: Municipal and Local Governments



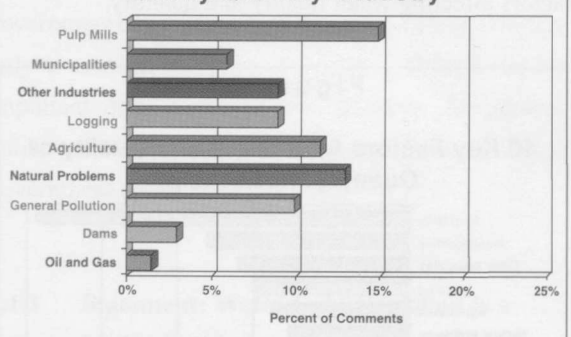
Source: Survey of Local and Municipal Governments

Households in the basins rate municipal water use and sewage as the second most important factor affecting quality and quantity. However, most of the stakeholder groups did not comment on municipal activities.

Aside from general agreement on the significant adverse effects of pulp mills and logging on water quality and quantity, there is no general consensus among stakeholder groups on the importance of other factors.

Figure 83

Key Factors Affecting Water Quality/Quantity: Industry



Source: Survey of Industrial Water Users

The impact of dams is fairly important to a variety of groups (local governments, environmental and recreational groups, commercial recreation companies and trappers), but dams are rated eighth by households.

Other recent studies have documented public concern about the effects of large-scale industrial development in Northern Alberta (NADC, 1993). Two hundred people from the region were surveyed in 1993 to determine specific concerns about fish and wildlife. About one-quarter of the respondents were concerned about the potential loss of habitat from increased forest harvesting, the decline in water quality due to pulp mill effluent, and problems associated with increased access.

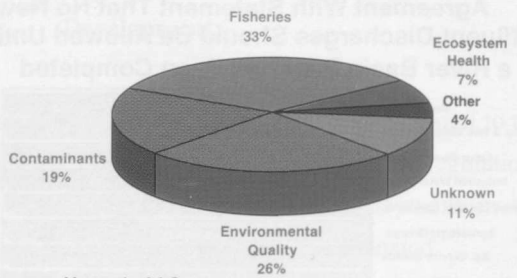
6.2.2 Pulp Mills

Nearly 39 percent of households identify pulp mills as the most important factor affecting water quality. Most stakeholder groups also believe that pulp mills are the prime factor affecting river health.

Both household and stakeholders perceive that fish contamination is one of the major effects of pulp mill effluents. Public perceptions of the environmental effects of pulp mills are shown in Figure 84.

Figure 84

Environmental Effects of Pulp Mills



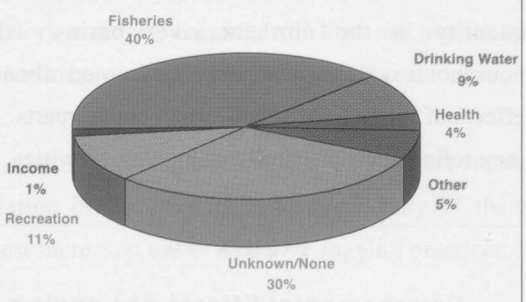
Source: Household Survey

As shown in Figure 85, 30 percent of these households are unsure of how or whether they had been directly affected by pulp mills. Forty percent of households report that their fishing activities have been adversely affected by pulp mills. Others

complain about losses of recreational opportunities and impacts on drinking water and their health.

Figure 85

Effects of Pulp Mills on Households



Source: Household Survey

There is strong support among households (83 percent) for tighter controls on discharges of pulp mill effluents. The majority of stakeholders also suggest tougher controls. Some stakeholder groups feel that no discharges of pulp mill wastes to water bodies should be allowed at all.

6.2.3 Municipal Water Use

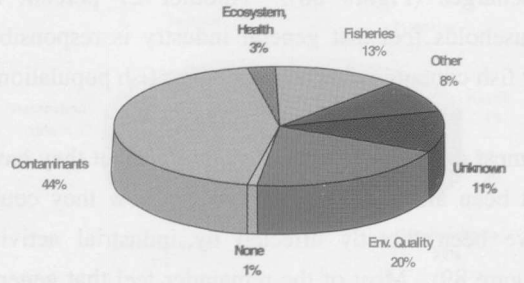
Twenty-one percent of basin households believe that municipal sewage effluent is another important factor affecting water quality in the northern basins. Urban households are more concerned about municipal effluents than rural residents.

Increased levels of contaminants in rivers and declining fish populations are seen as the key environmental effects of municipal sewage (Figure 86).

Three out of four households believe that they have been directly impacted by the effects of municipal sewage. As shown in Figure 87, these impacts include a reduction in the quality of fishing and other recreational activities, as well as negative impacts on drinking water quality.

Figure 86

Environmental Effects of Municipal Water Use

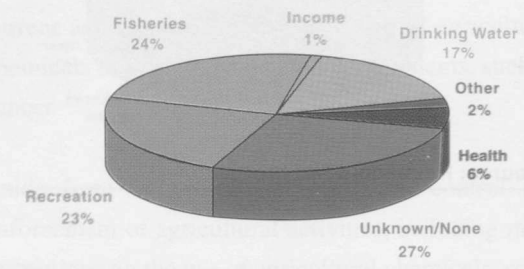


Source: Household Survey

Both households and stakeholders recommend that better regulation and control of discharges is the best approach for managing the water quality problems associated with municipal sewage effluents.

Figure 87

Effects of Municipal Water Use on Households



Source: Household Survey

6.2.4 General Industry

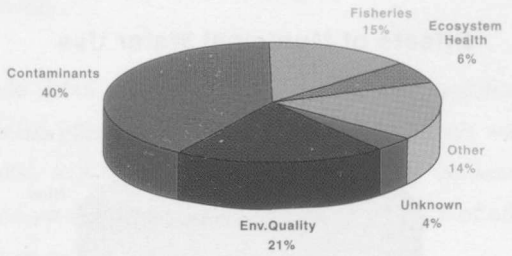
Some households believe that industry in general has had an adverse effect on water quality over the last 20 years. The environmental effects of general industry are of concern to 18 percent of households. According to survey results, this is the third most important factor affecting water quality or quantity in the northern river basins.

Of the households concerned about general industry, over 40 percent believe industry is responsible for water contamination from site runoff and effluent discharges (Figure 88). Another 27 percent of households feel that general industry is responsible for fish contamination and declining fish populations.

Almost one in three households report that they have not been affected by or are unsure how they could have been directly affected by industrial activity (Figure 89). Most of the remainder feel that general industry has adversely affected their recreational activities, especially fishing, Another 12 percent are concerned that industrial activities have affected their water supply.

Figure 88

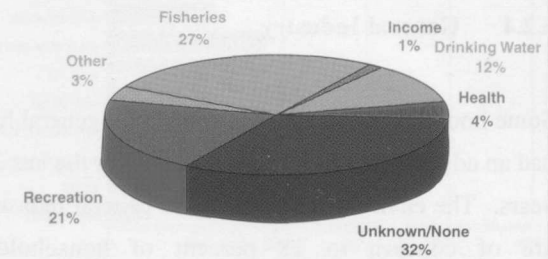
Environmental Effects of General Industry



Source: Household Survey

Figure 89

Effects of General Industry on Households



Source: Household Survey

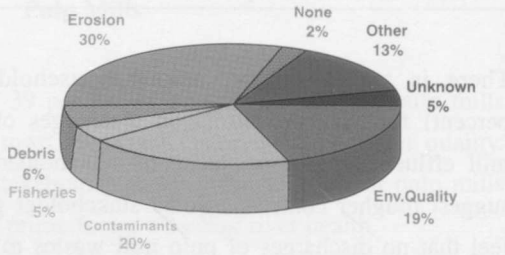
There is strong public support (84 percent of comments) for better regulation of industrial discharges in general.

6.2.5 Logging

Nearly 16 percent of respondent households believe that logging and forestry practices have adversely effected water quality. Logging ranked fourth overall on the list of key factors affecting water quality and quantity in the northern river basins. Farm households are slightly more concerned about the effects of logging than their urban counterparts. This may reflect their proximity to logging activities.

Figure 90

Environmental Effects of Logging

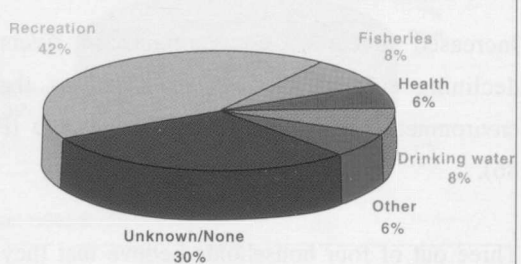


Source: Household Survey

Logging is believed to have caused a wide range of environmental problems. These include increased erosion, sedimentation, and contaminant levels (Figure 90).

Figure 91

Effects of Logging on Households



Source: Household Survey

Many households (42 percent) also report that logging has caused a significant loss of recreational opportunities (Figure 91). Another 30 percent of

households believe that they have not been directly affected by logging or are unsure about whether they have been affected.

With the exception of industrial water users, all stakeholder groups predict that without additional regulatory controls, logging will have an impact on their business operations in the next 10 years

The majority of households also support more regulation of the logging industry. Many of them suggest increased use of selective logging practices

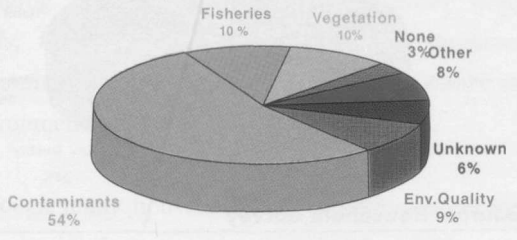
6.2.6 Agriculture

Agriculture is the fifth most-frequently mentioned factor affecting water quality in the northern river basins. Some 14 percent of households believe that agriculture has had an adverse effect on water. Another nine percent are concerned about problems resulting from farm use of fertilizers, herbicides and pesticides.

According to 54 percent of households, the key environmental effects of agriculture are contamination due to run-off from livestock operations and use of agricultural chemicals (Figure 92). Another concern is that agricultural land clearing has increased erosion.

Figure 92

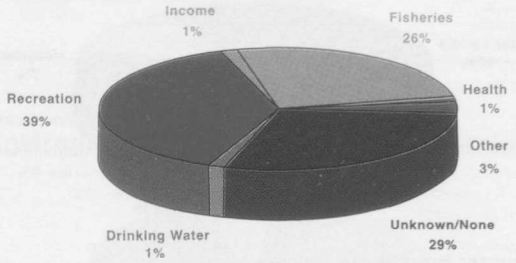
Environmental Effects of Agriculture



Source: Household Survey

Figure 93

Effects of Agriculture on Households



Source: Household Survey

Over 38 percent of households report that contaminants from agricultural activities have interfered with boating, swimming or other recreational activities, while 26 percent blame agricultural practices for contamination of fish (Figure 93).

Households are concerned that continuation of current agricultural practices and use of agricultural chemicals may cause human health problems, such as cancer.

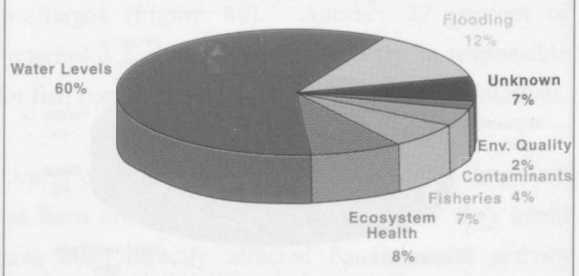
Aside from a general call for better control and enforcement of agricultural activities, including more restrictions on the use of agricultural chemicals, some of the stakeholders also suggest that wider buffer zones adjacent to water bodies be established.

6.2.7 Dams and Reservoirs

Concern about dams and reservoirs is highest among households living along the Peace and Slave rivers. At least 23 percent of households in these regions associate various problems with operations of the Bennett and Peace Canyon dams and the Williston Reservoir on the upstream reaches of the Peace River in British Columbia. However, within the entire basin, only eight percent of households feel that dams have significantly affected water quality or quantity.

Figure 94

Environmental Effects of Dams



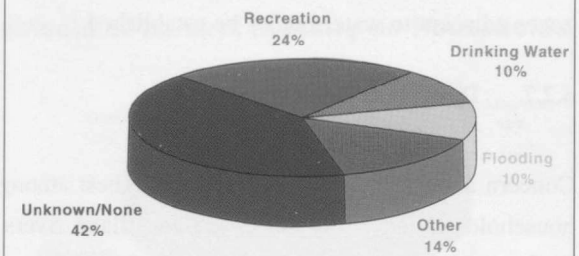
Source: Household Survey

As shown in Figure 94, the majority of these households (60 percent) believe that lower water levels in the basin are the main environmental effect of the dams. Other concerns include increased flooding and adverse impacts on ecosystem health and fish populations.

Although 41 percent of households in the basin believe that they have not been directly affected by dams, many others feel that recreational activities like boating and swimming have been impaired (Figure 95). Others report that they have experienced flooding because of the effects of dams.

Figure 95

Effects of Dams on Housholds



Source: Household Survey

Trappers, commercial recreation operators, agricultural groups and local governments are also concerned about lower river flows and loss of fish and wildlife habitat.

About 60 percent of households believe that current river regulation practices should either be stopped or modified to address environmental and other public concerns. Many households specifically want the operating plans for the Bennett Dam to be changed.

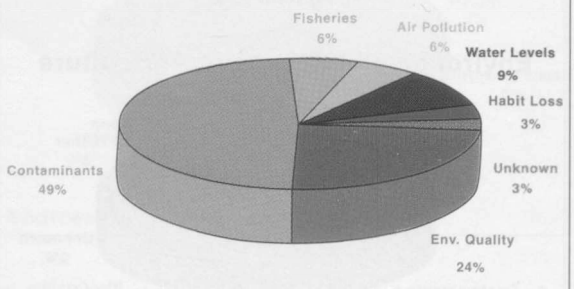
6.2.8 Oil and Gas, Oil Sands and Seismic Activities

Oil and gas, oil sands and seismic activities rank tenth, twelfth and thirteenth respectively in terms of their effects on water quality or quantity in the northern river basins. Less than five percent of basin households consider each of these activities to be a key factor affecting water quality and quantity in the basins.

About half of households concerned about oil and gas activities (49 per cent) believe that this industry is responsible for increased levels of contamination in rivers and lakes (Figure 96). Oil and gas operations and oil sands plants are both blamed for declines in fish edibility and health, while the oil and gas industry is blamed for contamination of drinking water supplies. Seismic activities are blamed for erosion and associated sedimentation problems in the basins. There is also concern about the use of potable water for oilfield injection.

Figure 96

Environmental Effects of Oil and Gas Operations

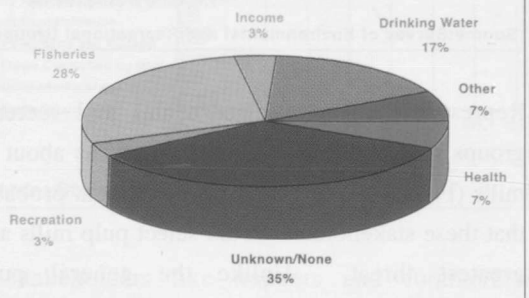


Source: Household Survey

Although many households report that they have not been directly affected by the oil and gas industry, others are concerned about impacts on drinking water and recreational fishing (Figure 97). A small portion also believe that oil and gas activities are having a direct effect on their health.

Figure 97

Effects of Oil and Gas Operations on Households



Source: Household Survey

Over 70 percent of these households believe that the environmental effects of the oil and gas industry need to be better regulated. Some also suggest that the oil and gas industry should no longer be allowed to use water for deep well injection purposes.

6.2.9 Natural Conditions

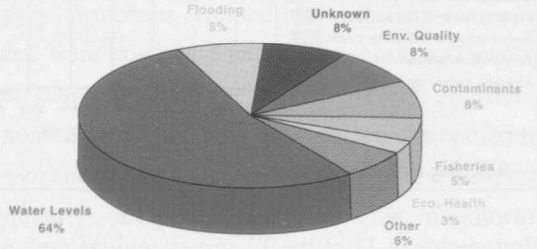
Natural conditions, including such things as low water conditions, changing weather patterns and reduced snowfall, received sufficient comments to rank sixth among the various factors.

The range of environmental effects associated with changing natural conditions include lower water levels, flooding, more debris in rivers, increased contaminants and a general reduction in environmental quality (Figure 98).

Although many households (42 percent) realize that little can be done to manage natural conditions, the remainder believe that steps could be taken to regulate activities that have exaggerated the effects of changing natural conditions. Recommended actions include reductions in water withdrawals, effluent discharges, and clear-cut logging.

Figure 98

Environmental Effects of Natural Conditions



Source: Household Survey

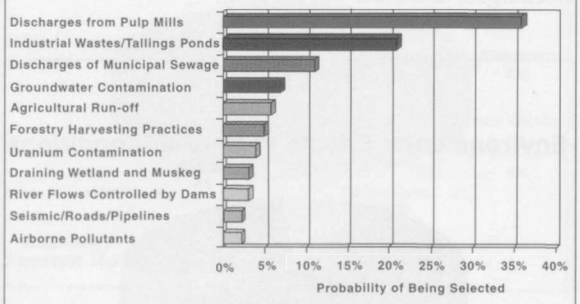
6.3 Most Important Threats to Water Quality and Quantity

While households and other stakeholders described a wide range of factors that have affected water quantity and quality in the basin, some of these factors are of greater concern than others. To determine the most significant threats to water quality and quantity, survey respondents were asked to rank 11 different types of threats using a best/worst scaling methodology (see Section 2.3). The results of this approach are presented in terms of the probability that each factor would be selected as most important threat to water quality and quantity.

According to the sample of basin households, pulp mills represent the greatest threat to water quality, with a 36 percent probability of being selected (Figure 99). Industrial wastes/tailings ponds are the second most serious threat (21 percent probability) while municipal effluents rank third (11 percent probability). All other factors are perceived to be relatively minor threats to water quality and quantity in the northern river basins.

Figure 99

Ranking of Threats to Water Quality and Quanity by Households

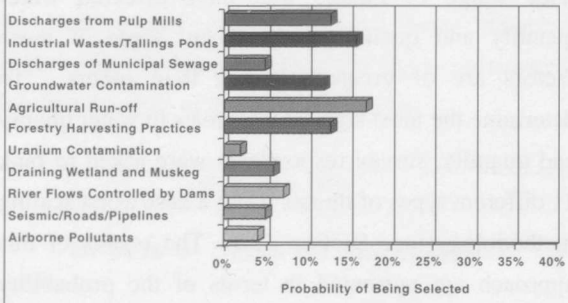


Source: Household Survey

Households in 11 of the 12 survey regions rank pulp mills as the greatest threat to water quality. In the twelfth region, pulp mills are rated second but still have a 28 percent probability of being selected.

Figure 100

Ranking of Threats by Local and Municipal Governments

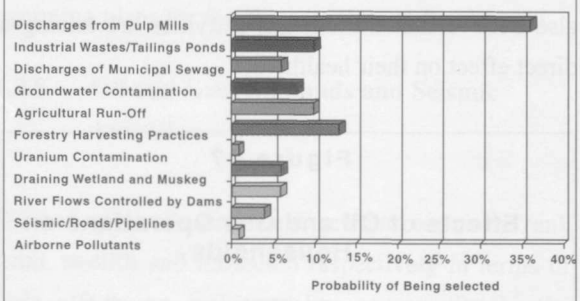


Source: Survey of Local and Municipal Governments

Stakeholder groups have a different perception of the most important threats to water quality and quantity. To municipal and local governments, pulp mills are less of a threat than are either agricultural run-off or industrial effluents/tailing ponds (Figure 100). In addition, municipal and local governments are half as likely to identify their operations (municipal effluent) as a problem than is the general public. However, local and municipal governments are more concerned about the effects of logging practices than are basin households.

Figure 101

Ranking Of Threats by Environmental and Recreational Groups

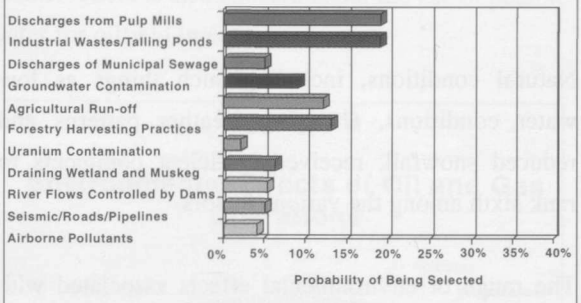


Source:Survey of Environmental and Recreational Groups

Representatives of environmental and recreation groups share the general public concerns about pulp mills (Figure 101). There is a 36 percent probability that these stakeholders would select pulp mills as the greatest threat. Unlike the general public, environmental and recreation groups are much more concerned about the effects of logging and agricultural practices and less concerned about municipal sewage.

Figure 102

Ranking of Threats by Agricultural Organizations



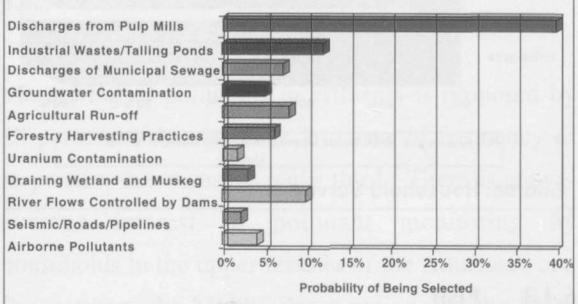
Source: Survey of Agricultural Stakeholders

For agricultural groups and agricultural service boards, pulp mills are of considerable concern, but industrial wastes/tailings ponds also received a 19 percent rating (Figure 102). These agricultural groups are much less concerned about the effects of municipal effluents than is the general public but,

surprisingly, show a higher concern about the effects of agricultural run-off.

Figure 103

Ranking of Threats by Trappers, Commercial Fishermen and Commercial Recreation Operators



Source: Stakeholders Survey

For stakeholders like trappers and commercial fishermen, whose livelihood depends on environmental quality, pulp mills represent the greatest threat to water quality/quantity. Pulp mills have more than a 40 percent chance of being selected by this group (Figure 103). This group is also more concerned about dams than is any other group, probably because dams on the Peace River are having significant effects on trapping and other resource harvesting activities on the Peace River and Peace/Athabasca Delta.

Industrial water users did not respond to this survey question in sufficient numbers to allow determination of their perceptions of the most important threats to water quality and quantity in the basins.

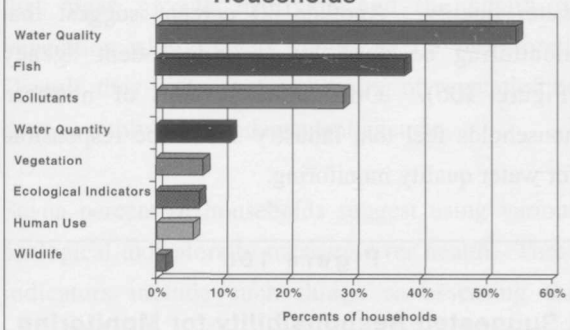
6.4 Measures of Ecosystem Health

Although other components of the NRB study are assessing the health of river from a technical perspective, households and stakeholders were asked to describe how they would measure river health.

Survey responses yielded 78 different measures which were combined into 13 categories. Three of these categories were suggested by at least 28 percent of households, while the remainder were proposed by 11 percent or less. Figure 104 summarizes the most-frequently suggested measures for monitoring ecosystem health.

Figure 104

Measures of Ecosystem Health Identified by Households



Source: Household Survey

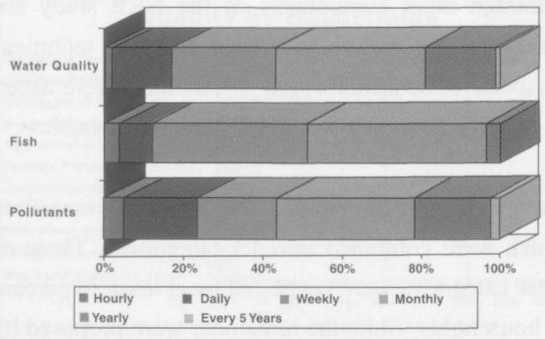
6.4.1 Water Quality

Nearly 55 percent of the households throughout the basin suggest that water quality should be used to assess the health of the basin's rivers. For seven of the eight stakeholder groups, water quality is also the most-frequently mentioned measure of river health.

Specific measures of water quality include oxygen levels, smell, taste and levels of contaminants within water bodies. In terms of frequency of monitoring, Figure 105 shows that 38 percent of households suggest monitoring of water quality on a monthly

Figure 105

Suggested Frequency of Monitoring



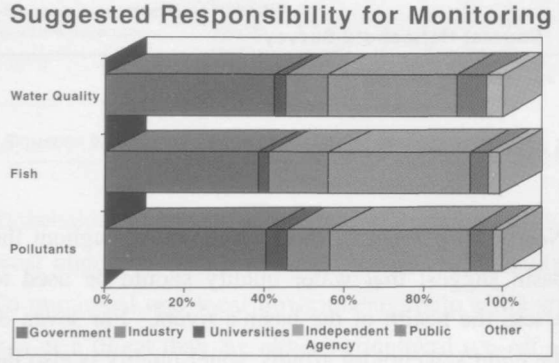
Source: Household Survey

basis while 26 percent propose weekly testing of water quality.

Forty percent of households in the basin feel that governments should be responsible for monitoring water quality. Another 30 percent suggest that monitoring be done by an independent agency (Figure 106). Only three percent of northern households feel that industry should be responsible for water quality monitoring.

Figure 106

Suggested Responsibility for Monitoring

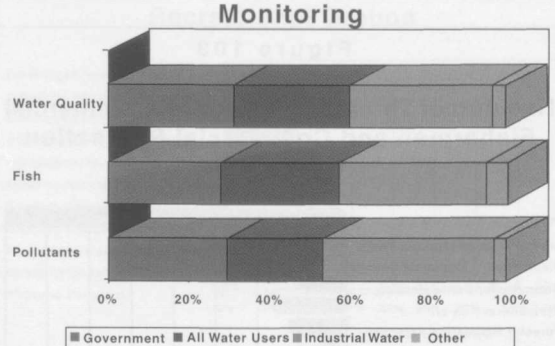


Source: Household Survey

Although basin residents do not want industry to be responsible for monitoring, 36 percent of households feel that industry should pay monitoring costs (Figure 107). In comparison, 31 percent of households believe that government should bear these costs, and 29 percent feel all water users should pay the costs of monitoring.

Figure 107

Suggested Responsibility for Paying for Monitoring



Source: Household Survey

6.4.2 Fish

The health of fish populations is the second most important indicator of river health in the basins. Monitoring of fish populations is proposed by 38 percent of households in the northern basins. The majority of these households (67 percent) are concerned about the health of fish from the perspective of human consumption. Among stakeholder groups, the highest interest in monitoring fish populations comes from trappers, agricultural service boards and commercial fishermen.

Survey data suggest that the health of fish populations could be monitored less frequently than most other indicators of river health (Figure 105). Forty percent of households suggest monthly monitoring, while 44 percent consider yearly testing to be sufficient. Stakeholders hold similar views; half recommend yearly monitoring while 22 percent propose monthly monitoring.

In terms of responsibilty for monitoring fish populations, 38 percent of households prefer that this be done by government while an almost equal portion (36 percent) propose that monitoring be done by an independent agency (Figure 106).

Households generally believe that industry should pay the costs of a fish monitoring program. In contrast, 38 percent of the stakeholder groups propose that government bear these costs, while 33 percent suggest that the costs be borne by all water users.

6.4.3 Levels of Pollutants

Monitoring of pollutants in effluents is proposed by 28 percent of households. In terms of frequency of responses, this measure ranks third. There is above-average interest in pollutant monitoring by households in the upper reaches of the Athabasca and Peace rivers, the Middle Peace region and the Slave River and delta region.

Monitoring of pollutants should be done monthly. This is recommended by 35 percent of households (Figure 105). Weekly testing of pollutant levels is proposed by 24 percent, while 19 percent of households support yearly testing. Stakeholder groups show no overall preference.

Figure 106 shows that there is no clear preference for who should be responsible for monitoring pollutants. Households show similar preferences for an independent agency (38 percent) and government (37 percent).

Again, a high proportion of households (48 percent) feel that industry should pay for the monitoring of pollutants. About 26 percent believe that government should pay these costs. Responses from stakeholders are similar, except that only one-third of them feel industry should pay monitoring costs.

6.4.4 Other Measures

According to Figure 104, households believe that five other measures of ecosystem health can be used to measure ecosystem health. These measures include water quantity, vegetation, ecological indicators, human use and wildlife.

Just over 11 percent of households believe that river health can be assessed by monitoring river flows. Water quantity or river flow monitoring is of greatest importance to households in the Slave River/Delta and Upper Peace regions. Their preference is that monitoring of flows be done on a monthly basis by government.

Seven percent of households propose using vegetation as a measure of river health. They believe that algae growth in rivers and the health of vegetation along rivers ought to be monitored. Overall, they prefer that monitoring of vegetation be done monthly by an independent agency.

Seven percent of households suggest using various ecological indicators to measure river health. These indicators include such things as assessing the biological status of the river ecosystem, changes in the food chain, biodiversity and the reproductive rates of forests. According to survey results, ecological indicators should be monitored monthly or annually, by either the government or an independent agency .

Another six percent of households believe that monitoring of various human activities could be used to assess river health. Possible measures include assessing recreational activity and various resource development activities, such as forestry, as well as monitoring human health and conducting periodic interviews with basin residents. Respondents feel that human activities ought to be assessed annually and should be a government responsibility.

Table 6

Summary of Household 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	Government
		Independent Agency	

Less than two percent of households believe that wildlife can be used to assess river health. They recommend that wildlife monitoring should be done annually by the government or an independent agency.

6.4.5 Discussion

The frequency of monitoring reflects a perception of the immediacy of threats. Monthly monitoring is suggested for the majority of indicators. However, Table 6 shows that, for those indicators where changes may take longer to occur, less frequent monitoring is proposed.

Households generally prefer that governments and /or an independent agency should monitor river health. There is very little support for industry being given this responsibility.

Households appear to feel that where industrial effluents are perceived to threaten river health, industries should pay monitoring costs. Where changes are due to natural variability or various public activities, governments should pay for monitoring

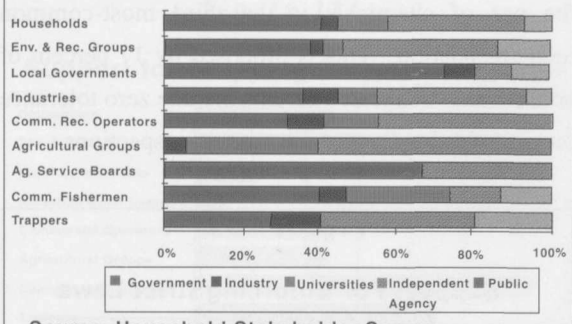
This suggests that there is an important relationship between who should be responsible for monitoring and who should pay the costs. Households that support government monitoring also tend to believe that governments should fund the monitoring system. The same applies to industry. When industries are chosen to do monitoring, they are also expected to pay monitoring costs.

In comparison, households that propose monitoring be done by an independent agency also believe that funding for such an agency should come from industry and other water users. If monitoring is to be done by universities, funding should come from government and industry.

Various stakeholders have different preferences on the issue of responsibility for monitoring river health. For example, Figure 108 shows that local and municipal governments and agricultural service boards prefer that governments do monitoring, while environmental and recreational groups prefer universities.

Figure 108

Suggested Responsibility for River Monitoring, by Stakeholders

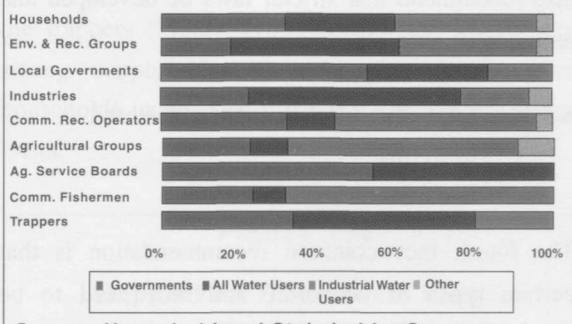


Source: Household Stakeholder Survey

In terms of costs, representatives of local and municipal governments and agricultural service boards feel that governments should pay (Figure 109). Industrial water users believe that all users should pay monitoring costs, and not just them.

Figure 109

Suggested Responsibility for Funding River Monitoring, by Stakeholders



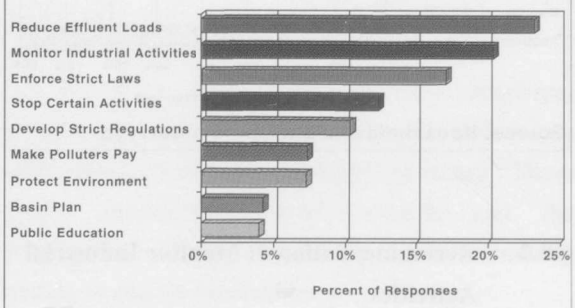
Source: Household and Stakeholder Survey

6.5 Study Recommendations

Households and stakeholders were given the opportunity to list up to three recommendations that they felt should be made by the Northern River Basins Study Board. About 60 percent of households responded. Although 45 categories of responses were identified, these were condensed into nine key recommended actions. A description of the percentage of households making these recommendations is provided in Figure 110.

Figure 110

Summary of Key Recommendations by Households



Source: Household Survey

The four most important recommendations made by households include reducing effluent loads, monitoring industrial activities, enforcing stricter laws, and stopping selected activities. The development of a river basin plan is another frequent recommendation of some stakeholder groups.

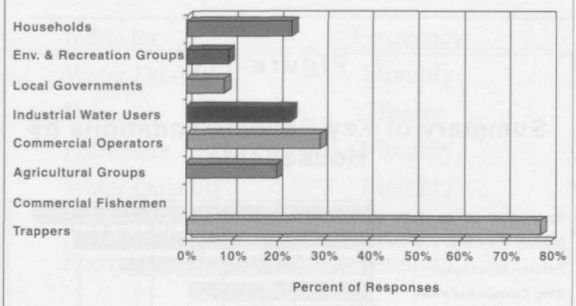
6.5.1 Recommendation 1: Reduce Effluent Loads

The most frequently-made recommendation, proposed by 23 percent of households, is that the amount of effluent and chemicals being dumped into water bodies in the northern basins needs to be decreased. The reduction of effluents and chemicals is the first priority for households in eight of the12 regions.

As shown in Figure 111, some stakeholders, such as trappers and commercial recreation operations that rely on environmental quality, also want an immediate decrease in effluents and chemicals. However, less than 10 percent of the industry and local government respondents feel that effluent loads need to be reduced.

Figure 111

Support for Reducing Effluent Loads



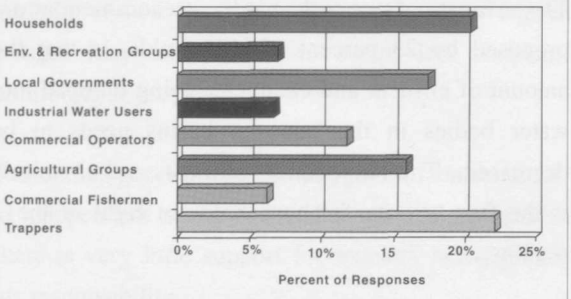
Source: Household and Stakeholder Surveys

6.5.2 Recommendation 2: Monitor Industrial Activities

Both households and the trapping community would like the NRBS Board to recommend more and/or better monitoring of industrial activities. Some households recommend that water quality and fish and wildlife populations be monitored. Other suggest increased monitoring of effluents from pulp mills and general industry.

Figure 112

Support for Monitoring Industrial Activities



Source: Household and Stakeholder Surveys

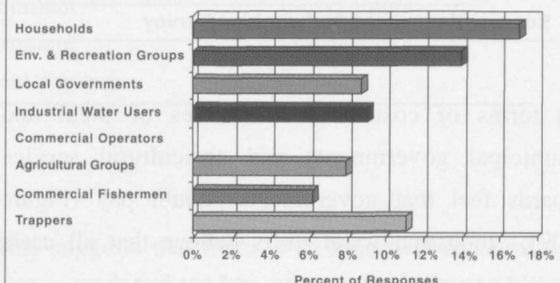
In general, stakeholders are less concerned about the need for more monitoring than are households. Only 16 percent of local government and agriculture groups propose increased monitoring of water quality in the basin (Figure 112).

6.5.3 Recommendation 3: Enforce Strict Laws

Increased enforcement of strict laws on pollution and the use of chemicals is the third most-common recommendation. This is proposed by 17 percent of households. Suggested actions include zero tolerance on second infractions and increased inspections.

Figure 113

Support For EnforcingStrict Laws



Source: Household and Stakeholder Surveys

A large portion of representatives from environmental and recreation groups and trappers also recommend that stricter laws be developed and enforced (Figure 113).

6.5.4 Recommendation 4: Stop Selected Activities

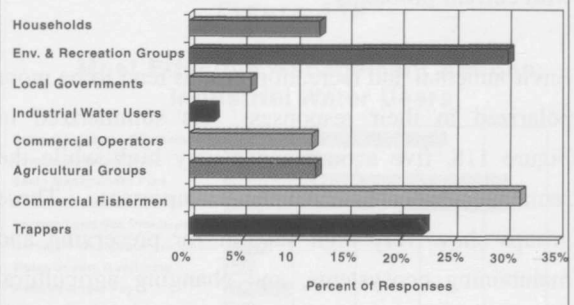
The fourth most-common recommendation is that certain types of economic activities need to be stopped. Specific suggestions include a ban on clear-cut logging, zero discharge of effluent from any new industry, no more dams, and the establishment of buffer zones between industrial, logging and farming activities and basin water courses. These measures would protect water quality and reduce sedimentation.

The main support for this type of action comes from environmental and recreation groups, commercial fishermen and trappers (Figure 114). Twelve percent

of households also support stopping certain types of activities.

Figure 114

Support for Stopping Selected Activities



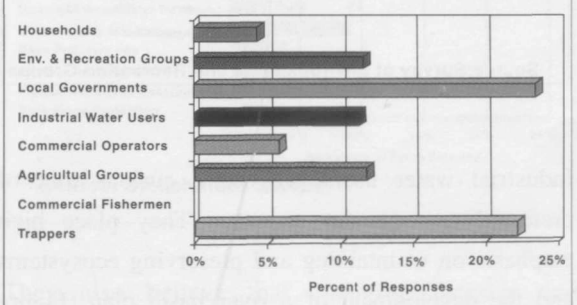
Source: Household and Stakeholder Surveys

6.5.5 Other Recommendations: River Basin Plans

Although only four percent of households asked that the NRBS Board recommend the development of a river basin plan, there is considerable support for planning from local and municipal governments and the trappers (Figure 115). Within the basin, very strong support for a basin plan comes from households in the Slave River and Peace-Athabasca Delta.

Figure 115

Support for River Basin Plan



Source: Household and Stakeholder Surveys

6.5.6 Summary

The results of the household survey suggest that basin residents want the NRBS Board to make recommendations that will act to quickly resolve current problems. The emphasis is on immediate reduction of effluent loads, more monitoring and enforcement, and stopping certain activities.

On the other hand, industries and municipal governments suggest the NRBS should take a less active approach to water management issues. These groups recommend more research and the development of basin management plans, eventually leading to stricter regulations.

Other stakeholder groups, such as environmental and recreation groups and agricultural groups, recommend actions that fall more in the middle in terms of immediacy of action. Rather than advocate an immediate reduction in effluent discharges, these groups propose developing strict regulations for existing activities and stopping expansion of selected future activities.

6.6 Most Effective Management Actions

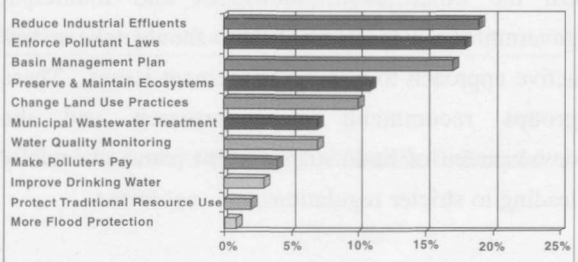
While households and stakeholders suggested a long list of management actions to correct current problems, some of these actions are preferred over others. To determine the most effective management actions, survey respondents were asked to comparatively rank a series of 11 specific management actions using a best-worst methodology. Survey results are described in terms of the probability that each management action would be selected as most effective management action.

For basin households, three specific management actions are preferred over all the others. These include reducing industrial effluent loads, enforcing

existing pollution laws, and developing a management plan for the basin (see Figure 116). These three actions have a 19, 18 and 17 percent probability of being selected as the most effective management actions.

Figure 116

Most Effective Management Actions: Households

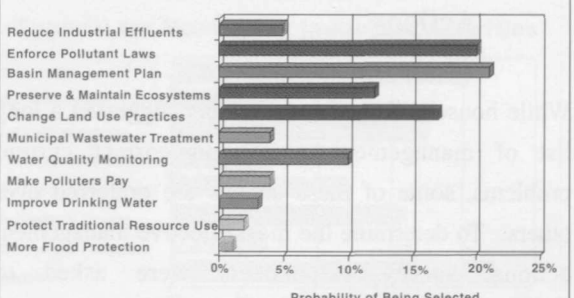


Source: Household and Stakeholder Surveys

There is some variability within the basin. However, these three actions are listed as the top three management actions in seven of the 12 regions.

Figure 117

Most Effective Management Actions: Local and Municipal Governments



Source: Stakeholder Survey

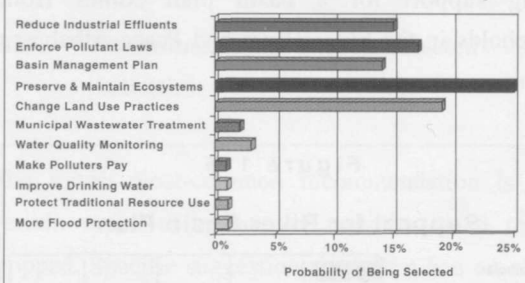
Local and municipal governments also place high importance on enforcing existing laws and developing a basin management plan. However, there is only a five percent probability that this group would choose reducing industrial effluent loads as the most effective management action (Figure 117).

Compared to basin households, local and municipal governments believe that changing forestry and agricultural land use practices to reduce erosion and pollution, and increased water quality monitoring will be more effective management actions in dealing with current problems.

Environmental and recreation groups tend to be more polarized in their responses. As summarized in Figure 118, five actions score very high while the remaining six are relatively unimportant. These groups show very high support for preserving and maintaining ecosystems, and changing agricultural and forestry land use practices. Enforcement of pollution laws, development of basin plans, and reducing industrial effluents are ranked third, fourth and fifth. These results suggest that environmental and recreation groups are more concerned about the effects of logging and agricultural land use practices on water quality and quantity than they are about industrial effluents.

Figure 118

Most Effective Management Actions: Environmental and Recreational Groups



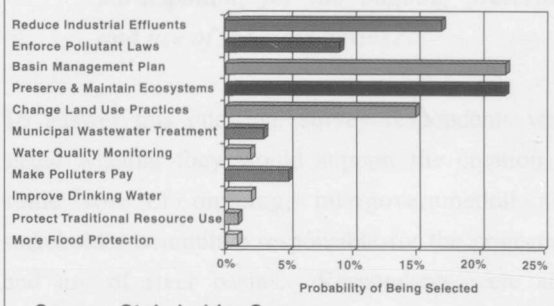
Source:Survey of Environmental and Recreation Groups

Industrial water users propose a curious mix of preferred management actions. They place high emphasis on maintaining and preserving ecosystems and the development of a river basin plan (Figure 119). They also show considerable support for reducing industrial effluent loads. However, industrial water users consider enforcement of pollution laws to be a less-effective action than

perceived by basin households. Industrial water users also have a higher probability of choosing polluter pay as a management action than does any other stakeholder group, including the general public.

Figure 119

Most Effective Management Actions: Industrial Water Users

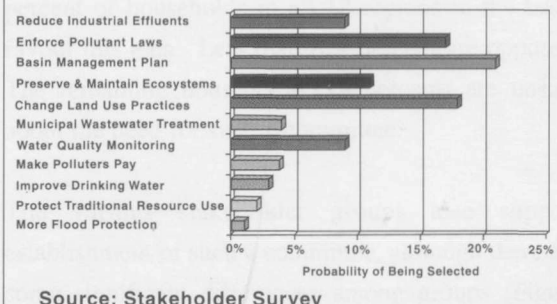


Source: Stakeholder Survey

Agricultural groups and agricultural service boards show much less support for reducing industrial effluents than does the general public. They believe that a basin management plan would be the most effective management tool (Figure 120).

Figure 120

Most Effective Management Actions: Agricultural Organizations



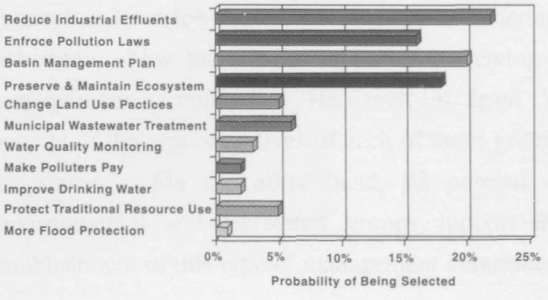
Source: Stakeholder Survey

They also believe that changing forestry and agricultural practices to reduce erosion and pollution, would be a highly-effective means for dealing with current water quality and quantity problems in the basin. This group also shows higher support for water quality monitoring as an effective management action.

The most effective management actions favoured by trappers, commercial fishermen and commercial recreation operators are quite similar to those proposed by basin households. There is very strong support for reducing industrial effluent loads and developing basin management plans (Figure 121). However, this group believes that maintaining and preserving ecosystems would be more effective than enforcing existing pollution laws.

Figure 121

Most Effective Management Actions: Trappers, Commercial Fishermen, and Commercial Recreation Operators



Source: Stakeholder Survey

In summary, this analysis again shows that basin households perceive the most effective management actions to be those that provide immediate solutions to existing water management problems. In general, reducing effluent loads and enforcing laws are preferred over basin plans. In comparison, municipal and local governments, industrial water users and agricultural stakeholders favour planning as a longer-term solution rather than immediate corrective actions.

7.0 FUTURE MANAGEMENT STRUCTURE

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 answer this question, survey respondents were asked whether they would support the creation of some sort of ongoing, intergovernmental and stakeholder committee responsible for the protection and use of river basins. Respondents were also questioned about the roles and responsibilities of such a committee, and their willingness to participate. Responses to these questions are summarized below.

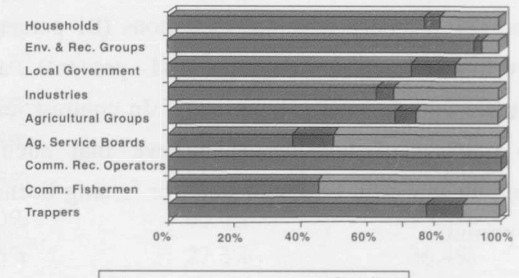
7.1 Establishment of a Management Committee

The majority of northern households support the establishment of some sort of inter-governmental and stakeholder committee responsible for the protection and use of northern river basins. Between 70 and 80 percent of households in all 12 regions in the basin favour this idea. 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 such a committee, although there are some significant differences among groups (Figure 122). Between 38 and 100 percent of stakeholder groups support the creation of such a committee. However, a very large proportion of some stakeholder groups are unsure.

Figure 122

Support For Establishment of an Ongoing, Inter-Government and Stakeholder Committee Responsible for Protection and Use of River Basins



Source: Household and Stakeholder Survey

Agricultural service boards, followed by commercial fishermen, show the lowest support for creating a management committee. However, at least 50 percent of the representatives of each of these groups are unsure. On the other hand, 92 percent of environmental and recreation groups support the establishment of this type of management committee.

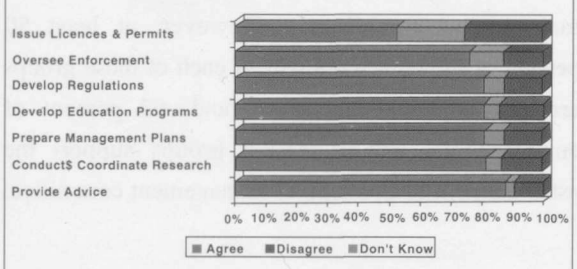
7.2 Committee Roles and Responsibilities

In order to define the potential roles and responsibilities of a government/stakeholder management committee, survey respondents were asked to indicate whether or not they feel this committee should be responsible for seven specific management functions that ranged from providing advice to performing regulatory and enforcement duties.

The majority of households believe that an inter-governmental and stakeholder management committee should be responsible for six of these management functions. More than three-quarters of households think that the committee should provide advice to federal, provincial and territorial governments (88 percent), coordinate and conduct research (81 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.

Figure 123

Roles and Responsibilities of an Ongoing Inter-Governmental and Stakeholder Management Committee



Source: Household Survey

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 result from 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 regarding four of the seven management functions: developing regulations, enforcing regulations, issuing licences and permits, and 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.

Among stakeholder groups, industrial water users and agricultural service boards have very different views from the rest. As shown in Table 7, these two groups show very low support for empowering a committee to develop regulations, oversee enforcement, or issue licences and permits. The majority of trappers and commercial fishermen also do not believe that the committee should be responsible for issuing 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 different degrees of uncertainty than on whether or not the committee should have this responsibility.

7.3 Participation on the Committee

The majority of households that responded to the survey (82 percent) are prepared to participate on an inter-governmental and stakeholder management committee. On a regional basis, this proportion ranges from 72 to 94 percent, although there are no statistically significant differences among regions.

Households are interested in two major types of committee involvement. About 41 percent are prepared to sit as committee members and make decisions and recommendations about water management. Many of these people feel that public members are necessary to balance the influence of special interest groups and they can provide better information than government employees.

Table 7

Stakeholder Support for Selected Roles and Responsibilities of an Ongoing, Intergovernmental and Stakeholder Management Committee
(Percent of Respondents Agreeing That Committee Should Have Specific Role)

	Develop Resource Regulations	Oversee Enforcement of Regulations	Issue Licences and Permits	Conduct and Coordinate Research
Households	81.0%	76.4%	52.8%	81.3%
Environmental & Recreation Groups	81.6%	64.9%	51.4%	78.4%
Municipal and Local Governments	88.0%	73.1%	45.8%	76.0%
Industrial Water Users	51.4%	25.7%	14.3%	79.4%
Agricultural Groups	68.8%	87.5%	50.0%	71.4%
Agricultural Service Boards	62.5%	37.5%	25.0%	62.5%
Commercial Recreation Operators	93.3%	80.0%	60.0%	93.3%
Commercial Fishermen	63.6%	45.5%	27.3%	36.4%
Trappers	85.7%	75.0%	37.5%	75.0%

Some suggest that committee members should be elected while others suggest they should 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 basin.

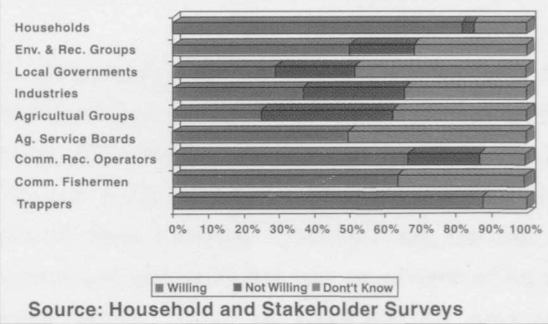
Another 44 percent of households are willing to provide information and advice to the committee. Of these, two-thirds want the opportunity to attend workshops, community forums and other types of meetings so that they can provide input on basin management issues. Another quarter of these households believe 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. They believe 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 collection 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 as the general public in participating on a committee.

Figure 124

Willingness of Stakeholder Groups to Participate on an Inter-Governmental and Stakeholder Management Committee



Source: Household and Stakeholder Surveys

This high interest in community participation in resource management decisions is consistent with the recent position paper on fish and wildlife in northern Alberta (NADC, 1993). Expanded community involvement in fish and wildlife management was the first recommendation made in the position paper.

8.0 CONCLUSIONS AND RECOMMENDATIONS

Water management involves striking a balance among human needs and environmental processes. Growing human water demands must be balanced against available supply. Consumptive human needs must be weighed against instream and other non-consumptive uses. Changes in quantity must be assessed in terms of changes in quality. Technical assessments must be balanced against public perceptions. And the effects of today's uses must be considered in terms of future options.

The Northern River Basins Study has been commissioned as part of the process to help define this balance for the Peace, Athabasca and Slave river basins. The Study has spent the last four years trying to identify and understand some of the basic biological, hydrological, socio-eonomic and other factors that will affect water management decisions now and in the future.

This report summarizes NRBS research in three key areas. It provides an assessment of current consumptive and non-consumptive uses of the aquatic resources of the basins. It summarizes the perceptions and concerns of basin residents and other stakeholders concerning the importance and severity of various water management issues. It also offers some suggestions concerning how basin residents and other stakeholders would like water to be managed in the future. This research included checking existing data sources, but mainly involved the use of surveys to ask basin residents and others about their uses of water, their perceptions, and their expectations.

8.1 Conclusions

Consumptive Water Use

The study found that, for the 269,000 residents of the basins, drinking water is the most important consumptive use of water. The majority of basin residents (55 percent) rely on municipal water systems. And, despite some evidence to the contrary, 94 percent of local government agencies believe that their processed drinking water meets national standards. Only 14 percent of basin households draw their water from sources other than municipal systems or groundwater, and about half of them employ some form of water treatment.

The survey results show that there is some concern about the use of chlorine to treat municipal effluent and to manufacture pulp. About 11 percent of households that use water directly from rivers report an increasing chlorine taste in their water during the last 10 years, even though none of them uses chlorine as a form of treatment.

Industry was found to the biggest consumer of water (by volume) in the NRBS area. About 56 percent of all licenced water use in the Alberta portion of the basins is for industries that withdraw water from the mainstem of the Athabasca River. Discharges of effluents from industrial plants is perceived to pose a major threat to water quality in the basin.

In comparison, agricultural water use accounts for less than three percent of licenced water use in the basin. While agriculture is not perceived as a major threat to water quantity, basin residents believe that run-off from livestock operations and the use of agricultural chemicals has had an adverse effect on water quality. There are about 800,000 cows and

calves in the region (three times the human population), and more than half of the estimated 21,000 farms in the region use pesticides, herbicides and/or fertilizers.

Non-Consumptive Water Use

The surveys determined that water-based recreation is the most common form of non-consumptive use of water in the basin. Almost three-quarters of northern residents participate in one or more types of water-based recreation. Over one-third of them (34 percent) use river mainstems for fishing or boating. Over half of the basin households fish, catching an average of 23.3 kilograms of fish per year, and one-third of these people consume all or part of their catch. Over 10 percent of households believe that river mainstems have become dirtier over the last 10 years, and 14 percent report a decline in the size and health of fish populations. It is important to note that basin residents are more concerned about the effects of industrial development and water pollution on their recreational activities than about effects on their drinking water supplies.

Commercial fishermen, trappers, river transportation companies and commercial recreation operations are other stakeholders whose livelihood depends directly or indirectly on water quality or quantity. Although the number of these people and/or operations is relatively small, they contribute considerable economic benefits for the region. The people involved in these activities are all concerned that any changes in water quality or quantity will significantly affect their livelihood.

Water Management Issues and Concerns

The surveys found that a large majority of the households surveyed believe that contamination of water quality, caused by industrial and municipal effluents, is a problem throughout the NRBS area. The general public sees pulp mills as being the most important source of contaminants affecting water quality. Municipal sewage, other industries, logging and agriculture are perceived to be other activities that negatively affect water quality and quantity.

In most cases, northern residents feel that increased regulation should be used by governments to better control activities that negatively impact water quality. Three-quarters of the households and two-thirds of stakeholders who responded to the survey disagree with a survey statement that "current water management regulations are interfering with economic development in the Northern basins".

In terms of future management actions, basin residents would like the NRBS Board to recommend that effluent loads in the rivers be reduced. Their second recommendation is that industrial effluent activities should be more closely monitored, while the third proposes better enforcement of existing pollution laws. The survey results strongly suggest that northern residents want the NRBS Board to make recommendations that will quickly resolve existing water quality problems.

The survey results also show that public perceptions are often quite different from those of stakeholder groups. The water management issues of concern to local governments and industry are not always the issues of concern to the public. Stakeholders often point the finger at other stakeholders, while the public plays no favourites.

This discrepancy between public and stakeholder attitudes is most apparent in terms of recommended actions. Local and industry advocate a cautious and slow approach to change that builds on more research and plans. Environmental groups want an immediate end to various effluent discharges and land use

practices. The general public prefers a middle path that favours gradual reductions in effluent discharges and more enforcement of existing regulations.

Future Basin Management

Basin residents want to have a say in how water resources are to be managed in the future. More than 70 percent support the creation of an ongoing inter-governmental and stakeholder committee responsible for the use and protection of northern rivers. About 80 percent are willing to participate on such a committee, either as a committee member or as a source of information and advice. The majority feel that the committee should provide advice to the federal, provincial and territorial governments, coordinate research, prepare a basin plan, develop regulations, undertake public education and oversee enforcement.

8.2 Recommendations

The socio-economic component of the NRBS represents a departure from the conventional, technical approach to water management studies. In mapping out public perceptions on water issues, the study has yielded information that allows water and environmental managers to better differentiate between technical and perceived management issues. Perceived problems are real problems, regardless of whether or not there is a technical cause, and still need to be dealt with by resource managers. However, the management approaches used to address perceived problems are substantially different from the technical solutions often considered.

The socio-economic studies also provide a rare, quantified summary of public views and understanding of current issues that can only be attained through surveys. This study shows that there are often very large differences between public and stakeholder values and opinions. It demonstrates that what industry wants or what local government wants, is not always what the general public wants.

This study is also a landmark in that no comparable research on water use and management issues has been attempted to date in the NRBS area. The social, economic, environmental, legal, jurisdictional and institutional views of northerners from both sides of the NWT-Alberta border will be of considerable value to the legislators and regulators of the three jurisdictions involved. Some basin residents who responded to the survey also mentioned that this type of survey provides a valuable means of monitoring river health and public perceptions of river management, and recommended that it be repeated on a regular basis.

In response to these suggestions it is recommended that assessments of public perceptions of river health should be undertaken at regular intervals as a way of monitoring change. These assessments should follow the survey approach used by the NRBS in order to allow direct comparison of results. This approach, which was based on a combination of telephone and mail surveys from a stratified random sample of basin residents, proved to be quite satisfactory and cost effective. The surveys and related analysis conducted for the Northern River Basins Study were undertaken at a modest expenditure (approximately $150,000).

It is also recommended that the same regional boundaries (based on telephone prefix regions or nearest equivalent) be used in future surveys. The NRBS surveys show few regional differences in public opinion at the present time. However, some regional differences in perceptions and issues may evolve in the future, and these should be monitored so that water management can be responsive to regional needs.

Finally, it is recommended that future river or resource management studies be undertaken using an ecosystem approach. This approach involves:

- defining the area to be studied in terms of river basin or other ecoregion boundaries;
- using an integrated approach to examine the interactions among land, water and other resources;
- supplementing technical, biophysical information with socio-economic information that include perceptions and values; and,
- considering transboundary effects.

Within this process, surveys of the general public and stakeholder groups can be used to provide decision-makers with quantitative, representative data on public perceptions and values. In addition, surveys offer a structured opportunity for public involvement. They can be used to solicit input from a broad range of interests, and present a less intimidating and more user-friendly method for personal involvement in resource management decisions.

References and Bibliography

Alberta Agriculture, Food and Rural Development. 1994. Agricultural Statistics Yearbook, 1993. Agdex 853-10.

Alberta Agriculture, Food and Rural Development. n.d. Census of Agriculture, Selected Statistics by Municipality, 1971 to 1991.

Alberta Economic Development and Tourism. 1990. 1990 Alberta Non-Resident Travel Exit Survey: Provincial Summary.

Armstrong, Tanya F., Dennis S. Prince, Stephen J. Stanley and Daniel W. Smith. 1995. Assessment of Drinking Water Quality in the Northern River Basins Study Area: Synthesis Report. NRBS Synthesis Report No. 9.

Drobot Contracting Services Ltd. 1995. Northern River Basins Study Project 4121-D3: Implementation of Household Survey. Northern River Basins Study Project Report No. 70.

Finn, Adam and Jordan J. Louviere. 1992. Determining the appropriate response to evidence of public concern: the case of food safety in Journal of Public Policy and Marketing, Vol. 11(1), Fall 1992, pp. 12-25.

Flett, Lloyd and Lea Bill. 1995. A Report of Wisdom Synthesized From the Traditional Knowledge Component Studies. NRBS Synthesis Report No. 12.

Golder Associates Ltd. 1995. Water Resources Use and Management Issues for the Peace Athabasca and Slave River Basins: Design of Questionnaire and Survey Methods. Northern River Basins Study Project Report No. 58.

Health and Welfare Canada and Environment Canada. 1991. Wilderness Water: A Guide to Wilderness Drinking Water. Pamphlet.

Lussier, Richard. Soils Management Specialist, Alberta Agriculture, Food and Rural Development, Spirit River, Alberta. (personal communications) 1996. Comments/Review of Northern River Basin Study, Agriculture Section. Fax dated January 2, 1996.

Nichols Applied Management. 1996. Factors Affecting Future Development in Key Economic Sectors in the Peace, Athabasca and Slave River Basins. Northern River Basins Study Project Report No. 73.

Northern Alberta Development Council. 1993. Fish and Wildlife in Northern Alberta: Conference Background Report.

Praxis, Inc. 1994. Status and Future Requirements for Socio-Economic Research and Public Communications and Consultations. Northern River Basins Project Report No. 31.

Praxis, Inc. and Kerrie Hale. 1994. Inventory and Compilation of Existing Socioeconomic Information for the Peace, Athabasca and Slave River Basins. NRBS Project 4101-C1.

Prowse, T. 1996. General Hydrology and Effects of Flow Regulation on the Peace, Athabasca and Slave Rivers. NRBS Synthesis Report No. 1.

Reicher, Philippe. 1995. Water Resources Use and Management Issues for the Peace, Athabasca and Slave River Basins: Implementation of Surveys of Interest Groups, Industries and Municipal Governments. Northern River Basins Study Project Report No. 75.

Reicher, Philippe and John P. Thompson. 1995. Use of Aquatic Resources in the Northern River Basins: Results of the Household and Stakeholders Surveys. Northern River Basins Study Project Report No. 69.

South Slave Research Centre. 1995. Water Resources Use and Management Issues for the Peace, Athabasca and Slave River Basins: Stakeholder Screening Survey. Northern River Basins Study Project Report No. 57.

Statistics Canada. 1991 Census for Alberta and the Northwest Territories. Data series 2A and 2B on computer diskette.

Williams, Michael. 1996. Water Resources Use and Management Issues for the Peace, Athabasca and Slave River Basins: Best/Worst Analysis of Survey Questions and Threats and Actions. Northern River Basins Study Project Report No. 80.

Synthesis Report

The Northern River Basins Study was established to examine the relationship between industrial, municipal, agricultural and other development and the Peace, Athabasca and Slave river basins.

Over four and one half years, about 150 projects, or "mini studies" were contracted by the Study under eight component categories including contaminants, drinking water, nutrients, traditional knowledge, hydrology/hydraulics, synthesis and modelling, food chain and other river uses. The results of these projects, and other work and analyses conducted by the Study are provided in a series of synthesis reports.

This Synthesis Report documents the scientific findings and scientific recommendations of one of these component groups. This Synthesis Report is one of a series of documents which make up the Northern River Basins Study's final report. A separate document, the Final Report, provides further discussion on a number of scientific and river management issues, and outlines the Study Board's recommendations to the Ministers.

Project reports, synthesis reports, the Final Report and other NRBS documents are available to the public and to other interested parties.