Canada Alberta Northwest Territories

Northern River Basins Study





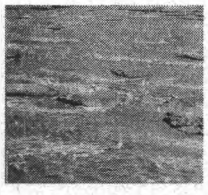





NORTHERN RIVER BASINS STUDY PROJECT REPORT NO. 80

WATER RESOURCES USE AND MANAGEMENT ISSUES

FOR THE PEACE, ATHABASCA AND SLAVE RIVER BASINS: BEST/WORST ANALYSIS OF SURVEY QUESTIONS ABOUT THREATS AND ACTIONS



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by

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PREFACE:

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

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

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

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

(Dr. Fred J. Wrona, Science Director) (Date) 10 Jan 96

Whereas it is an explicit term of reference of the Science Advisory Committee "to review, for scientific content, material for publication by the Board",
IT IS HERE ADVISED BY THE SCIENCE ADVISORY COMMITTEE THAT;
this publication has been reviewed for scientific content and that the scientific practices represented in the report are acceptable given the specific purposes of the project and subject to the field conditions encountered.
SUPPLEMENTAL COMMENTARY HAS BEEN ADDED TO THIS PUBLICATION: [ ] Yes [ ] No

(Dr. P. A. Larkin, Ph.D., Chair) (Date) Jan 9/96

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

(Lucille Partington, Co-chair) (Date) Jan. 11/96

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

WATER RESOURCES USE AND MANAGEMENT ISSUES FOR THE PEACE, ATHABASCA AND SLAVE RIVER BASINS: BEST/WORST ANALYSIS OF SURVEY QUESTIONS ABOUT THREATS AND ACTIONS

STUDY PERSPECTIVE

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

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

Related Study Questions

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

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

This report deals with step four, analysis of the survey results and specifically with two questions that asked respondents to rank various sets of threats to water quality/quantity and possible management strategies. The two questions employed a fractional factorial design. A fractional factorial design refers to a statistical method used when there are many choices (in this case 11) and it may be cumbersome for respondents to put them into the order of preference or concern all at once. Instead, each respondent is asked to choose the best/worst examples from several smaller choice sets. In this case, there were three choice sets which could have four, six or eight choices to select from.

The over whelming top two perceived threats to water quality/quantity were discharges from pulp mills and industrial wastes/tailings ponds. These two threats were perceived to be a much greater risk than the other nine threats combined. With reference to management action, while there was strong support for developing a management plan for the entire basin, there was also more diversity in responses than compared to perceived threats. With some respondent groups, preserving or maintaining ecosystems and reducing industrial effluent loads ranked higher.

These analyses will be combined with other information obtained in the survey of households and stakeholder groups to describe current attitudes and opinions on water management issues. The householder and stakeholder surveys marked the first time that residents and stakeholders of the study area have been surveyed to this extent. The resulting information will be useful for this study and also future planning.

REPORT SUMMARY

Two of the objectives of the Other Uses Component of the Northern River Basins Study were to determine which water management problems or issues were of greatest concern to basin residents and to recommend a series of management actions to address these concerns. Information about water management issues and actions was collected as part of surveys conducted with a random sample of northern households (Project 4121-D3) and with various stakeholder groups (Project 4121-D4). As part of these surveys, respondents were asked to choose the best and worst examples of various sets of threats to water quality/quantity and of possible management actions.

The responses to the two sets of Best/Worst questions were analyzed using logistic regression. This analysis produced the following estimates:

1) the probability that each of 11 possible threats to water quality/quantity will be selected as the area of most concern; and

2) the probability that each of 11 possible management actions will be selected as the most effective response to such concerns

The probabilities produced by this analysis can be ranked from lowest to highest to determine the preferences of northern households and various stakeholder groups within the basin.

The results of the analysis of threats to water quality and quantity showed fairly consistent results among stakeholder groups and among the 12 regions used in the household survey. The top two perceived threats to water quality/quantity proved to be:

- discharges from pulp mills; and

- industrial wastes/tailings ponds.

There was considerable variability in the ranking of the remaining threats, especially among stakeholder groups. Furthermore, the top two threats were perceived to be of much greater concern than all of the nine remaining threats.

In terms of recommended management actions, there was much more variability in the results. Overall there was greatest support among households and stakeholder groups for developing a management plan for the entire basin. However, some groups placed higher emphasis on preserving and maintaining ecosystems or reducing industrial effluent loads.

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1.0 BACKGROUND

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

The Study Board developed a vision statement to provide overall guidance for the various technical activities being conducted in support of the study and also identified 16 questions that serve to focus study activities. Eight scientific component groups were established to address these 16 questions, and the Other Uses Component was given responsibility for answering Question #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 stakeholders uses the water resources of the basin, especially the mainstems of the Peace, Athabasca and Slave rivers.

The Study Board also requested that some work be done to determine the issues, needs and expectations of stakeholders regarding management of the Athabasca, Peace and Slave rivers. This information was required to support the Board in developing effective recommendations that address stakeholder concerns.

To provide this information, the Other Uses Component developed and implemented a survey of a stratified random sample of northern households (Project 4121-D3) and surveys of various stakeholder groups (Project 4121-D4). In all surveys, several approaches were used to collect information on stakeholder issues, concerns and expectations. These ranged from unstructured, open-ended questions to a highly structured choice experiment that used Best/Worst scaling with a fractional factorial survey design.

Interpretation of the results of the Best/Worst questions requires specialized analysis, based on the use of a logit model and logistic regression. This project summarizes the results of this analysis. Interpretation of the other parts of the surveys was done as part of Project 4121-E2 (Reicher and Thompson, 1996).

2.0 DESCRIPTION OF THE ANALYSIS

2.1 BEST/WORST ANALYSIS

The use of Best/Worst analysis is a relatively new approach for assessing preferences. The traditional approach has involved asking people to rank the items being compared (for example, which threat to water quality is of greatest importance) using a scale of 1 to 5 and then using the average scores as the basis for ordering the items. The resulting list is often difficult to interpret however, since statistical testing often shows little differences among average scores for the various items.

An alternative approach uses a hierarchical ordering process. This process requires survey respondents to rank one item against all other items, one pair at a time. Once all possible pairs have been compared, this process reveals a hierarchy of choices. While this process is highly effective, it is limited to comparing small numbers of items because of the very large number of possible pairs that can result as the number of items to be compared increases (a factorial design). For example, a comparison of four items involves making choices from six sets of pairs while a ranking of eight items would involve 28 pairs and 11 items would generate 55 pairs.

Best/Worst analysis was developed as an alternative method for scaling preferences using hierarchical ordering. This approach requires respondents to "choose the two items having, respectively, the most and the least of characteristic from repeatedly presented subsets of items, to be able to scale the entire set of items on the characteristic " (Finn and Louviere, 1992). In other words, respondents are presented with groups of items, rather than pairs, and are asked to select the best and worst items from each group. This approach provides an ordinal ranking of the items and an interval scaling that allows for more rigorous testing of differences among items.

This process also involves making repeated comparisons among various groupings of the items and the number of groupings can also be quite large. However, this problem can be addressed by using a "balanced orthogonal subset" of the overall factorial design (Finn and Louviere, 1992). This fractional factorial approach requires that each item appears the same number of times and that the groupings are constructed so that each item is compared to each other item the same number of times. With this approach, the 11 items to be compared are presented in 12 sets containing, 4, 6 or 8 items.

2.2 SURVEY QUESTIONS

Best/Worst analysis was used to collect information on two specific issues. This approach was used to determine which of 11 existing threats to water quality and quantity was of greatest concern to residents of the basin and the various stakeholder groups. The 11 threats used in the survey were developed from comments made at public meetings conducted by the NRB Study Board in various communities in the basin and included:

1. Agricultural run-off (pesticides, herbicides, fertilizers)
2. Groundwater contamination

3. Forestry harvesting practices
4. Draining wetlands and muskeg
5. Discharges of municipal sewage effluent
6. Seismic exploration/road and pipeline development
7. Regulation of river flows by dams
8. Discharges of pulp mill effluent
9. Airborne pollutants
10. Uranium contamination (Lake Athabasca)
11. Industrial wastes/tailing ponds

Similarly, Best/Worst analysis was used to determine which of 11 possible management actions respondents felt would be most effective in dealing with existing water quality and quantity problems in the basin. These included:

1. Change land use practices (forestry, agriculture) to reduce erosion and non-point pollution.
2. Improve municipal wastewater treatment.
3. Provide more flood protection.
4. Protect traditional fishing, hunting & trapping
5. More enforcement of existing pollution laws.
6. Reduce industrial effluent loads.
7. Preserve and maintain ecosystems
8. Make polluters pay an annual fee based on the volume of effluent they produce.
9. Improve treatment of municipal drinking water
10. Increase monitoring of water quality
11. Develop management plan for entire basin.

These Best/Worst assessments were based on a 12 question fractional factorial design (Hadamard design) with the 11 threats or management actions, each with 2 levels (present/absent). To reduce response bias, the 12 questions were divided into 4 sets of 3 questions and each respondent was asked to make choices from only one of the four sets. Thus, four different versions of the questionnaire were used in the household and stakeholder surveys. Survey results were then pooled to provide an overall assessment of respondent preferences.

In the first set of 3 questions, respondents were asked to indicate the threat to water quality that concerned them the most. In addition, respondents were also asked to indicate the threat that was of least concern. In the second set of 3 questions, respondents were asked to indicate the management action that they believed would be the most effective and the one they believed to be the least effective. Examples of a Best/Worst task for threats to water quality/quantity and management actions are as follows:

Most concern (check only one)	Threat to water quality/quantity	Least concern (check only one)
	1. Agricultural run-off (pesticides, herbicides, fertilizers)	
	4. Draining wetlands and muskeg	
	5. Discharges of municipal sewage	
	7. River flows controlled by dams	

Most effective (check only one)	Management action	Least effective (check only one)
	1. Change land use practices (forestry, agriculture) to reduce erosion and pollution	
4	4. Protect traditional fishing, hunting & trapping	
5	5. Enforce existing pollution laws	
7	7. Preserve and maintain ecosystems	

A copy of the household questionnaire is provided in Appendix C to show how the questions were actually posed within the context of the overall survey

2.3 RESPONDENT GROUPS AND SUB-GROUPS

Both the household and stakeholder survey employed stratified sample designs. In order to test for possible differences in water use patterns and water management concerns among northern residents, the study area was divided into 12 regions:

1. Upper Athabasca River
2. Middle Athabasca River
3. Lower Athabasca River
4. Upper Peace River
5. Middle Peace River
6. Lower Peace River
7. Slave River and Delta
8. Smoky/Wapiti Basins
9. Lesser Slave Basin
10. Pembina/Macleod Basins
11. Wabasca Basin
12. Lac la Biche Basin

These regions are shown if Figure 1.

Sufficient responses were received from respondents in each region to allow a separate analysis to be prepared for each region.

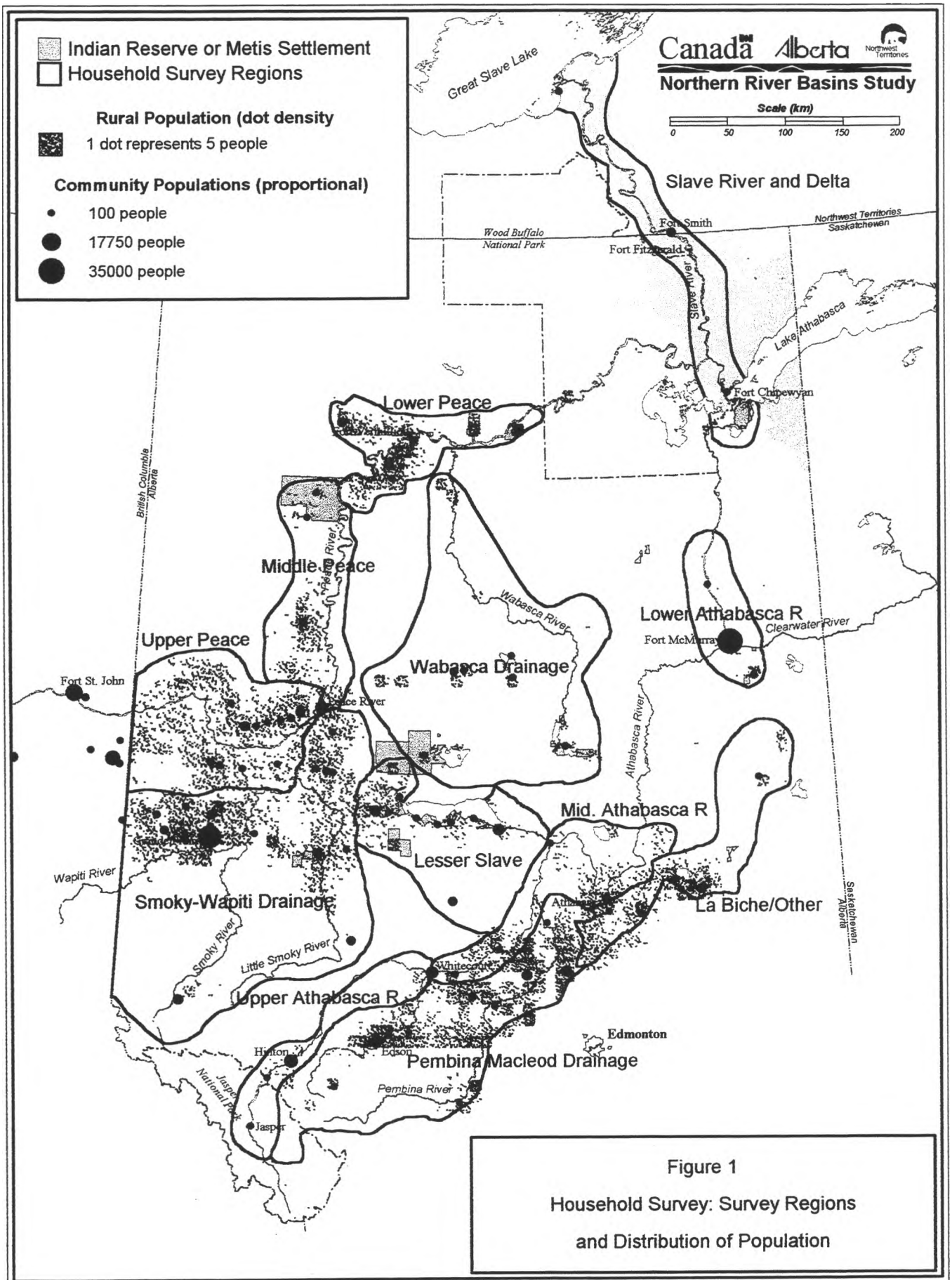

Figure 1

Household Survey: Survey Regions and Distribution of Population

Eight types of stakeholder groups were surveyed. These included:

1. Municipal and local governments
2. Agricultural groups
3. Agricultural service boards
4. Commercial recreation businesses
5. Industrial water users
6. Trappers
7. Commercial fishermen
8. Environmental and recreation groups

Unfortunately, insufficient responses were received from each group to conduct separate analyses so some of the groups were aggregated to increase sample sizes. While the responses for industrial users (Ind) and environmental/recreation groups (Env) were assessed separately, trappers were grouped together with commercial fishermen and commercial recreation businesses (Com). Similarly, agricultural service boards were grouped with municipal/local governments in one case (Gov), and with agricultural groups and municipal local governments in a second case (Ag). In these analysis, the results for these stakeholder groups were also compared to the aggregate results for the household survey (H).

2.4 STATISTICAL ANALYSIS

Survey results for each of the subgroups were analyzed by estimating a logit model using logistic regression[1]. The logit model was selected rather than a linear model because the data were discrete rather than continuous.

The basic form of the logit model is as follows:

$$\Pr(i) = \frac{e^{Ui}}{\sum_{j \in C_n} e^{Uj}}$$

where U_i is the utility (respondent's preference) associated with the *i*th water quality threat or management action. The measure of utility U_i, is a function of the water quality threats or management actions.

The model coefficient estimates (see Appendix A) were then used to calculate the probability that a water quality threat was the greatest concern for the threat models and the probability that a management action was the most effective for the management action models.

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[1] Hosmer, D. and Lemeshow, S. (1989) *Applied Logistic Regression*, Wiley, New York.

The following table shows an example of how the probabilities were calculated for the threats to water quality/quantity for the Upper Athabasca Region.

#	Threat	Coefficients	Exp(Coef.)	Probability
1	agricultural run-off	-0.72697	0.483371	0.020404
2	groundwater contamination	0.27733	1.319602	0.055702
3	forestry harvesting practices	-0.00215	0.997852	0.042121
4	draining wetlands and muskeg	-0.7893	0.454163	0.019171
5	discharges of municipal sewage	0.91284	2.491388	0.105165
6	seismic exploration/road and pipeline	-1.75289	0.173272	0.007314
7	river flows controlled by dams	-0.87985	0.414845	0.017511
8	discharges from pulp mills	2.37764	10.77943	0.455015
9	airborne pollutants	-0.98428	0.373708	0.015775
10	uranium contamination	-0.09961	0.90519	0.038209
11	industrial wastes/tailing ponds	1.66723	5.297473	0.223614
		SUM	23.6903	1.000000

The probability that a water quality/quantity threat is the greatest concern is computed by taking the exponential of the model coefficient estimate for a threat and dividing this by the sum of the exponentials.

The coefficient for the last threat is calculated as the negative of the sum of all the other coefficients.

Calculation of the probabilities for the other regions and management actions were computed in the same manner.

3.0 RESULTS

3.1 TABLES OF PROBABILITIES AND RANKINGS

The following table displays the probability that a threat to water quality/quantity will be selected as the issue of most concern to the household sample by region:

	Regions											
Threat to water quality/quantity	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
agricultural run-off	2%	5%	6%	10%	8%	3%	4%	6%	11%	5%	4%	6%
groundwater contamination	6%	6%	8%	5%	4%	7%	8%	7%	3%	13%	5%	8%
forestry harvesting practices	4%	11%	3%	5%	2%	9%	3%	3%	4%	4%	4%	5%
draining wetlands and muskeg	2%	2%	4%	1%	2%	2%	5%	2%	4%	3%	3%	3%
discharges of municipal sewage	11%	7%	6%	10%	15%	16%	14%	10%	8%	12%	11%	20%
seismic exploration/road and pipeline development	1%	2%	1%	2%	1%	1%	1%	2%	2%	2%	4%	2%
river flows controlled by dams	2%	3%	2%	1%	3%	4%	13%	2%	2%	2%	4%	2%
discharges from pulp mills	46%	34%	39%	46%	41%	34%	34%	28%	30%	29%	37%	30%
airborne pollutants	2%	1%	5%	2%	1%	3%	2%	2%	2%	2%	3%	2%
uranium contamination	4%	2%	9%	2%	3%	5%	5%	3%	5%	4%	4%	3%
industrial wastes/tailing ponds	22%	27%	18%	16%	20%	16%	11%	36%	30%	24%	21%	19%

The following table displays the probability that a threat to water quality/quantity will be selected as the issue of most concern to the stakeholder sample by group:

	Household & Stakeholder Groups					
Threat to water quality/quantity	**H**	**Ag.**	**Gov.**	**Com.**	**Ind.[2]**	**Env.**
agricultural run-off	6%	12%	17%	8%		10%
groundwater contamination	7%	9%	12%	5%		8%
forestry harvesting practices	5%	13%	13%	6%		13%
draining wetlands and muskeg	3%	6%	6%	3%		6%
discharges of municipal sewage	11%	5%	5%	7%		6%
seismic exploration/road and pipeline development	2%	5%	5%	2%		4%
river flows controlled by dams	3%	5%	7%	10%		6%
discharges from pulp mills	36%	19%	13%	42%		36%
airborne pollutants	2%	4%	4%	4%		1%
uranium contamination	4%	2%	2%	2%		1%
industrial wastes/tailing ponds	21%	19%	16%	12%		10%

[2] There was insufficient data to estimate a model for group 6 (industrial users)

The following table displays the ranking of the probabilities which predict that a threat will be selected as the issue of most concern to the household sample by region:

	Regions											
Threat to water quality/quantity	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
agricultural run-off	7	6	5	4	4	8	8	5	3	5	9	5
groundwater contamination	4	5	4	6	5	5	5	4	8	3	4	4
forestry harvesting practices	5	3	9	5	8	4	9	7	6	7	5	6
draining wetlands and muskeg	8	10	8	11	9	10	6	8	7	8	11	7
discharges of municipal sewage	3	4	6	3	3	3	2	3	4	4	3	2
seismic exploration/road and pipeline development	11	9	11	8	11	11	11	11	9	9	6	11
river flows controlled by dams	9	7	10	10	7	7	3	9	10	11	7	9
discharges from pulp mills	1	1	1	1	1	1	1	2	1	1	1	1
airborne pollutants	10	11	7	9	10	9	10	10	11	10	10	10
uranium contamination	6	8	3	7	6	6	7	6	5	6	8	8
industrial wastes/tailing ponds	2	2	2	2	2	2	4	1	2	2	2	3

The following table displays the ranking of the probabilities which predict that a threat will be selected as the issue of most concern to the stakeholder sample by group:

	Household & Stakeholder Groups					
Threat to water quality/quantity	**H**	**Ag.**	**Gov.**	**Com.**	**Ind.**	**Env.**
agricultural run-off	5	4	1	4		4
groundwater contamination	4	5	5	7		5
forestry harvesting practices	6	3	3	6		2
draining wetlands and muskeg	9	6	7	9		7
discharges of municipal sewage	3	9	9	5		6
seismic exploration/road and pipeline development	11	8	8	10		9
river flows controlled by dams	8	7	6	3		8
discharges from pulp mills	1	2	4	1		1
airborne pollutants	10	10	10	8		11
uranium contamination	7	11	11	11		10
industrial wastes/tailing ponds	2	1	2	2		3

The following table displays the probability that a management action will be selected as the most effective response by the household sample by region:

	Regions											
Management actions	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
change land use practices to reduce erosion and pollution	8%	6%	8%	10%	7%	7%	5%	14%	24%	11%	11%	7%
improve municipal wastewater treatment	10%	5%	6%	5%	10%	12%	5%	8%	5%	8%	6%	8%
provide more flood protection	1%	1%	1%	1%	2%	3%	1%	1%	1%	1%	3%	1%
protect traditional fishing, hunting, and trapping	2%	3%	2%	1%	1%	2%	3%	2%	1%	2%	8%	2%
enforce existing pollution laws	26%	23%	24%	15%	10%	10%	18%	21%	18%	20%	12%	11%
reduce industrial effluent loads	12%	19%	15%	24%	34%	18%	17%	18%	18%	19%	15%	21%
preserve and maintain ecosystems	11%	10%	11%	13%	6%	9%	14%	9%	7%	14%	11%	14%
make polluters pay an annual fee based on the volume they produce	5%	4%	3%	5%	2%	4%	3%	2%	6%	4%	9%	7%
improve treatment of municipal drinking water	2%	2%	3%	3%	4%	4%	4%	2%	2%	3%	3%	4%
increase monitoring of water quality	9%	6%	8%	8%	11%	5%	3%	7%	4%	6%	8%	6%
develop a management plan for the entire basin	13%	22%	19%	15%	13%	26%	27%	16%	15%	12%	15%	20%

The following table displays the probability that a management action will be selected as the most effective response by the stakeholder sample by group:

	Household & Stakeholder Groups					
Management actions	**H**	**Ag.**	**Gov.**	**Com.**	**Ind.**	**Env.**
change land use practices to reduce erosion and pollution	10%	18%	17%	5%	15%	19%
improve municipal wastewater treatment	7%	4%	4%	6%	3%	2%
provide more flood protection	1%	1%	1%	1%	1%	1%
protect traditional fishing, hunting, and trapping	2%	2%	2%	5%	1%	1%
enforce existing pollution laws	18%	17%	20%	16%	9%	17%
reduce industrial effluent loads	19%	9%	5%	22%	17%	15%
preserve and maintain ecosystems	11%	11%	12%	18%	22%	27%
make polluters pay an annual fee based on the volume they produce	4%	4%	4%	2%	5%	1%
improve treatment of municipal drinking water	3%	3%	3%	2%	2%	1%
increase monitoring of water quality	7%	9%	10%	3%	2%	3%
develop a management plan for the entire basin	17%	21%	21%	20%	22%	14%

The following table displays the ranking of the probabilities which predict that a management action will be selected as the most effective response by the household sample by region:

	Regions											
Management actions	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
change land use practices to reduce erosion and pollution	7	5	5	5	6	6	6	4	1	5	5	7
improve municipal wastewater treatment	5	7	7	7	5	3	5	6	7	6	9	5
provide more flood protection	11	11	11	10	10	10	11	11	11	11	11	11
protect traditional fishing, hunting, and trapping	10	9	10	11	11	11	10	10	10	10	7	10
enforce existing pollution laws	1	1	1	3	4	4	2	1	2	1	3	4
reduce industrial effluent loads	3	3	3	1	1	2	3	2	3	2	1	1
preserve and maintain ecosystems	4	4	4	4	7	5	4	5	5	3	4	3
make polluters pay an annual fee based on the volume they produce	8	8	8	8	9	8	9	8	6	8	6	6
improve treatment of municipal drinking water	9	10	9	9	8	9	7	9	9	9	10	9
increase monitoring of water quality	6	6	6	6	3	7	8	7	8	7	8	8
develop a management plan for the entire basin	2	2	2	2	2	1	1	3	4	4	2	2

The following table displays the ranking of the probabilities which predict that a management action will be selected as the most effective response by the stakeholder sample by group:

	Household & Stakeholder Groups					
Management actions	**H**	**Ag.**	**Gov.**	**Com.**	**Ind.**	**Env.**
change land use practices to reduce erosion and pollution	5	2	3	7	4	2
improve municipal wastewater treatment	6	7	7	5	7	7
provide more flood protection	11	11	11	11	11	11
protect traditional fishing, hunting, and trapping	10	10	10	6	10	8
enforce existing pollution laws	3	3	2	4	5	3
reduce industrial effluent loads	2	6	6	1	3	4
preserve and maintain ecosystems	4	4	4	3	1	1
make polluters pay an annual fee based on the volume they produce	8	8	8	10	6	9
improve treatment of municipal drinking water	9	9	9	9	9	10
increase monitoring of water quality	7	5	5	8	8	6
develop a management plan for the entire basin	1	1	1	2	2	5

The charts in figures 2 through 7 show a visual representation of the results of the analysis. Each chart consists of a number of temperature scales on which the probability that a threat or management action would be the most important are plotted.

3.2 PROBABILITY OF A THREAT TO WATER QUALITY/QUANTITY BEING THE ISSUE OF MOST CONCERN

Figure 2 shows the probability that a threat to water quality/quantity will be selected as the issue of most concern to the stakeholder sample by group.

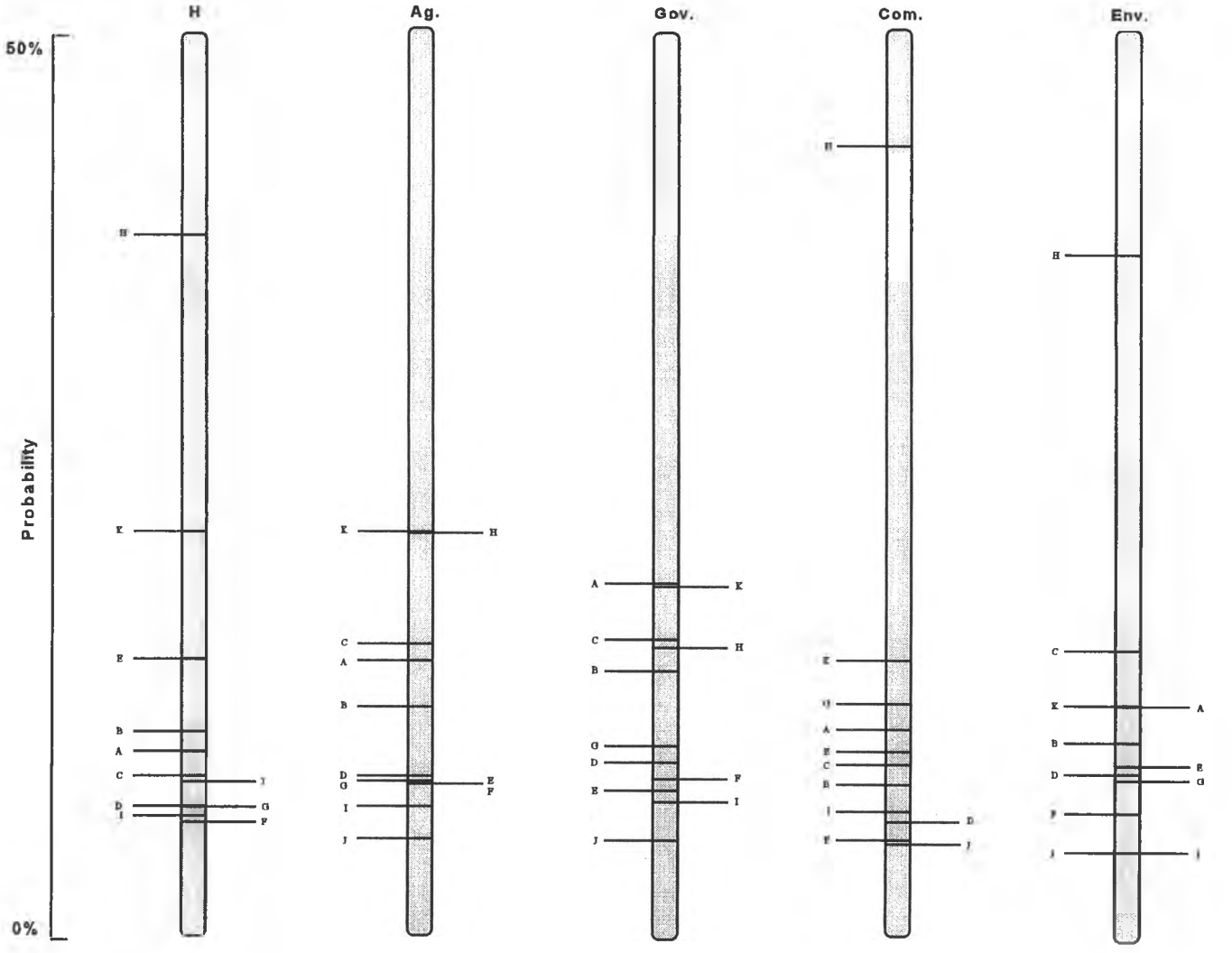
From this figure we see that, in general, the threat of most concern is discharges from pulp mills (H) except for the government group (GOV) where agricultural runoff (A) is seen as the issue of most concern.

In general, industrial wastes/tailings ponds (K) has the second highest probability of being selected as the issue of most concern except for environmental groups (Env) where forestry harvesting practices © has the second highest probability.

Figures 3 and 4 show the probability that a threat to water quality/quantity will be selected as the issue of most concern to the household sample by region.

From these figures we see that in general, the regions are similar to the household sample as a whole except for the Smoky/Wapiti and the Lesser Slave basins. In the Smoky/Wapiti Basin industrial wastes/tailing ponds (K) are of most concern while discharges from pulp mills are seen as the most concern in the other regions. The probability that discharges from pulp mills (H) and industrial wastes/tailing ponds (K) is almost the same in the Lesser Slave Basin but this probability is different in other regions.

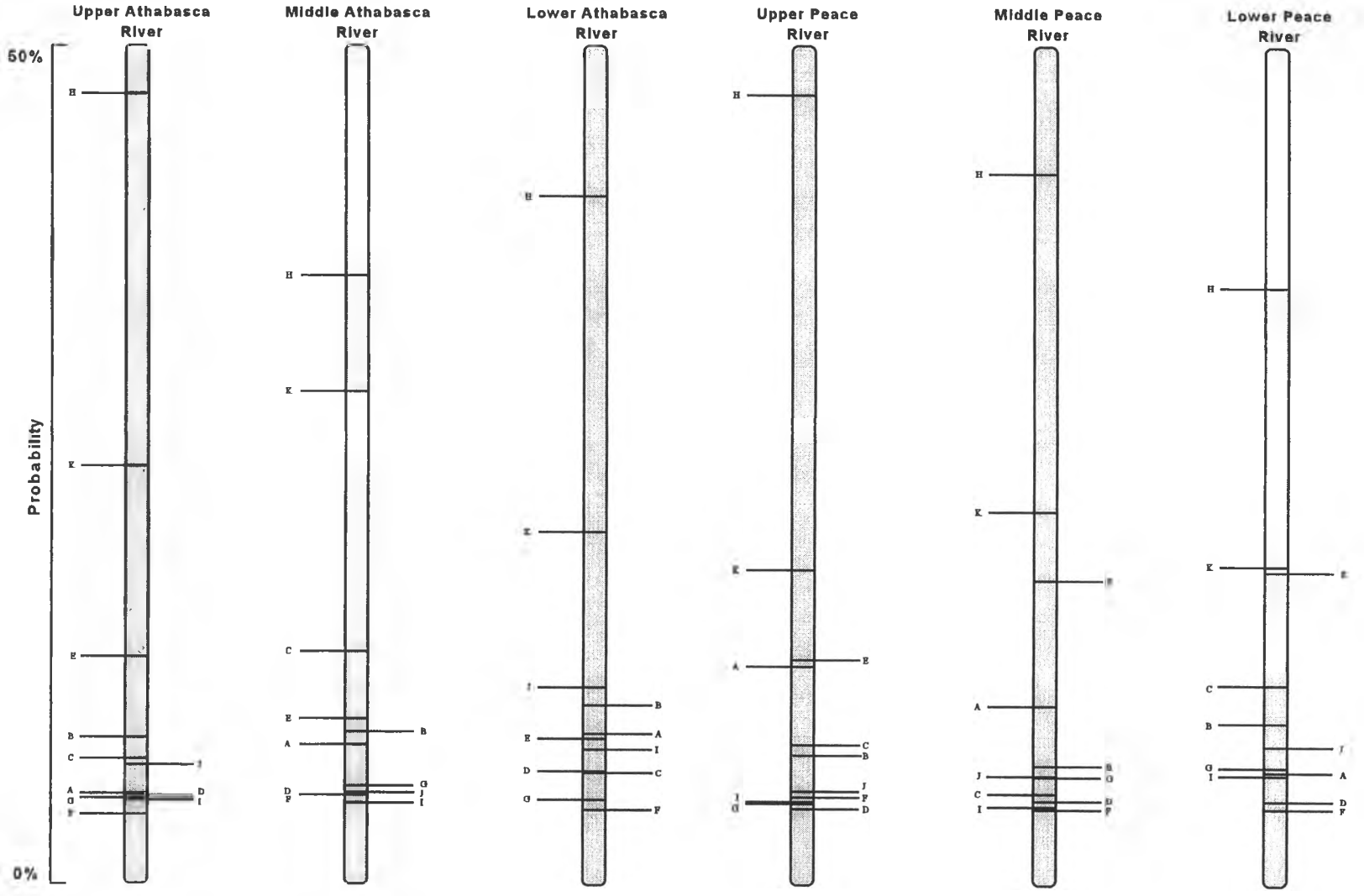
Figure 2: Threats to Water Quality and Quantity by Household & Stakeholder Groups



Threats to Water Quality and Quantity

(A) agricultural run-off
(B) groundwater contamination
(C) forestry harvesting practices
(D) draining wetlands and muskeg
(E) discharges of municipal sewage
(F) seismic exploration/road and pipeline development
(G) river flows controlled by dams
(H) discharges from pulp mills
(I) airborne pollutants
(J) uranium contamination
(K) industrial wastes/tailing ponds

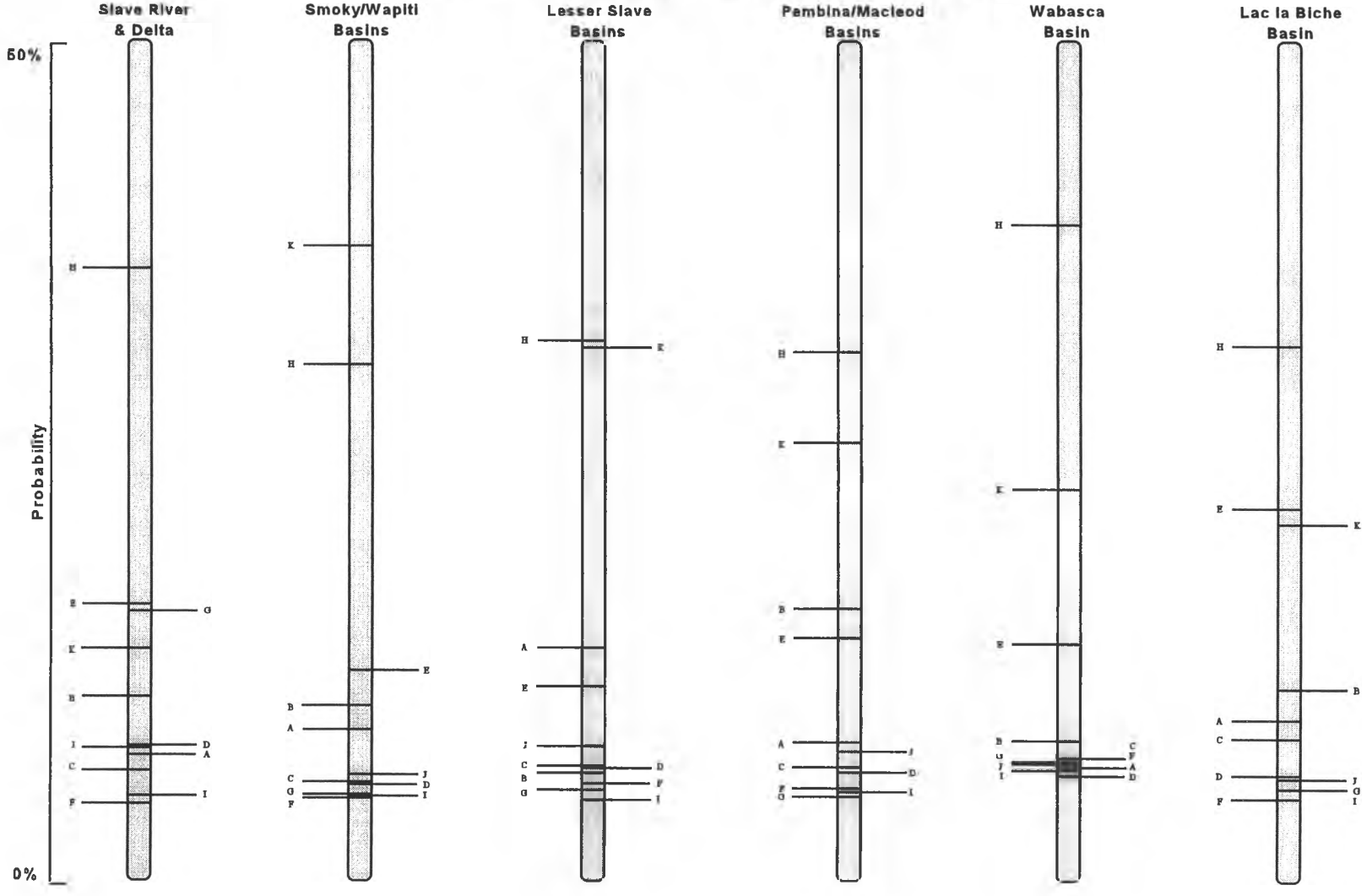
Figure 3: Threats to Water Quality and Quantity by Region



Threats to Water Quality and Quantity

(A) agricultural run-off
(B) groundwater contamination
(C) forestry harvesting practices
(D) draining wetlands and muskeg
(E) discharges of municipal sewage
(F) seismic exploration/road and pipeline development
(G) river flows controlled by dams
(H) discharges from pulp mills
(I) airborne pollutants
(J) uranium contamination
(K) industrial wastes/tailing ponds

Figure 4: Threats to Water Quality and Quantity by Region



Threats to Water Quality and Quantity

(A) agricultural run-off
(B) groundwater contamination
(C) forestry harvesting practices
(D) draining wetlands and muskeg
(E) discharges of municipal sewage
(F) seismic exploration/road and pipeline development
(G) river flows controlled by dams
(H) discharges from pulp mills
(I) airborne pollutants
(J) uranium contamination
(K) industrial wastes/tailing ponds

3.3 PROBABILITY OF A MANAGEMENT ACTION BEING SELECTED AS THE MOST EFFECTIVE RESPONSE

Figure 5 shows the probability that a management action will be selected as the issue of most concern to the stakeholder sample by group.

From this figure we see that in there is variability in the probability that a management action will be of most concern by stakeholder group. For the Household (H), Agriculture (Ag), Government (Gov) and Commercial (Com) groups, the high probability management actions are:

- developing a management plan for the entire basin (K)
- enforce existing pollution laws (E)

For the Industrial users (Ind) and Environmental (Env) groups, preserve and maintain ecosystems (G) has the highest probability of being selected.

Figures 6 and 7 show the probability that a threat to water quality/quantity will be selected as the issue of most concern to the household sample by region.

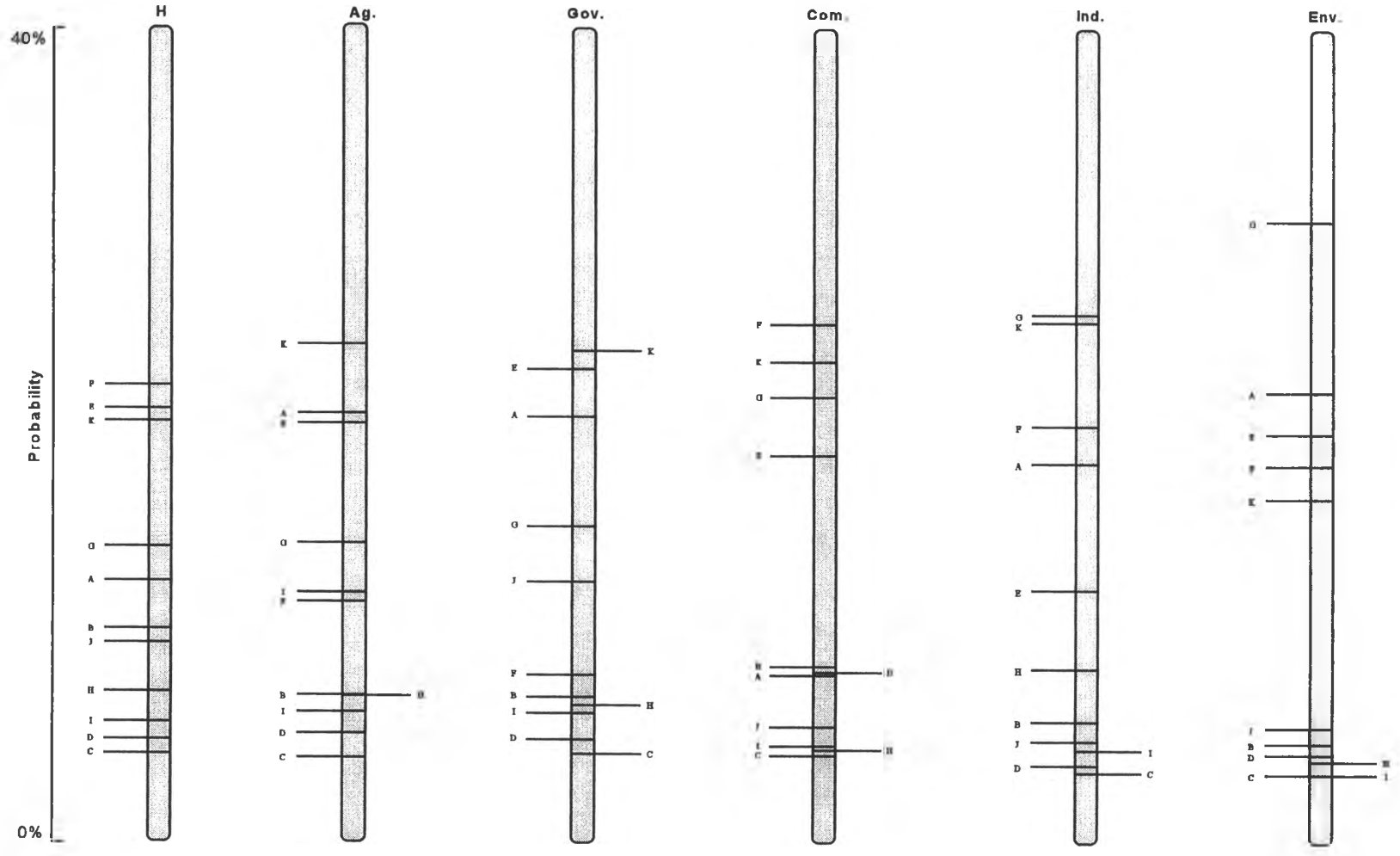
From these figures we see that in general the regions are similar to the household sample in that the high probability management actions are:

- reduce industrial effluent loads (F)
- enforce existing pollution laws (E)
- develop a management plan for the entire basin (K)

For the Lesser Slave Basin, changing land use practices to reduce erosion and pollution (A) has the highest probability as the preferred management action.

For the Pembina/Macleod and Lac la Biche basins, preserve and maintain ecosystems (G) has a high probability of being selected.

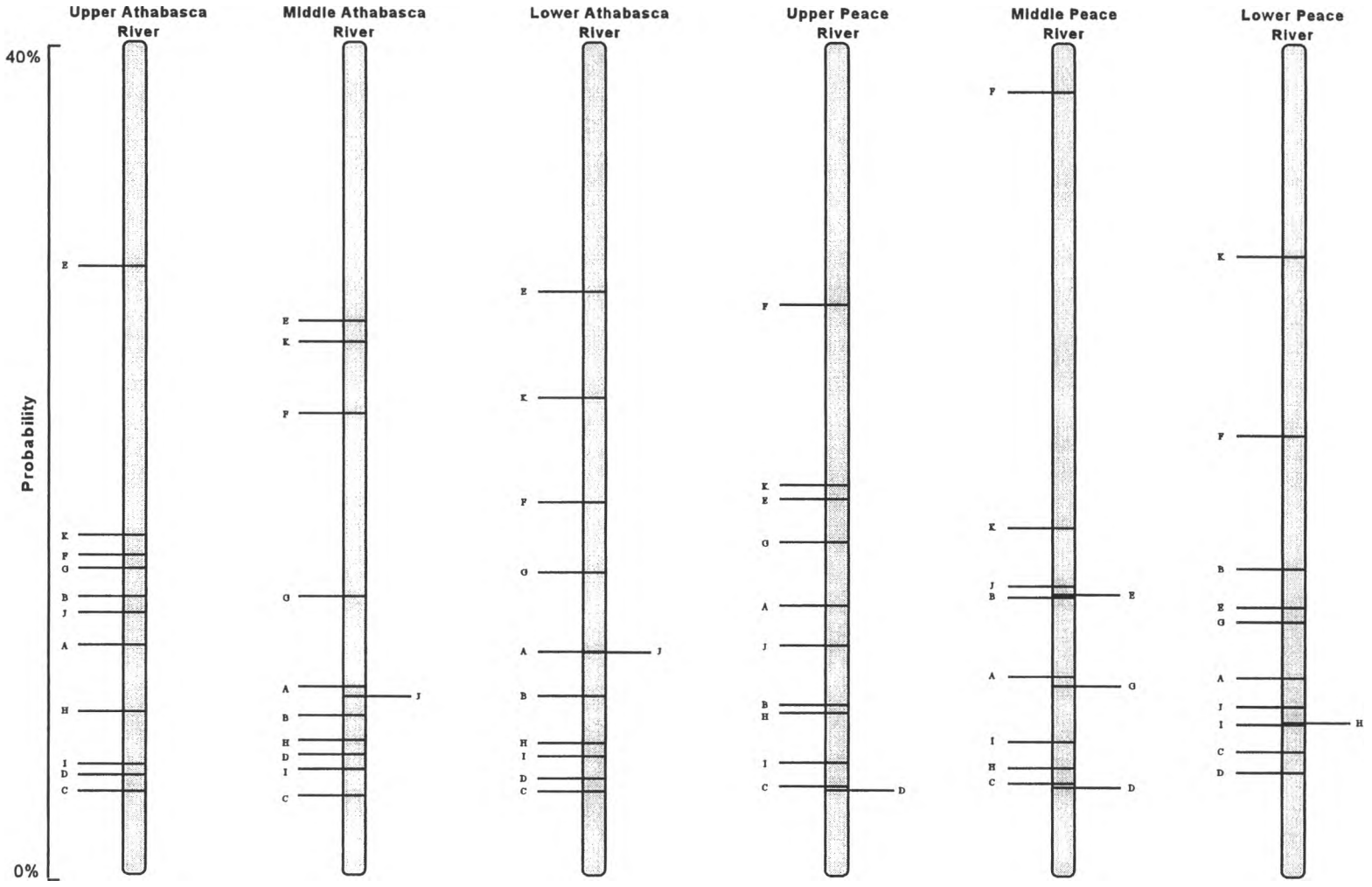
Figure 5: Management Actions by Household & Stakeholder Groups



Management Actions

(A) change land use practices to reduce erosion and pollution
(B) improve municipal wastewater treatment
(C) provide more flood protection
(D) protect traditional fishing, hunting, and trapping
(E) enforce existing pollution laws
(F) reduce industrial effluent loads
(G) preserve and maintain ecosystems
(H) make polluters pay an annual fee based on the volume they produce
(I) improve treatment of municipal drinking water
(J) increase monitoring of water quality
(K) develop a management plan for the entire basin

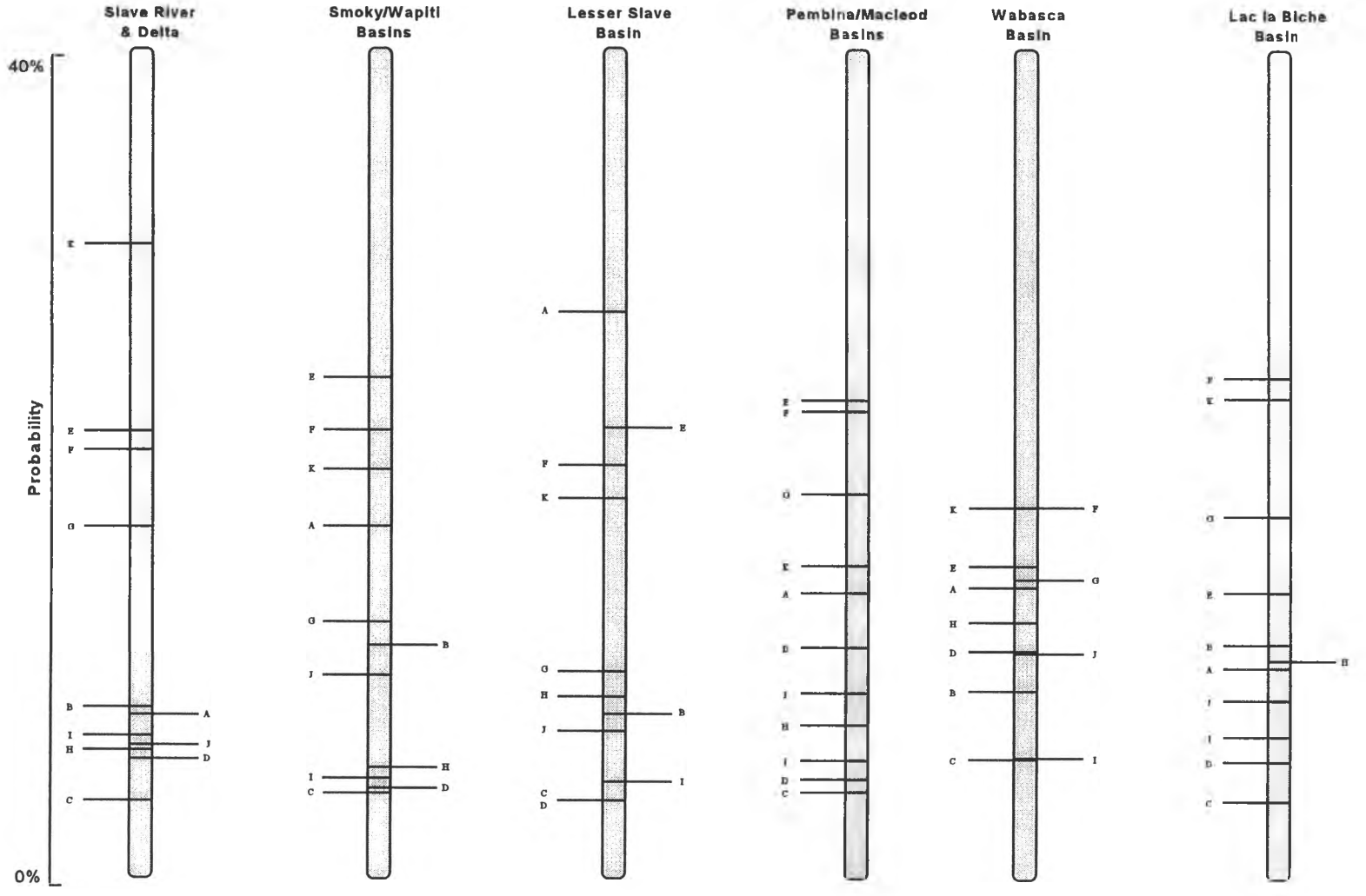
Figure 6: Management Actions by Region



Management Actions

(A) change land use practices to reduce erosion and pollution
(B) improve municipal wastewater treatment
(C) provide more flood protection
(D) protect traditional fishing, hunting, and trapping
(E) enforce existing pollution laws
(F) reduce industrial effluent loads
(G) preserve and maintain ecosystems
(H) make polluters pay an annual fee based on the volume they produce
(I) improve treatment of municipal drinking water
(J) increase monitoring of water quality
(K) develop a management plan for the entire basin

Figure 7: Management Actions by Region



Management Actions

(A) change land use practices to reduce erosion and pollution
(B) improve municipal wastewater treatment
(C) provide more flood protection
(D) protect traditional fishing, hunting, and trapping
(E) enforce existing pollution laws
(F) reduce industrial effluent loads
(G) preserve and maintain ecosystems
(H) make polluters pay an annual fee based on the volume they produce
(I) improve treatment of municipal drinking water
(J) increase monitoring of water quality
(K) develop a management plan for the entire basin

APPENDIX A - MODEL ESTIMATION RESULTS

Threats to Water Quality and Quantity

The goodness-of-fit measures shown in each of the following reports is akin to the R-squared measure in regression. The first measure (McFadden's RhoSq) does not adjust for the number of parameters and the second measure (McFadden's RhoSq(AIC)) does.

Each parameter has a number of statistics associated with it: the parameter estimate, the standard error of the parameter, the asymptotic t-statistic for the hypothesis that the parameter is equal to zero and the two-tailed probability that a standard normal variate would have a value greater than the t-statistic.

Region 1 Estimation Report

```
GOODNESS-OF-FIT STATISTICS:
     McFadden's RhoSq           .255725             .255725
     McFadden's RhoSq(AIC)      .228434             .228434

                  Parameter        SE of      Asymptotic
                  Estimate       Parameter      t-Stat    Pr(Z>|t|)
               ------------------------------------------------------
 intercpt        .34903740      .53062106          .658     .5107
 alt1           -.72696553      .24960530        -2.912     .0036
 alt2            .27732635      .25887298         1.071     .2840
 alt3           -.21473495E-02  .27495454         -.008     .9938
 alt4           -.78930260      .26046807        -3.030     .0024
 alt5            .91284142      .25781815         3.541     .0004
 alt6           -1.7528915      .23132253        -7.578     .0000
 alt7           -.87984911      .24102042        -3.651     .0003
 alt8            2.3776427      .26832167         8.861     .0000
 alt9           -.98427515      .23608643        -4.169     .0000
 alt10          -.99606153E-01  .24718938         -.403     .6870
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Region 2 Estimation Report

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GOODNESS-OF-FIT STATISTICS:
     McFadden's RhoSq           .198316             .198316
     McFadden's RhoSq(AIC)      .175842             .175842

                  Parameter        SE of      Asymptotic
                  Estimate       Parameter      t-Stat    Pr(Z>|t|)
               ------------------------------------------------------
 intercpt        .77075682      .52472696         1.469     .1419
 alt1           -.68093562E-02  .22481377         -.030     .9758
 alt2            .15276084      .22966013          .665     .5059
 alt3            .75985923      .22769931         3.337     .0008
 alt4           -.95397081      .21792690        -4.377     .0000
 alt5            .27529706      .22367227         1.231     .2184
 alt6           -.94846669      .21054357        -4.505     .0000
 alt7           -.70684118      .21396434        -3.304     .0010
 alt8            1.9019560      .21978752         8.654     .0000
 alt9           -1.2671956      .21160948        -5.988     .0000
 alt10          -.87277989      .21964462        -3.974     .0001
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Region 3 Estimation Report

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GOODNESS-OF-FIT STATISTICS:
     McFadden's RhoSq           .185817             .185817
     McFadden's RhoSq(AIC)      .162998             .162998

                  Parameter        SE of      Asymptotic
                  Estimate       Parameter      t-Stat    Pr(Z>|t|)
               ------------------------------------------------------
 intercpt       -.34844846E-01  .32762057         -.106     .9153
 alt1            .31810636E-01  .22957240          .139     .8898
 alt2            .30358203      .21960489         1.382     .1668
 alt3           -.49157328      .22405659        -2.194     .0282
 alt4           -.47126418      .22160983        -2.127     .0335
 alt5           -.16218625E-01  .21806711         -.074     .9407
 alt6           -1.6054067      .21893263        -7.333     .0000
 alt7           -1.1737443      .21246006        -5.525     .0000
 alt8            1.9405820      .22059414         8.797     .0000
 alt9           -.14185985      .21621945         -.656     .5118
 alt10           .44050194      .21174516         2.080     .0375
 ------------------------------------------------------------------------------
```

Region 4 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.249045	.249045
McFadden's RhoSq(AIC)	.225622	.225622

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	-.10808553	.33037333	-.327	.7435
alt1	.77288055	.24040698	3.215	.0013
alt2	-.21245239E-01	.25145107	-.084	.9327
alt3	.10598409	.24611389	.431	.6667
alt4	-1.3666097	.21122974	-6.470	.0000
alt5	.81726273	.22131419	3.693	.0002
alt6	-.87718592	.26596247	-3.298	.0010
alt7	-1.1543178	.22935525	-5.033	.0000
alt8	2.2885110	.23592612	9.700	.0000
alt9	-1.0927201	.21637845	-5.050	.0000
alt10	-.71970590	.23442663	-3.070	.0021

Region 5 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.247620	.247620
McFadden's RhoSq(AIC)	.220605	.220605

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	-.13507472E-01	.39245557	-.034	.9725
alt1	.50120846	.26603396	1.884	.0596
alt2	-.18085821	.25897584	-.698	.4850
alt3	-.77121608	.24910235	-3.096	.0020
alt4	-1.0162040	.24327290	-4.177	.0000
alt5	1.2075251	.24950538	4.840	.0000
alt6	-1.4226592	.23823722	-5.972	.0000
alt7	-.36822235	.24861514	-1.481	.1386
alt8	2.1757716	.25162975	8.647	.0000
alt9	-1.2138178	.23675777	-5.127	.0000
alt10	-.35963458	.26184713	-1.373	.1696

Region 6 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.196235	.196235
McFadden's RhoSq(AIC)	.159448	.159448

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	-.34492553	.35271668	-.978	.3281
alt1	-.50145745	.28482461	-1.761	.0783
alt2	.12665960	.28311045	.447	.6546
alt3	.43874992	.30687972	1.430	.1528
alt4	-1.2300691	.26751442	-4.598	.0000
alt5	1.0214253	.28995383	3.523	.0004
alt6	-1.5681516	.25876378	-6.060	.0000
alt7	-.40311915	.27912249	-1.444	.1487
alt8	1.7641276	.28860381	6.113	.0000
alt9	-.56548047	.27076000	-2.088	.0368
alt10	-.12538812	.28039797	-.447	.6547

Region 7 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.183862	.183862
McFadden's RhoSq(AIC)	.156595	.156595

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	-.49662570	.25906067	-1.917	.0552
alt1	-.36474959	.23814436	-1.532	.1256
alt2	.26036002	.24537588	1.061	.2887
alt3	-.62847625	.27461511	-2.289	.0221
alt4	-.20679974	.26112878	-.792	.4284
alt5	.81238392	.24305898	3.342	.0008
alt6	-1.4819823	.21538603	-6.881	.0000
alt7	.78506775	.23106284	3.398	.0007
alt8	1.7420990	.23447653	7.430	.0000
alt9	-1.2663567	.23644094	-5.356	.0000
alt10	-.22963543	.24791781	-.926	.3543

Region 8 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.201647	.201647
McFadden's RhoSq(AIC)	.187466	.187466

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	.90827507	.51364912	1.768	.0770
alt1	.19714692	.17571524	1.122	.2619
alt2	.39652127	.18855546	2.103	.0355
alt3	-.63068369	.18924874	-3.333	.0009
alt4	-.71500424	.18711622	-3.821	.0001
alt5	.67158134	.17797329	3.773	.0002
alt6	-1.1218199	.15875300	-7.066	.0000
alt7	-1.0102658	.16553785	-6.103	.0000
alt8	1.7650583	.17323707	10.189	.0000
alt9	-1.0784257	.17736595	-6.080	.0000
alt10	-.47020993	.19869662	-2.366	.0180

Region 9 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.189595	.189595
McFadden's RhoSq(AIC)	.161507	.161507

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	-.18908234	.39208717	-.482	.6296
alt1	.69876429	.25911637	2.697	.0070
alt2	-.55320516	.23794671	-2.325	.0201
alt3	-.40977540	.24135121	-1.698	.0895
alt4	-.43301338	.26709320	-1.621	.1050
alt5	.44414518	.26737136	1.661	.0967
alt6	-.79054021	.22183023	-3.564	.0004
alt7	-.96745452	.23357790	-4.142	.0000
alt8	1.7068704	.25151857	6.786	.0000
alt9	-1.2813456	.23360700	-5.485	.0000
alt10	-.10773170	.24006165	-.449	.6536

Region 10 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.189678	.189678
McFadden's RhoSq(AIC)	.175754	.175754

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	-.28233373E-01	.27674968	-.102	.9187
alt1	-.11737951	.18210183	-.645	.5192
alt2	.85633490	.17604209	4.864	.0000
alt3	-.47387822	.17077451	-2.775	.0055
alt4	-.57372513	.16887256	-3.397	.0007
alt5	.71151455	.17560084	4.052	.0001
alt6	-.94316082	.17754378	-5.312	.0000
alt7	-1.2415543	.16736520	-7.418	.0000
alt8	1.6414956	.17292646	9.492	.0000
alt9	-1.0524101	.16167558	-6.509	.0000
alt10	-.23679853	.16441405	-1.440	.1498

Region 11 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.139498	.139498
McFadden's RhoSq(AIC)	.107958	.107958

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	.20333573	.39591574	.514	.6075
alt1	-.51169398	.24738493	-2.068	.0386
alt2	-.14195281	.24381306	-.582	.5604
alt3	-.38683319	.25579906	-1.512	.1305
alt4	-.70651211	.25154352	-2.809	.0050
alt5	.61738241	.26708068	2.312	.0208
alt6	-.39269633	.23960177	-1.639	.1012
alt7	-.44571629	.24052042	-1.853	.0639
alt8	1.8208627	.26624695	6.839	.0000
alt9	-.59907106	.24391845	-2.456	.0140
alt10	-.49172224	.23536121	-2.089	.0367

Region 12 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.192917	.192917
McFadden's RhoSq(AIC)	.164103	.164103

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	.24122465	.39480065	.611	.5412
alt1	.12867319	.25042312	.514	.6074
alt2	.38786191	.25110284	1.545	.1224
alt3	-.65446375E-01	.26971112	-.243	.8083
alt4	-.63491122	.25927505	-2.449	.0143
alt5	1.2326942	.24482269	5.035	.0000
alt6	-1.2659446	.22341453	-5.666	.0000
alt7	-.94797879	.23353081	-4.059	.0000
alt8	1.6480555	.24251886	6.796	.0000
alt9	-.96191701	.24432953	-3.937	.0001
alt10	-.70380322	.25600855	-2.749	.0060

Group 1 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.173728	.173728
McFadden's RhoSq(AIC)	.171778	.171778

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	.10917158	.10007339	1.091	.2753
alt1	.34446670E-01	.65263811E-01	.528	.5976
alt2	.21214879	.65123224E-01	3.258	.0011
alt3	-.24029506	.66521351E-01	-3.612	.0003
alt4	-.72459892	.63936302E-01	-11.333	.0000
alt5	.67446875	.64181908E-01	10.509	.0000
alt6	-1.1121062	.60210723E-01	-18.470	.0000
alt7	-.74283145	.61181591E-01	-12.141	.0000
alt8	1.8293940	.63903558E-01	28.627	.0000
alt9	-.93895280	.61092548E-01	-15.369	.0000
alt10	-.30721201	.63820764E-01	-4.814	.0000

Groups 2, 3, & 4 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.116528	.116528
McFadden's RhoSq(AIC)	.094185	.094185

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	.79736945	.39253263	2.031	.0422
alt1	.51273899	.21150427	2.424	.0153
alt2	.26506040	.20290893	1.306	.1914
alt3	.59098591	.20109068	2.939	.0033
alt4	-.27550230	.20956008	-1.315	.1886
alt5	-.36960246	.21127309	-1.749	.0802
alt6	-.36915874	.21375575	-1.727	.0842
alt7	-.32912245	.20848336	-1.579	.1144
alt8	.98573464	.20512540	4.806	.0000
alt9	-.65967722	.20081205	-3.285	.0010
alt10	-1.3394785	.18979033	-7.058	.0000

Groups 2 & 4 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.117897	.117897
McFadden's RhoSq(AIC)	.088450	.088450

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	.75265448	.40932330	1.839	.0659
alt1	.78838189	.24052028	3.278	.0010
alt2	.43631513	.22869058	1.908	.0564
alt3	.57065962	.23075330	2.473	.0134
alt4	-.18474832	.24454837	-.755	.4500
alt5	-.48107895	.24523513	-1.962	.0498
alt6	-.33133880	.23853814	-1.389	.1648
alt7	-.34874287E-01	.23644378	-.147	.8827
alt8	.54317391	.23840054	2.278	.0227
alt9	-.62340793	.23113678	-2.697	.0070
alt10	-1.4632237	.21741308	-6.730	.0000

Groups 5, 7, & 8 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.169658	.169658
McFadden's RhoSq(AIC)	.131348	.131348

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	.35731229	.36471862	.980	.3272
alt1	.33987825	.29231174	1.163	.2449
alt2	-.14806661	.29093393	-.509	.6108
alt3	.50240443E-01	.26949326	.186	.8521
alt4	-.69341184	.27402825	-2.530	.0114
alt5	.17447046	.28024854	.623	.5336
alt6	-1.1571035	.27052341	-4.277	.0000
alt7	.50743930	.27327307	1.857	.0633
alt8	1.9682829	.27744691	7.094	.0000
alt9	-.50374451	.27919638	-1.804	.0712
alt10	-1.2703648	.28164913	-4.510	.0000

Group 9 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.179439	.179439
McFadden's RhoSq(AIC)	.146807	.146807

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	-.34847492	.28451844	-1.225	.2207
alt1	.46487697	.27462873	1.693	.0905
alt2	.22069767	.26892703	.821	.4118
alt3	.73956969	.25148553	2.941	.0033
alt4	-.48529541E-01	.27836791	-.174	.8616
alt5	.22118330E-01	.27760420	.080	.9365
alt6	-.52385110	.27391746	-1.912	.0558
alt7	-.10601671	.26573159	-.399	.6899
alt8	1.7528751	.25054381	6.996	.0000
alt9	-1.5195173	.24900790	-6.102	.0000
alt10	-1.4737977	.24770205	-5.950	.0000

Management Actions

Region 1 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.177345	.177345
McFadden's RhoSq(AIC)	.148879	.148879

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	-.70658794	.24558354	-2.877	.0040
alt1	.19118751	.25410830	.752	.4518
alt2	.43949974	.24160199	1.819	.0689
alt3	-1.7094586	.25123224	-6.804	.0000
alt4	-1.2145707	.24930322	-4.872	.0000
alt5	1.3617347	.24243816	5.617	.0000
alt6	.61415860	.24845890	2.472	.0134
alt7	.56374462	.24766182	2.276	.0228
alt8	-.29535198	.26281224	-1.124	.2611
alt9	-1.0046950	.24016177	-4.183	.0000
alt10	.36238299	.23675106	1.531	.1259

Region 2 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.203129	.203129
McFadden's RhoSq(AIC)	.180791	.180791

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	-.48630455	.26849811	-1.811	.0701
alt1	.13178437E-01	.22327550	.059	.9529
alt2	-.23997240	.23055705	-1.041	.2980
alt3	-1.7943274	.21449685	-8.365	.0000
alt4	-.71578896	.21798520	-3.284	.0010
alt5	1.3461408	.22129939	6.083	.0000
alt6	1.1406601	.21599384	5.281	.0000
alt7	.53565119	.23123765	2.316	.0205
alt8	-.51902972	.22297370	-2.328	.0199
alt9	-.99955867	.21802460	-4.585	.0000
alt10	-.69317990E-01	.22282195	-.311	.7557

Region 3 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.183737	.183737
McFadden's RhoSq(AIC)	.160297	.160297

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	-.36244552	.27106526	-1.337	.1812
alt1	.20397627	.23056847	.885	.3763
alt2	-.98984473E-01	.22629413	-.437	.6618
alt3	-1.6327976	.22158604	-7.369	.0000
alt4	-1.2443618	.21460622	-5.798	.0000
alt5	1.3629974	.22127563	6.160	.0000
alt6	.85151281	.22428371	3.797	.0001
alt7	.59673460	.23062790	2.587	.0097
alt8	-.58808180	.22842685	-2.574	.0100
alt9	-.78807739	.22188452	-3.552	.0004
alt10	.20029452	.21645594	.925	.3548

Region 4 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.189803	.189803
McFadden's RhoSq(AIC)	.165200	.165200

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	-.62919247	.24539169	-2.564	.0103
alt1	.43934520	.23917631	1.837	.0662
alt2	-.18962640	.24219234	-.783	.4337
alt3	-1.4696698	.23092872	-6.364	.0000
alt4	-1.6008191	.21511737	-7.442	.0000
alt5	.84615659	.22047987	3.838	.0001
alt6	1.3229261	.25530653	5.182	.0000
alt7	.70368158	.24245750	2.902	.0037
alt8	-.26932497	.23710203	-1.136	.2560
alt9	-.90386561	.22441950	-4.028	.0001
alt10	.22980896	.22407180	1.026	.3051

Region 5 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.183626	.183626
McFadden's RhoSq(AIC)	.155186	.155186

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	-.38931678	.26858281	-1.450	.1472
alt1	.79430821E-01	.25083763	.317	.7515
alt2	.51899231	.25603670	2.027	.0427
alt3	-1.3042963	.23480411	-5.555	.0000
alt4	-1.4226637	.23809839	-5.975	.0000
alt5	.53172555	.24787234	2.145	.0319
alt6	1.7136622	.23658291	7.243	.0000
alt7	.14841116E-01	.25491528	.058	.9536
alt8	-.95864164	.24395777	-3.930	.0001
alt9	-.54005965	.25150432	-2.147	.0318
alt10	.57064718	.25225423	2.262	.0237

Region 6 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.114637	.114637
McFadden's RhoSq(AIC)	.078000	.078000

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	.86912220E-01	.39803591	.218	.8272
alt1	-.79127057E-01	.26592455	-.298	.7660
alt2	.49641653	.27256594	1.821	.0686
alt3	-.81804499	.25944091	-3.153	.0016
alt4	-1.1785478	.25533653	-4.616	.0000
alt5	.32784015	.27171406	1.207	.2276
alt6	.92465935	.26393202	3.503	.0005
alt7	.25787023	.26953793	.957	.3387
alt8	-.45084804	.27232717	-1.656	.0978
alt9	-.48341935	.27231596	-1.775	.0759
alt10	-.30582902	.25951581	-1.178	.2386

Region 7 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.188427	.188427
McFadden's RhoSq(AIC)	.161620	.161620

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	.59306550E-02	.38991086	.015	.9879
alt1	-.19833011	.23716673	-.836	.4030
alt2	-.12985191	.23636150	-.549	.5827
alt3	-1.9224096	.24603261	-7.814	.0000
alt4	-.73493349	.25041979	-2.935	.0033
alt5	1.1170344	.24236621	4.609	.0000
alt6	1.0672155	.22190058	4.809	.0000
alt7	.83683220	.23372702	3.580	.0003
alt8	-.59956289	.24725288	-2.425	.0153
alt9	-.41800832	.24627710	-1.697	.0896
alt10	-.52974046	.23397490	-2.264	.0236

Region 8 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.193443	.193443
McFadden's RhoSq(AIC)	.179043	.179043

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	-.16905751	.20763744	-.814	.4155
alt1	.81664552	.16740388	4.878	.0000
alt2	.29917115	.19033539	1.572	.1160
alt3	-1.5872163	.18062937	-8.787	.0000
alt4	-1.3841505	.18467194	-7.495	.0000
alt5	1.2260897	.16891353	7.259	.0000
alt6	1.1000331	.15798397	6.963	.0000
alt7	.42608506	.17506412	2.434	.0149
alt8	-.89955974	.17812127	-5.050	.0000
alt9	-1.1011836	.18251509	-6.033	.0000
alt10	.11101927	.19850670	.559	.5760

Region 9 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.237107	.237107
McFadden's RhoSq(AIC)	.211184	.211184

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	-.48491726	.26872833	-1.804	.0712
alt1	1.4531885	.23968670	6.063	.0000
alt2	-.92933911E-01	.24911742	-.373	.7091
alt3	-1.7985082	.22116509	-8.132	.0000
alt4	-1.7690624	.24595280	-7.193	.0000
alt5	1.1923924	.26591891	4.484	.0000
alt6	1.1631757	.22517386	5.166	.0000
alt7	.22958410	.25926430	.886	.3759
alt8	.44466687E-01	.26111429	.170	.8648
alt9	-1.1281644	.24636559	-4.579	.0000
alt10	-.28433000	.25106650	-1.132	.2574

Region 10 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.167113	.167113
McFadden's RhoSq(AIC)	.153355	.153355

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	-.59272737	.17543293	-3.379	.0007
alt1	.47508825	.17978526	2.643	.0082
alt2	.20440108	.17269411	1.184	.2366
alt3	-1.5901551	.15964162	-9.961	.0000
alt4	-1.2386623	.16194516	-7.649	.0000
alt5	1.0847845	.17351719	6.252	.0000
alt6	1.0589572	.17527555	6.042	.0000
alt7	.78227805	.17682803	4.424	.0000
alt8	-.39695540	.17433760	-2.277	.0228
alt9	-.85810456	.16688965	-5.142	.0000
alt10	-.10727474	.16489355	-.651	.5153

Region 11 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.070252	.070252
McFadden's RhoSq(AIC)	.038496	.038496

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	.25299731	.31709655	.798	.4250
alt1	.30007983	.23863468	1.257	.2086
alt2	-.28296228	.23568203	-1.201	.2299
alt3	-1.0204403	.23628908	-4.319	.0000
alt4	-.17873355E-01	.25274806	-.071	.9436
alt5	.38474209	.24821248	1.550	.1211
alt6	.59473342	.23398611	2.542	.0110
alt7	.33196706	.23861993	1.391	.1642
alt8	.14156394	.24897659	.569	.5696
alt9	-.99738800	.23648862	-4.217	.0000
alt10	-.27928730E-01	.22737142	-.123	.9022

Region 12 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.196689	.196689
McFadden's RhoSq(AIC)	.162190	.162190

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	-.54455322	.30818624	-1.767	.0772
alt1	.92438168E-01	.27722237	.333	.7388
alt2	.23234006	.28313398	.821	.4119
alt3	-1.9553001	.27693048	-7.061	.0000
alt4	-1.3817902	.26093115	-5.296	.0000
alt5	.48948714	.27914632	1.754	.0795
alt6	1.1523456	.26267428	4.387	.0000
alt7	.77582832	.27382118	2.833	.0046
alt8	.14044579	.28529185	.492	.6225
alt9	-.50657305	.27497467	-1.842	.0654
alt10	-.14323282	.28804534	-.497	.6190

Group 1 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.157272	.157272
McFadden's RhoSq(AIC)	.155289	.155289

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	-.35322965	.73086060E-01	-4.833	.0000
alt1	.36347034	.64582099E-01	5.628	.0000
alt2	.91008488E-01	.65443832E-01	1.391	.1643
alt3	-1.5211115	.62348872E-01	-24.397	.0000
alt4	-1.1618528	.63039531E-01	-18.431	.0000
alt5	.97642771	.63961114E-01	15.266	.0000
alt6	1.0377771	.62080526E-01	16.717	.0000
alt7	.51641202	.65109722E-01	7.931	.0000
alt8	-.42305676	.65697873E-01	-6.439	.0000
alt9	-.82008555	.63795296E-01	-12.855	.0000
alt10	-.46759970E-03	.63938578E-01	-.007	.9942

Groups 2, 3 & 4 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.164293	.164293
McFadden's RhoSq(AIC)	.142332	.142332

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	-.31410961	.26878343	-1.169	.2426
alt1	.97919609	.21093222	4.642	.0000
alt2	-.44206988	.20929154	-2.112	.0347
alt3	-1.6714287	.20632951	-8.101	.0000
alt4	-1.0032683	.21288585	-4.713	.0000
alt5	.95269052	.21884485	4.353	.0000
alt6	.27153827	.22179699	1.224	.2209
alt7	.54984980	.22284557	2.467	.0136
alt8	-.44814791	.22103455	-2.028	.0426
alt9	-.66211375	.21269432	-3.113	.0019
alt10	.32290337	.20030268	1.612	.1069

Groups 2 & 4 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.168289	.168289
McFadden's RhoSq(AIC)	.139552	.139552

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	-.40331624	.30290924	-1.331	.1830
alt1	1.0019283	.24428219	4.102	.0000
alt2	-.42820767	.23881401	-1.793	.0730
alt3	-1.4845174	.23228708	-6.391	.0000
alt4	-1.0800744	.24736810	-4.366	.0000
alt5	1.1269787	.25228817	4.467	.0000
alt6	-.20109577	.25142965	-.800	.4238
alt7	.64793068	.25460802	2.545	.0109
alt8	-.52882042	.25315792	-2.089	.0367
alt9	-.63169878	.24260918	-2.604	.0092
alt10	.40729238	.23186737	1.757	.0790

Groups 5, 7, & 8 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.207268	.207268
McFadden's RhoSq(AIC)	.170297	.170297

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	-.60440353	.34785558	-1.738	.0823
alt1	-.10494786	.30358941	-.346	.7296
alt2	-.29811037E-01	.30223491	-.099	.9214
alt3	-1.3986790	.26513467	-5.275	.0000
alt4	-.80340824E-01	.28621605	-.281	.7789
alt5	.99486670	.29814196	3.337	.0008
alt6	1.3289347	.28244495	4.705	.0000
alt7	1.1571199	.29323237	3.946	.0001
alt8	-1.2418610	.27238280	-4.559	.0000
alt9	-1.1304423	.28385102	-3.983	.0001
alt10	-.73880699	.29350072	-2.517	.0118

Group 6 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.293092	.293092
McFadden's RhoSq(AIC)	.259416	.259416

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	-1.0964413	.31753853	-3.453	.0006
alt1	1.1274184	.28951969	3.894	.0001
alt2	-.49291129	.30879354	-1.596	.1104
alt3	-2.0306127	.31756795	-6.394	.0000
alt4	-1.6255654	.28730045	-5.658	.0000
alt5	.62879493	.30116161	2.088	.0368
alt6	1.2437834	.29976692	4.149	.0000
alt7	1.5099639	.28672657	5.266	.0000
alt8	.10612301	.31786338	.334	.7385
alt9	-1.1157802	.27916695	-3.997	.0001
alt10	-.84510378	.29998325	-2.817	.0048

Group 9 Estimation Report

GOODNESS-OF-FIT STATISTICS:

McFadden's RhoSq	.289236	.289236
McFadden's RhoSq(AIC)	.256865	.256865

	Parameter Estimate	SE of Parameter	Asymptotic t-Stat	Pr(Z>|t|)
intercpt	-.86874973	.33122944	-2.623	.0087
alt1	1.5054172	.30588409	4.922	.0000
alt2	-.73584315	.30251878	-2.432	.0150
alt3	-2.0203325	.26997148	-7.484	.0000
alt4	-1.0193764	.29131204	-3.499	.0005
alt5	1.3937011	.31748019	4.390	.0000
alt6	1.2974315	.31543927	4.113	.0000
alt7	1.8677957	.30474037	6.129	.0000
alt8	-1.0597319	.29344163	-3.611	.0003
alt9	-2.0077906	.28216546	-7.116	.0000
alt10	-.40966132	.28374904	-1.444	.1488

APPENDIX B - TERMS OF REFERENCE

NORTHERN RIVER BASINS STUDY

DRAFT

SCHEDULE A - TERMS OF REFERENCE

Project 4121-E2: Analysis of Survey Data

I. BACKGROUND & OBJECTIVES

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

The Study Board developed a vision statement to provide overall guidance for the various technical activities being conducted in support of the study and also identified 16 questions that serve to focus study activities. One of these questions is:

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

Eight component groups have since been established to address these 16 questions and the Other Uses Component is primarily responsible for developing and undertaking research and investigations related to the use of water resources. This group is working in close association with the Traditional Knowledge Component, which is responsible for collecting information on resource use and values of indigenous people and long-time residents.

In order to collect information about stakeholders and their uses of aquatic resources, the Other Uses Component has undertaken surveys of 10 different categories of northern residents, including random samples of the general public and representative surveys of various types of special interest groups. A consultant is now required to analyze the results of these surveys and prepare a report which will generate much of the content for the final synthesis report for the Other Uses Component. A summary of previous projects that have been conducted on behalf of the Other Uses Component and provide the background information for this work is provided in Table 1. A copy of the draft table of contents for the synthesis report is provided as Attachment 1.

Table 1

SUMMARY OF COMPLETED PROJECTS RELATED TO THIS WORK

PROJECT NUMBER	PROJECT TITLE	PROJECT DESCRIPTION
4121-D1	Stakeholder Screening	This project expanded on the list of stakeholders identified as part of Project 4111-B1, contacted the majority of them by telephone and determined potential interest in future data collection activities. A proposal to undertake regional workshops was abandoned in favour of a telephone/mail survey to collect more detailed information on resource use and stakeholder attitudes.
4121-D2	Questionnaire Design and Survey Methods	This project examined several approaches for undertaking a stratified random sample of households in the study area and recommended an approach based on use of telephone sampling tied to 12 specific geographical areas within the basin. A draft of the questionnaire to be used for the household survey was also developed and submitted for review by the Study Board and the Science Advisory Committee.
4121-D3	Implementation of Household Survey	The survey of northern households commenced in mid-January of 1995. Within two weeks about 1400 households had been contacted by telephone and had agreed to complete a detailed questionnaire which was sent out by mail. The raw results of the survey are now available.

4121-D4	Survey of Interest Groups, Industries and Municipal Governments	Nine different types of surveys were developed for specific categories of stakeholders within the basin and questionnaires were sent to approximately 700 different groups and associations by mid-February, 1995. The raw results of these surveys are now available.

Although different questionnaires were employed in the surveys of ten different populations, many of the same questions were used so that comparisons among user groups could be undertaken, especially related to issues and concerns. Different questions were required to identify how the different groups make use of the northern rivers. A description of the ten survey populations and the number of completed survey responses received to date is provided below:

Survey Population	Description	Number Sent	Number Received
General Households	Households were selected at random from each of 12 regions and contacted by telephone to solicit participation in the survey which was sent by mail.	~1400	~715
Agricultural Associations	Includes representatives of various agricultural groups and community agricultural associations.	86	18
Agricultural Service Boards	Organizations created by municipal districts to provide assistance to local farmers.	24	7
Tourism/Recreation Businesses	Includes guides, outfitters and hunting and fishing lodges.	51	17
General Stakeholder Groups	Includes environmental and recreation groups plus Native friendship centres.	160	39
Industrial Users	Individuals or companies holding industrial water licences.	100	43
Municipal & Local Governments	Cities, towns, summer villages and native communities.	112	33
Commercial Fishermen	Individuals and enterprises involved in commercial fishing	47	10
Trappers	Individuals and enterprises involved in trapping	24	9
River Transportation	Individuals involved in commercial river transportation	3	1

Completed responses for each of the ten survey populations have, to a large extent, been codified and been entered into an SPSS/PC+ data base. Verbatim transcripts of written comments on the major open-ended questions have also been prepared and, because of their complexity, these responses have not yet been codified to facilitate analysis of the information.

II. REQUIREMENTS

In general, the Contractor will prepare a detailed statistical analysis of the results of the household survey and all nine stakeholder surveys. This will entail mainly descriptive statistics with testing for significant differences among stakeholder groups and among the 12 regions in the household survey. Where appropriate, survey results will be extrapolated to produce basin-wide estimates of resource use. Analysis will focus on the following:

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

This information will be summarized in a final report that will comprise a major part of the final synthesis paper for the Other Uses Component and will also be used to produce a summary that could be distributed to basin residents through RiverViews.

In detail, the following tasks will be completed:

1. The Contractor will review the design of the various surveys and the coding of the survey results, based on a review of documentation from projects 4121-D3 and 4121-D4.

2. The Contractor will finish coding the stakeholder surveys, using the coding practices developed for the household survey. In some cases this may just involve adding data labels to identify the codes already used while in other cases, this will involve reviewing the results of individual surveys, assigning numeric codes, entering the numeric codes in the SPSS/PC+ database, and then adding the value labels. The Contractor will work closely with the Project Liaison Officer to ensure that the resulting codes are consistent with and supportive of other areas of research being undertaken by the NRBS.

3. The Contractor will, using the survey results, prepare a description of each type of consumptive and non-consumptive water use. This description will include estimates of the number of users, the amount of use, the location of these uses, how these uses have changed in recent years, and the potential for change in use in the near future. Key types of water us to be addressed are: municipal use; domestic use; agricultural use; industrial

use; recreational uses; traditional fishing, hunting and trapping; river transportation; and commercial fishing. These descriptions should be consistent Section 3.0 of the draft table of contents for the synthesis report.

4. The Contractor will review the summary of written comments related to questions 58 to 72 of the household survey. These questions are common to all surveys and attempt to identify to the factors that have most affected water quality or quantity in the study area.. The Contractor will develop a system for grouping these comments into meaningful categories that are amenable to numeric analysis and then submit this for review by the Project Liaison Officer. Upon approval, the contractor will code all responses and enter them into the respective databases. The Contractor will then undertake a basic frequency analysis of the responses by sub-basin and by stakeholder group, and then provide a written summary of the results. This summary should include a quantitative analysis of which factors were of greatest importance, highlighting any significant differences among groups, plus a qualitative description that summarizes the effects that these factors have had upon basin residents using, as much as possible, their own words. The resulting report should be consistent with Section 4.0 of the draft table of contents for the synthesis report.

5. The Contractor will review the results of questions 75 and 76 of the household survey and the corresponding questions for the stakeholder surveys. These results have been coded but need to be recoded to reduce overlapping categories and to focus the analysis on the key recommendations that respondents would like the Study Board to make. The Contractor will work with the Project Liaison Officer to develop a recoding strategy and to then implement this strategy when completed. The Contractor will then undertake a basic frequency analysis of the responses by sub-basin and by stakeholder group, and then provide a written summary of the results. This summary should include a quantitative analysis of which recommendations were identified most often, highlighting any significant differences among groups, plus a a qualitative description of how this measure should be monitored, who should be responsible for monitoring and who should be paying for monitoring. The resulting report should be consistent with Section 6.2 of the draft table of contents for the synthesis report.

6. The Contractor will review the results of questions 77 and 79 of the household survey and the corresponding questions for the stakeholder surveys. These results have been coded but need to be recoded to reduce overlapping categories and to focus the analysis on the key indicators of river health. The Contractor will work with the Project Liaison Officer to develop a recoding strategy and to then implement this strategy when completed. The Contractor will then undertake a basic frequency analysis of the responses by sub-basin and by stakeholder group, and then provide a written summary of the results. This summary should include a quantitative analysis of which measure of river health were identified most often, highlighting any significant differences among groups, plus a qualitative description of these recommendations using, as much as possible, their own

words. The resulting report should be consistent with Section 6.1 of the draft table of contents for the synthesis report.

7. The Contractor will prepare an simple descriptive analysis of the results of questions 80 to 82 in the household survey, including the development of coding system for question 82. This analysis should highlight any similarities or differences among sub-basins or among stakeholder groups. The results of the analysis will be passed onto the Operations Committee of the NRBS for their use and interpretation.

8. The Contractor will prepare a brief report that describes the results of the analysis undertaken as part of tasks 3 to 6 above. A draft report will be submitted for review and comment, and a final report will then be prepared to incorporate any comments raised during the review process. The final report will eventually become part of the synthesis report for the Other Uses Component.

This study must be completed in two phases. The first phase consists of preparing a very simple overview of the survey results for possible use in the RiverViews publication. This Overview report is due July 15, 1995. The remainder of the analysis must then be completed by August 31, with the draft report being submitted at that time.

The study will be conducted under the supervision of the Component Leader (Bruce MacLock) and Project Liaison Office (John Thompson), and an advisory group which consists of:

- Hugh Seaton, Director, Research and Coordination, Northern Alberta Development Council
- Dr. Terry Veeman, Professor, Department of Rural Economy, University of Alberta
- Dr. Vic Adamowicz, Professor, Department of Rural Economy, University of Alberta
- Dr. Derek Bjonback, Chief, Socio-Economic Division, Environment Canada

III. REPORTING REQUIREMENTS

1) The Contractor is to provide draft and final reports in the style and format outlined in the NRBS Style Manual. A copy of the Style Manual entitled " A Guide for the Preparation of Reports" will be supplied to the contractor by the NRBS.

2) Ten copies of the Draft Overview Report along with an electronic disk copy are to be submitted to the Project Liaison Officer by July 15, 1995. The complete Draft Report is due August 31, 1995.

   Three weeks after the receipt of review comments on the draft report, the Contractor is to provide the Project Liaison Officer with two unbound, camera-ready copies and ten cerlox-bound copies of the final report along with an electronic version.

3) The final report is to include the following: an acknowledgment section that indicates any local involvement in the project, Project Summary, Table of Contents, List of Tables, List of Figures and an Appendix with the Terms of Reference for this Project.

Text for the report should be set up in the following format:

a) Times Roman 12 point (Pro) or New Times Roman (WPWIN60) font.
b) Margins are 1" at top and bottom, 7/8" on left and right.
c) Headings in the report body are labeled with hierarchical decimal Arabic numbers
d) Text is presented with full justification; that is, aligns on both left and right margins.
e) Page numbers are Arabic numbers for the body of the report, centred at the bottom of each page and bold.

- If photographs are to be included in the report text they should be high contrast black and white.
- All tables and figures in the report should be clearly reproducible by a black and white photocopier.
- Along with copies of the final report, the Contractor is to supply an electronic version of the report in Word Perfect 5.1 or Word Perfect for Windows Version 6.0 format.
- Electronic copies of tables, figures and data appendices in the report are also to be submitted to the Project Liaison Officer in a spreadsheet (Quattro Pro preferred, but also Excel or Lotus) or database (dBase IV) format. Where appropriate, data in tables, figures and appendices should be geo-referenced.

IV. DELIVERABLES

1. All figures and maps are to be delivered in both hard copy (paper) and digital formats. Acceptable formats include: DXF, uncompressed Eoo, VEC/VEH, Atlas and ISIF. All digital maps must be properly geo-referenced.
2. All sampling locations presented in report and electronic format should be geo-referenced. This is to include decimal latitudes and longitudes (to six decimal places) and UTM coordinates. The first field for decimal latitudes/longitudes should be latitudes (10 spaces wide). The second field should be longitude (11 spaces wide).

The Project Liaison Officer (Component Coordinator) for the project is:

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Co-Leader, Other Uses Component
Research and Strategic Services
Alberta Environmental Protection
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OR

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APPENDIX C - NORTHERN RIVER BASINS STUDY HOUSEHOLD QUESTIONNAIRE

Canada Alberta Northwest Territories

Northern River Basins Study
Household Questionnaire

Part I. Introduction

Your telephone number _____

Thank you for agreeing to answer this questionnaire. One of the objectives of the study is to find out how Northerners use and value the Peace, Athabasca and Slave Rivers. Your household was selected at random to help provide this information. We need your cooperation to answer a series of questions about how you and members of your household make use of the water resources of the region. We are collecting information from about 1,200 households. Individual responses will be kept confidential.

Part II. General Questions

1a. Where are you currently living? *(Circle one answer.)*

A. Town/city (specify) _____ *(Go to question 2.)*
B. Farm
C. Cottage/rural subdivision
D. Native reserve
E. Metis settlement
F. Other (specify) _____

1b. ***(if B to F selected)*** What is the name of the closest city, town, hamlet or village?

_____

2. How long have you been living in this location? *(Circle one answer.)*

A. Less than 1 year
B. Between 1 and 5 years
C. Between 5 and 10 years
D. Between 10 and 15 years
E. Between 15 and 20 years
F. More than 20 years

3. How long have you been living in the Peace, Slave or Athabasca River basins? *(Circle one answer.)*

A. Less than 1 year
B. Between 1 and 5 years
C. Between 5 and 10 years
D. Between 10 and 15 years
E. Between 15 and 20 years
F. More than 20 years

4. Which one of the following major rivers is nearest your current residence? *(Circle only one answer.)*

A. Athabasca River
B. McLeod River
C. Pembina River
D. Peace River
E. Wapiti River
F. Smoky River
G. Little Smoky River
H. Wabasca River
I. Slave River

5. About how far away is this river from your current residence?

_____ Kilometre **Or** _____ Miles

6. Do you identify yourself as? *(Circle one answer.)*

A. Aboriginal ——> Are you on a registered Tribal roll? Yes ____ No ____
B. Metis
C. Non-native

7. Which of the following categories best describes your household? *(Circle only one answer.)*

A. Single person
B. Couple with no children
C. Couple with children
D. Extended family
E. Single parent family
F. Two or more unrelated adults
G. Two or more related adults
H. Other *(describe below)*

_____

8. Including yourself, how many people are in your household? _____ people

9. Of these, how many are in the following age categories?

A. Under 5 years old _____
B. 5 to 9 years old _____
C. 10 to 14 years old _____
D. 15 to 19 years old _____
E. 20 to 34 years old _____
F. 35 to 44 years old _____
G. 45 to 54 years old _____
H. 55 to 64 years old _____
I. 65 years and older _____

10. How old are you? _____

11. Are you? _____ Male _____ Female

12. In which industries are you and members of your household currently employed? *(Circle all that apply.)*

A. Agriculture
B. Trapping/commercial fishing
C. Oil and gas
D. Forestry (logging)
E. Manufacturing (lumber, paper, etc.)
F. Construction
G. Transportation/communications/utilities
H. Retail or wholesale trade
I. Finance, insurance, other services
J. Government (health, education)
K. Unemployed
L. Other *(describe below)*

_____

Part III. General Use of Water Resources

The next part of this questionnaire asks some general questions about how you and members of your household use the water, fish, plants and wildlife in the river basin.

13. What is the source of your household's everyday drinking water? *(Circle one answer.)*

A. Municipal water plant ——> *(Go to question 15)*
B. Bottled water ——> *(Go to question 15)*
C. Well
D. Lake water Which lake? _____
E. River water Which river? _____
F. Dug out
G. Spring water
H. Other *(describe)* _____

14. Do you treat this water in any way before drinking it?

_____ Yes *(describe)* _____
_____ No

15. Are there any problems with the amount of water available from this source throughout the year?

_____ Yes *(describe)* _____
_____ No

16. Are there any problems with the quality of water available from this source throughout the year?

_____ Yes *(describe)* _____
_____ No

17. **Over the last 10 years,** have there been any noticeable changes in the quality or amount of water available from your usual water supply?

_____ Yes *(describe the changes you have noticed such as amount, smell, colour, taste, clarity)* _____
_____ No

18. Do you agree or disagree with each of the following statements?
(Check only one answer for each question.)

	Totally Agree	Agree	Disagree	Totally Disagree	Unsure
A. Water quality in the Peace, Athabasca and Slave Rivers is not really a major issue at the moment so new restrictions on industrial, agricultural or municipal water use are not required.					
B. Pollution of northern rivers is only a concern in a few locations and more enforcement of existing standards will solve these problems.					
C. Contamination of northern rivers is a major problem and some industries or municipalities should be forced to reduce effluent discharges, even if it means closing some operations.					
D. Existing water management regulations are interfering with economic development in the region and should be reduced or eliminated.					
E. New effluent discharges should not be allowed until a river basin plan has been completed.					

Part IV. Subsistence Use of Water Resources

19. Do you or any members of your household use any water resources for subsistence? By subsistence, we mean harvesting fish or wildlife only for your consumption or as a source of income.

_____ Yes
_____ No ——> *(Go to Yellow Section, Page 11, Question 39.)*

20. How often do you or members of your household participate in the following subsistence activities? *(Check appropriate answer for each activity.)*

	Daily	Weekly	Monthly	Yearly
Fishing				
Trapping				
Hunting				
Other *(specify below)*				

_____

Subsistence fishing

If you or members of your household do not participate in subsistence fishing, go to Question 27.

21a. List the three main species of fish and indicate how many pounds of these fish you and members of your household actually catch in an average year.

Name of species	Average annual catch *(specify pounds or kilograms)*
#1	
#2	
#3	

21b. Of these three species of fish, which would you prefer to catch. *(List in order of preference.)*

Preference	Name of species
#1	
#2	
#3	

22. In which three main bodies of water do you and members of your household usually fish and what proportion of your total catch comes from each? *(List in order of importance.)*

Importance	Name of water body	Percent (%) of annual catch
#1		
#2		
#3		

23. Do you or members of your household fish in the mainstems of the Athabasca, Peace or Slave Rivers or any of their major tributaries?

_____ Yes _____ No

If yes, please indicate the three most important sites along these rivers and indicate the proportion of total catch that comes from each location. *(To help describe the site, use the nearest major landmark that people would know.)*

Importance	Name or Description of Site	Percent (%) of annual catch
#1		
#2		
#3		

24. Over the past 10 years, have you or any members of your household noticed any changes in the number, quality or health of fish you have caught?

_____ Yes _____ No

If yes, describe the types of changes you have noticed.

Number: _____
Quality: _____
Health: _____
Other: _____

25. Of the fish you catch, how much of the total annual catch:

	Percent (%) of annual catch
Is eaten by you and members of your household?	
Is given away or sold to others for their consumption?	
Is fed to dogs or other animals?	

26. How many pounds or kilograms of caught fish does a typical person in your household consume in an average week?

_____ Pounds **OR** _____ Kilograms **OR** _____ Number of fish eaten

Subsistence trapping

If you or members of your household do not participate in subsistence trapping, go to Question 32.

27a . List the three main species of furbearers and indicate how many of these animals you and members of your household actually trap in an average year.

Name of species	Average annual catch *(specify pounds or kilograms)*	Average number of animals trapped per year
#1		
#2		
#3		

27b. Of these three furbearers that you trap, which would you prefer to trap. *(List in order of importance.)*

Preference	Name of species
#1	
#2	
#3	

28. Describe the location of your trapping area or if you are a registered trapper, indicate your registered trapline number. *(To help describe the area, use the nearest major landmark that people would know.)*

_____

_____

_____

29. Do you or members of your household trap within 10 kilometres (6 miles) of the mainstems of the Athabasca, Peace or Slave Rivers or any of their major tributaries?

_____ Yes _____ No

If yes, please indicate the three most important locations along these rivers and indicate the proportion of total catch that comes from each location. *(To help describe the area, use the nearest major landmark that people would know.)*

Importance	Name or Description of Site	Percent (%) of annual catch
#1		
#2		
#3		

30. Over the past 10 years, have you or any members of your household noticed any changes in the number, quality or health of the furbearers you trapped?

_____ Yes _____ No

If yes, describe the types of changes you have noticed.

Number: _____
Quality: _____
Health: _____
Other: _____

31. Do you or members of your household eat any parts of the animals you trap?

_____ Yes _____ No

If yes, please indicate the type of animal you trap, all portions of the animal you eat, and the number of animals that your household eats in an average year.

Type of Animal	Parts eaten	Number eaten per year

Subsistence hunting

If you or members of your household do not participate in subsistence hunting, go to Question 39.

32. In an average year, about how many animals do you or members of your household kill for food (subsistence hunting) each year?

_____ Animals killed

33a. List the three main species of animals and indicate how many of these animals you and members of your household actually hunt and kill in an average year:

Type of animal	Number killed per year
#1	
#2	
#3	

33b. Of these three species of animals, which would you would prefer to hunt? *(List in order of importance.)*

Preference	Type of animal
#1	
#2	
#3	

34. Do you or members of your household hunt within 10 kilometres (6 miles) of the mainstems of the Athabasca, Peace or Slave rivers, or any of their major tributaries?

_____ Yes _____ No

If yes, please indicate the three most important sites along these rivers and indicate the proportion of total kills from each location. *(To help describe the area, use the nearest major landmark that people would know.)*

Importance	Name or Description of Site	Percent (%) of animals killed
#1		
#2		
#3		

35. Over the past 10 years, have you or any members of your household noticed any changes in the number, quality or health of animals killed for food?

_____ Yes _____ No

If yes, describe the types of changes you have noticed.

Number: _____
Quality: _____
Health: _____
Other: _____

36. Of the animals that you have killed, what proportion of the meat:

	Percent (%) of animals killed
Is eaten by you and members of your household?	
Is given away to others for their consumption?	
Is fed to dogs or other animals?	

37. How many pounds or kilograms of wild game meat does a typical person in your household consume in an average week?

_____ Pounds **OR** _____ Kilograms

General questions

38. While you are subsistence fishing, trapping or hunting, do you ever consume or use river or lake water?

_____ Yes _____ No

If Yes, do you treat this water in any way before drinking it?

_____Yes *(describe how)* _____
_____No _____

Part V. Recreational Activities

39. For each of the following recreational activities, please indicate how often you or members of your household participate in the activities listed below. Also indicate the average length of trips in days and the average number of household residents participating on these trips.

Main Activity	Number of trips in an average year	Average length of trip (days)	Average number of household members on the trip
Fishing			
Boating			
Swimming (lakes/rivers)			
Canoeing			
Camping			
Hunting			
Other			

40. List in order of preference, the sites on rivers and lakes that you and members of your household visit most often for recreational purposes. Also, indicate the usual recreational activity on these trips, the number of trips to each site in an average year, and the main reason for preferring this site. *(To help describe the area, use the nearest major landmark that people would know.)*

	Site #1	Site #2	Site #3
Site name or description			
Usual activity			
Number of trips per year			
Main reason for preferring site			

41. Do you or members of your household use the mainstems of the Athabasca, Peace or Slave Rivers, or any of their major tributaries for recreational purposes?

_____ Yes _____ No *(If No, go to Question 45.)*

If yes, please describe the three locations along these rivers that you use most often, indicate the usual recreational activity at each site, and state the number of trips taken to each site in an average year. *(To help describe the area, use the nearest major landmark that people would know.)*

	Site #1	Site #2	Site #3
Site name or description			
Usual activity			
Number of trips preferring site			

42. List, in order of importance, the three species of fish that you prefer to catch recreationally from themainstems of the Athabasca, Peace or Slave Rivers or any of their major tributaries and indicate how many pounds or kilograms of these fish you and members of your household catch in an average year from these locations. *(Include the numbers of fish you keep and release.)*

Importance	Type of fish	Average annual recreational catch *(specify pounds* **OR** *kilograms)*
#1		
#2		
#3		

43a. On average, about how many pounds or kilograms of fish caught from these locations do you and members of your household consume per year?

_____ Pounds **OR** _____ Kilograms **OR** _____ Number of fish eaten

43b. Which, of these fish species you catch recreationally, do you eat?

44. On average, about how many pounds or kilograms of fish caught from these locations is given away to others?

_____ Pounds **OR** _____ Kilograms **OR** _____ Number given away

45. Over the past 10 years, have you or any members of your household noticed any changes in the water, fish, animals or plants along the mainstems of the Athabasca, Peace or Slave Rivers or any of their major tributaries?

_____ Yes _____ No

If yes, describe the types of changes you have noticed.

Water: _____
Fish: _____
Animals: _____
Plants: _____
Other: _____

46. When involved in water-based recreational activities in the region, do you ever consume river or lake water?

_____ Yes _____ No

If yes, do you treat this water in any way before drinking it?

_____Yes *(describe how)* _____
_____No _____

Part VI. Agricultural Water Use

47. Are you or any members of your household involved in farming of any sort?

_____ Yes
_____ No ———> *(If No, go to White Section, Page 15 Question 57.)*

48. Which of the following terms best describes your farming operation? *(Circle one answer.)*

A. Grains/oilseeds
B. Mixed farming (grain and livestock)
C. Specialty crops *(describe)*_____
D. Livestock only ———> *(Go to question 55.)*

49. How many acres do you plant or harvest in an average year? _____ acres

50. Please list the types of crops you grow.

_____
_____
_____

51a. Do you irrigate any of these crops?

_____ Yes _____ No
If yes, what is the source of this water? *(Name the waterbody.)*_____

51b. Do you have a water license? _____ Yes _____ No

51c. Home many acres of land do you irrigate in an average year? _____ acres

51d. How much water (total volume) do you use in an average year?_____ acres-feet **OR**
_____ inches/acre/year

52. Do you use any herbicides?

_____ Yes _____ No

If yes, please list the types of herbicides you normally use and the amount (by weight or by volume) applied in an average year.

Name or brand of herbicide	Amount applied in an average year *(specify weight or volume)*
1.	
2.	
3.	
4.	
5	
6.	
7	
8.	

53. Do you use any pesticides?

_____ Yes _____ No

If yes, please list the types of pesticides you normally use and the amount (by weight or by volume) applied in an average year.

Name or brand of pesticide	Amount applied in an average year *(specify weight or volume)*
1.	
2.	
3.	
4.	
5	
6.	
7	
8.	

54. Do you use any fertilizers?

_____ Yes _____ No

If yes, please list the types of fertilizers you normally use and the amount (by weight or by volume) applied in an average year.

Name or brand of fertilizers	Amount applied in an average year *(specify weight or volume)*
1.	
2.	
3.	
4.	
5	
6.	
7	
8.	

Farmers without livestock, go to Question 57.

55. How many of each of the following types of livestock do you have?

Type of livestock	Number
1. Cattle	
2. Horses	
3. Pigs/swine	
4. Sheep	
5. Poultry	

Other livestock *(specify)*	Number
6.	
7.	
8.	
9.	
10.	

56. Please describe how you normally dispose of livestock manure.

_____

_____

_____

Part VII Water Management Values and Issues

57. Although this section appears to be lengthy, the answers to these questions are very important. We appreciate you taking the time to complete these questions. In your opinion, what three factors have had the greatest effect on the amount or the quality of water in the major river basin in which you live (Peace, Athabasca or Slave) over the last 20 years?

Factor 1. _____
Factor 2. _____
Factor 3. _____

Thinking about the <u>first factor</u> you mentioned:

58. Describe the ways in which it has affected water quality, fish, wildlife, vegetation or the health of the river.

Factor 1. _____

59. Describe the ways in which it has affected you or members of your household.

Factor 1. _____

60. If no steps are taken to control your Factor 1, describe how you think the health of the rivers will be affected over the next 10 years.

Factor 1. _____

61. If no steps are taken to control your Factor 1, describe how you think the health of members of your household will be affected over the next 10 years.

Factor 1. _____

62. If the Northern River Basins Study were to suggest ways for managing this problem, what actions do you think they should recommend?

Factor 1. _____

Thinking about the <u>second factor</u> you mentioned:

63. Describe the ways in which it has affected water quality, fish, wildlife, vegetation or the health of the river.

Factor 2. _____

64. Describe the ways in which it has affected you or members of your household.

Factor 2. _____

65. If no steps are taken to control your Factor 2, describe how you think the health of the rivers will be affected over the next 10 years.

Factor 2. _____

66. If no steps are taken to control your Factor 2, describe how you think the health of members of your household will be affected over the next 10 years.

Factor 2. _____

_____

67. If the Northern River Basins Study were to suggest ways for managing this problem, what actions do you think they should recommend?

Factor 2. _____

_____

Thinking about the <u>third factor</u> you mentioned:

68. Describe the ways in which it has affected water quality, fish, wildlife, vegetation or the health of the river.

Factor 3. _____

_____

69. Describe the ways in which it has affected you or members of your household.

Factor 3. _____

_____

70. If no steps are taken to control your Factor 3, describe how you think the health of the rivers will be affected over the next 10 years.

Factor 3. _____

_____

71. If no steps are taken to control your Factor 3, describe how you think the health of members of your household will be affected over the next 10 years.

Factor 3. _____

_____

72. If the Northern River Basins Study were to suggest ways for managing this problem, what actions do you think they should recommend?

Factor 3. _____

_____

73. Below are three groups of potential threats to water quality and water quantity in the northern river basins. For each of the three groups, please indicate in the side boxes:

the **one** that you are **most** concerned about **and**
the **one** that you are **least** concerned about.

(Answer each group on its own. Overlap among groups has been done on purpose.)

Group 1:

Most concern *(check only one)*	Threat to water quality/quantity	**Least** concern *(check only one)*
	1. Agricultural run-off (pesticides, herbicides, fertilizers)	
	4. Draining wetlands and muskeg	
	5. Discharges of municipal sewage	
	7. River flows controlled by dams	

Group 2:

Most concern *(check only one)*	Threat to water quality/quantity	**Least** concern *(check only one)*
	1. Agricultural run-off (pesticides, herbicides, fertilizers)	
	2. Groundwater contamination	
	5. Discharges of municipal sewage	
	8. Discharges from pulp mill	
	9. Airborne pollutants	
	11. Industrial wastes/tailing ponds	

Group 3:

Most concern *(check only one)*	Threat to water quality/quantity	**Least** concern *(check only one)*
	4. Draining wetlands and muskeg	
	5. Discharges of municipal sewage	
	6. Seismic exploration/road and pipeline development	
	7. River flows controlled by dams	
	8. Discharges from pulp mills	
	9. Airborne pollutants	
	10. Uranium contamination (e.g. Lake Athabasca)	
	11. Industrial wastes/tailing ponds	

74. For each of the three groups of management actions listed below, please indicate in the side boxes:

the **one** that you think would be the **most** effective in dealing with current problems and
the **one** that you think would be the **least** effective.

(Answer each group on its own. Overlap among groups has been done on purpose.)

Group 1:

Most effective *(check only one)*	Management action	**Least** effective *(check only one)*
	1. Change land use practices (forestry, agriculture) to reduce erosion and pollution	
	4. Protect traditional fishing, hunting & trapping	
	5. Enforce existing pollution laws	
	7. Preserve and maintain ecosystems	

Group 2:

Most effective *(check only one)*	Management action	**Least** effective *(check only one)*
	1. Change land use practices (forestry, agriculture) to reduce erosion and pollution	
	2. Improve municipal wastewater treatment	
	5. Enforce existing pollution laws	
	8. Make polluters pay an annual fee based on the volume they produce	
	9. Improve treatment of municipal drinking water	
	11. Develop a management plan for the entire basin	

Group 3:

Most effective *(check only one)*	Management action	**Least** effective *(check only one)*
	4. Protect traditional fishing, hunting & trapping	
	5. Enforce existing pollution laws	
	6. Reduce industrial effluent loads	
	7. Preserve and maintain ecosystems	
	8. Make polluters pay an annual fee based on the volume they produce	
	9. Improve treatment of municipal drinking water	
	10. Increase monitoring of water quality	
	11. Develop a management plan for the entire basin	

75. One of the responsibilities of the Northern River Basins Study is to assess the health of northern rivers. Describe the three most important ways that you would measure the health of a river. *Please write in your response to the first question in the boxes provided. For the other questions, circle <u>one</u> answer per box.*

Measure 1	Measure 2	Measure 3

76.

	Measure 1	Measure 2	Measure 3
A. How do you think this measure of <u>river health has changed over the last 20 years?</u>			
B. How often do you think this measure of river health should be monitored?	A. Hourly B. Daily C. Weekly D. Monthly E. Yearly F. Every 5 years G. Every 10 years	A. Hourly B. Daily C. Weekly D. Monthly E. Yearly F. Every 5 years G. Every 10 years	A. Hourly B. Daily C. Weekly D. Monthly E. Yearly F. Every 5 years G. Every 10 years
C. Who do you think should be responsible for monitoring this measure of river health?	A. Government B. Industry C. Universities D. Independent agency E. Public F. Other	A. Government B. Industry C. Universities D. Independent agency E. Public F. Other	A. Government B. Industry C. Universities D. Independent agency E. Public F. Other
D. Who do you think should be responsible for paying for monitoring this measure of river health?	A. Government B. All water users C. Industrial water users D. Other	A. Government B. All water users C. Industrial water users D. Other	A. Government B. All water users C. Industrial water users D. Other

77. What are the three most important recommendations you would like the Northern River Basins Study to make?

#1 _____

#2 _____

#3 _____

78. Please list any recreational, environmental, agricultural or professional organizations to which you or any members of your household belong.

_____

_____

_____

79. Do you have any other comments that you would like to make to the Northern River Basins Study?

_____

_____

Thank you for completing this survey. Please return it in the self-addressed stamped envelope provided <u>before February 15th, 1995.</u>

Prepared by Praxis, Inc. and Drobot Data Services

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