SURVEY ON PUBLIC PERCEPTIONS OF OUTDOOR AIR QUALITY ISSUES IN THE CITY OF PRINCE GEORGE

by

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PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF

THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE

in

NATURAL RESOURCES AND ENVIRONMENTAL STUDIES

THE UNIVERSITY OF NORTHERN BRITISH COLUMBIA

July 1997

ABSTRACT

A public opinion survey was conducted with five hundred area residents within the city of Prince George, British Columbia to determine public perceptions of outdoor air quality issues in the area. Information gathered from this survey will be used to incorporate public input into the Prince George Air Quality Management Plan. The survey contained 53 Likert-type, yes/no and open-ended questions which were organized under six separate section headings: public satisfaction with air quality, air quality as a priority in the community, perception of sources of outdoor air pollution, woodstove and fireplace inventory, transportation issues, and public participation and education. Survey results suggested that Prince George residents were not satisfied with current airshed conditions, they believed poor air quality affected their quality of life and they were pessimistic about future improvements to air quality. Industrial and mobile sources were identified by respondents as the primary contributors to air pollution. Additionally, residents expressed a need for more education on air quality issues and called for increased public awareness of the negative impacts and human health consequences of poor air quality in the city. A majority of respondents also indicated that they would participate in pollution-reducing activities if it would help improve outdoor air quality. Based on survey results, recommendations for future management of the Prince George airshed were identified.

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ACKNOWLEDGMENT

I would first like to thank my supervisor Annie Booth for always sharing her time and experience with me, for giving me direction and advice when I needed it, and especially, for all the "little" things she has done for me over the past two years. I would also like to acknowledge the support and guidance of my committee members, Leslie King (*for her undying encouragement*), Peter Jackson (*for always being there*) and Greg Halseth (*for answering every question I could not*). This project and my goals could have not been realized without their time and effort.

I would also like to thank the City of Prince George, the Ministry of Environment, Lands and Parks and the Prince George Airshed Technical Committee for supporting this research. Additionally, my appreciation is extended to Dr. Bruno Zumbo and Dr. Alex Michalos of UNBC for sharing their survey expertise and to Dr. Greg Poelzer for his time and guidance.

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1.0 INTRODUCTION

The purpose of this study is to determine public perceptions of outdoor air quality issues in the Prince George airshed. This research is part of a larger study under the direction of the Prince George Airshed Technical Management Committee and will serve as one of the preliminary steps towards policy development and implementation of an Air Quality Management Plan for the city. This survey is one of the consultative approaches to be used to gather public input for incorporation into the first draft of the management plan. The Prince George Airshed Technical Management Committee considers research into public perceptions to be a critical part of airshed management. Their goal is to encourage a collaborative effort at the community level to find practical solutions to this environmental problem.

Air quality issues span concerns ranging from airshed aesthetics to human health impacts. Although this environmental problem requires the participation of federal and provincial governments, business and other institutions, solutions to poor air quality will also depend upon conscientious individuals and community based action. With an integrated approach to airshed management, a broader range of solutions are available to address air quality problems and protect human health and the environment.

Residents of British Columbia have expressed the desire for greater participation in local decision making about environmental resources and want to become involved in the process of sustainability, resource management and decisions impacting the natural

environment (British Columbia Round Table on the Environment and the Economy, 1992). Air pollution is a serious concern and citizens throughout the province have recognized the need to develop community plans to address this environmental problem. Those residing in the Greater Vancouver area said in a 1990 "Urban Futures Public Opinion Survey" that air quality was one of their highest priority concerns which led, in part, to the implementation of a regional air quality management plan (Greater Vancouver Regional District, 1994). For those in British Columbia's "northern capital" Prince George, poor air quality is also a major issue. In a survey conducted by Michalos (1995) titled "The Quality of Life in Prince George," air pollution was ranked the third worst thing about living in Prince George. When asked what they would change to improve the quality of life in the city, eliminating air pollution was again one of the top three things indicated (Michalos, 1995). This survey uncovered the growing social concern that residents of the city have for their air quality.

Addressing problems specific to a particular airshed requires the participation of provincial and local governments as well as the collective efforts of the community. To ensure this type of collaboration in addressing Prince George's air quality issues, the Prince George Airshed Technical Management Committee was created in December of 1995. Experts from the Ministry of Environment, Lands and Parks, the Fraser-Fort George Regional District, the City of Prince George, the University of Northern British Columbia, the College of New Caledonia, and the Ministry of Health, work together on this local commission to understand the variables that cause poor air quality and to find practical solutions to alleviate the problem. The collaborative objective of the committee,

indeed the reason for its genesis, is to "guide the preparation and implementation of an air quality management plan for Prince George and the immediate surrounding area" (Prince George Airshed Technical Management Committee, 1996).

The air quality problem in Prince George is complex and its severity dependent upon a number of factors: the local topography and location of the city, season, meteorological conditions, individual sensitivity to pollutants, degree of industrialization and the current laws and policies that exist to protect the environment and human health. Unlike other large B.C. cities of the lower mainland, Prince George's primary airshed contaminants are derived from industrial sources (e.g., pulp mills, oil refinery) rather than transportation sources; although residential contributions to local effects of poor air quality can be significant (Prince George Airshed Technical Management Committee, 1996). Therefore, a study focusing on northern attitudes and perceptions is important in the creation of a management plan that is tailored to meet the city's needs.

Prince George is located approximately 650 kilometers north of Vancouver with a population of 69,655 (Statistics Canada, 1994b.). Ninety kilometers from the geographical center of the province, the city is the major center for the northern and central interior of B.C. The city's economy is dependent primarily on the forest industry which constitutes about 70% of the total basic income and employs the city's largest labour force (De Silva and Stewart, 1996). The Prince George Forest District is the top producer of forest products in B.C., grossing twice as much as any other district in the province (Prince George Region Development Corporation, 1994). Prince George also

has the highest densities of pulpmills in the province with three in total (Sinclair, 1990). Other secondary industries include mining, producing chemical products and oil refining. Prince George is also known as the center for commercial, wholesale and distribution services for the central interior.

The city of Prince George is situated in a flat, river valley at the confluence of the Fraser and Nechako Rivers. Over half of the city's population resides in this valley which is surrounded by mountains and commonly referred to as the "bowl" of Prince George. The mountains, or the sides of the "bowl," can dramatically reduce wind speeds. Calm winds and frequent temperature inversions, along with the topography of the city, can result in poor mixing conditions that lead to unacceptable ambient levels of contaminants. Pollutants get trapped in the "bowl" area of the city because they can not escape the valley and the risk to human health and other effects increases with the length of exposure to these high levels of pollution. These high levels can lead to an "air quality episode" which occurs when the concentration of a pollutant exceeds the provincial air quality objective (guideline established to protect human health and the environment from the negative effects of a pollutant) and rises above acceptable levels for an extended period of time (Prince George Airshed Technical Management Committee, 1996).

Fine particulates (PM_{10}) and Total Reduced Sulphur (TRS) have been identified as priority contaminants by the Airshed Technical Management Committee (see Table 1, Appendix A for a description of these pollutants). In 1995, Prince George experienced nine air quality episodes for PM_{10} throughout the year and TRS air quality episodes

occurred on sixty-five days of the year. Reductions of PM_{10} and TRS emissions are required if the air quality objectives for these two contaminants are to be achieved. The major sources of these pollutants are industrial sources, although the contribution of mobile road dust to PM_{10} levels is uncertain, indicating the need to address mobile sources in addition to industrial sources. Other pollutants monitored in the city (e.g., ozone, sulphur dioxide and nitrogen dioxide) never exceeded air quality objectives in 1995, although without proper management and planning, increases in population and industry could cause problems with these pollutants as well (Prince George Airshed Technical Management Committee, 1996).

Earlier health studies conducted in the city have been inconclusive. A 1986 health study showed a small but clear association between emergency room visits and incidences of high TRS, but a later 1991 study reported the opposite effect. The researchers concluded that using the number of visits to the emergency room at the Prince George Regional Hospital was not a sensitive enough indicator due to the comparatively small size of the population (Prince George Airshed Technical Management Committee, 1996). It is unfortunate that these studies do not shed light on the fact that the Northern Interior Health Unit, which includes Prince George, ranks second in the province for death rates and respiratory mortality rates, with respiratory disease rates 30-50% higher than those expected for the area (Prince George Airshed Technical Management Committee, 1996).

Until another health study is conducted in Prince George, findings from recent provincial health studies will be used to shed light on the consequences of poor air quality

to human health. For example, it has been estimated that increases in PM_{10} pollution cause 82 extra deaths in BC every year, 69 extra hospitalizations for lung disorders and 283 extra emergency room visits for asthma; as well having large impacts on activity restriction, school absenteeism and respiratory symptoms (Vedal, 1995). As more is understood about the dynamics of air pollution and its consequences to human health, concerns over the social, environmental, economic and political aspects of poor air quality will demand attention.

One of the first goals of the Airshed Technical Management Committee was to draft a background report that would systematically identify management objectives and priorities and help in the design of an airshed management strategy. Historically, public participation and consultation has usually been sought after policy decisions by authorities are made, generating little to no social commitment to environmental causes because the concerns of affected citizens were not considered (Commission on Resources and Environment, 1995). Recognizing that British Columbians want to become more intimately involved in local decision and policy making processes that lead to impacts on the environment in which they live (British Columbia Round Table on the Environment and the Economy, 1992), the Airshed Technical Management Committee advocated that the final selection of actions to be recommended to government decision makers for policy development should be done only after the incorporation of public input into the management plan. This advocacy ensures that those who will receive the benefits, or bear the costs, of management actions are consulted and that all relevant issues and priorities have been identified and discussed (Prince George Airshed Technical Management

Committee, 1996). The background report recommends the following consultative approaches be used to gather public input:

- a public opinion survey
- media advertising
- open houses and workshops

The public opinion survey was designated to be the first step used to gather public input on air quality issues and is the impetus for this study. Information collected from the study will help guide the organization of the subsequent consultative steps in the management process (Prince George Airshed Technical Management Committee, 1996). The survey results will also help to provide the framework required by the Prince George Airshed Technical Management Committee to select management priorities for the city's air quality management plan.

2.0 RESEARCH OBJECTIVES

This study was designed primarily to determine public perceptions of air quality in the Prince George airshed and issues surrounding air quality management. Some of the major issues formulated by the committee that could help guide policy development, identify public concerns and provide public input into the management plan were:

- Are residents satisfied with air quality in the city?
- How informed do citizens feel about air quality issues?
- How does air quality rate as a priority in the community?
- What are perceptions of sources of poor air quality?
- What are the impacts of residential wood-burning on the airshed?
- What pollution-reducing activities are the citizens of Prince George most willing to participate in?
- How do residents think public education could be improved?
- What are the local impacts of poor air quality?
- What are the implications of public perceptions to management and policy?

In addition, by using a questionnaire to provide answers to the above questions, this research will assist the Prince George Airshed Technical Management Committee to:

- Determine whether public perception of air quality issues reflect problems perceived by airshed managers.

- Encourage a broad public partnership between community, government, health and social scientists, as well as environmental researchers.
- Increase public awareness concerning an environmental issue that directly impacts every citizen residing within the local community.
- Help to set standards for decision making procedures and policy development in other northern communities.
- Provide a means for management planning of a community issue through community based action.

Most importantly, this study will contribute to an integrated policy making procedure that will improve the quality of life for Prince George area residents. Survey findings will be used by the committee to ensure that significant trends in opinion have been identified and discussed for incorporation into the management plan. Results will also be used by the Ministry of Environment, Lands and Parks to assist in completing a residential woodburning emissions inventory for the Prince George airshed. Additionally, it is believed that these findings and the advertisement of the publicly shaped Air Quality Management Plan will encourage Prince George residents to actively participate in a process they helped to create through their combined responses to survey questions from this study.

3.0 METHODOLOGY

An initial draft of the survey was first designed in the spring of 1996. Survey questions were formatted employing Likert-type scales, yes/no responses and open-ended answers. Likert scaling, developed by sociologist Rensis Likert, is a measurement technique based on the use of standardized response categories such as "strongly agree" to "strongly disagree" (Babbie, 1995). Questions from the survey spanned a variety of issues concerning air quality and included questions under the following six section headings:

- public satisfaction with current air quality
- air quality as a priority in the community
- perceptions of sources of air pollutants to identify unknown sources and problems
- woodstove and fireplace inventory
- willingness to participate in source reduction and alternatives (i.e. carpooling, restricted backyard burning) to reduce local effects of poor air quality and mobile sources of road dust
- demographic questions

A short form questionnaire derived from the survey was piloted at the Ministry of Environment, Lands and Parks information booth during Environment Week at a local shopping mall. One hundred and six members of the greater Prince George area responded to the survey. Survey data were analyzed to identify the relevancy of issues posed to respondents and to test question formatting. General information and

suggestions for additional questions were also gathered. Following analysis of respondent comments, amendments were made to the pilot survey. Technical terms that the general public was not familiar with were removed which made the questionnaire more "user-friendly." A finalized draft entitled "Survey on Public Perceptions of Outdoor Air Quality Issues in the City of Prince George" was formalized in November of 1996.

The formalized survey was conducted from November 23, 1996 to December 10, 1996. In order to determine the social attitudes towards air quality of the Prince George population at large, five hundred residents from the greater Prince George area were selected at random for participation in the survey. Participants were selected through the employment of systematic sampling procedures outlined in Babbie (1995) using the 1996 Prince George telephone directory (sampling interval = 45). Participants were asked to volunteer approximately fifteen minutes of their time to answer fifty-three questions. Upon agreement to participate in the survey, each respondent was guaranteed that the answers and comments they made were strictly confidential and that the design of the study ensured that individual phone numbers were in no way linked to the corresponding survey. Upon completion of data analysis, the original surveys were shredded.

Calls were made throughout the day and from 7-9 pm in the evenings. Residential phone numbers were repeatedly called (up to five attempts per household) until residents were reached and either consented or objected to survey participation. Overall, the non-response rate was 30.1%, with the largest proportion of non-response consisting of those

contacts who were unwilling to participate in the survey (27.7%). Other telephone surveys have had similar refusal rates (Lavrakas, 1993). It is possible that a certain segment of the population could have disproportionately refused to participate in the survey or were more likely to not be at home. This could have resulted in a loss of representativeness from a portion of the population from which no data were gathered. Therefore, it is important to look at the sample characteristics to determine if major segments of the population are missing in the sample.

Using Appendix G of Babbie (1995) with a sample of 500 respondents, the estimated sampling error for this survey ranges from $\pm$ 2.7 to $\pm$ 5.0 percentage points at the 95% level of confidence and this range should be used as a guiding principle to estimate the approximate accuracy of any given result. In addition to sampling error, other potential sources of bias and imprecision affect the accuracy of results and these additional sources of error are discussed throughout the text of this paper.

Since the sampling frame for this survey on perceptions of air quality was chosen from a telephone directory, it is important to note the bias inherent in this type of survey methodology. Those citizens of Prince George who did not have a telephone, were new subscribers or who had an unlisted number were automatically excluded from the sample. Results are subject to the potential effects of this type error when generalizing to the entire population as the conclusions drawn from this survey will only be applicable to those Prince George citizens who had a number that could be reached. In general, those citizens who cannot be reached via the telephone have lower incomes than the population

with telephones; therefore, any telephone survey is likely to find somewhat higher levels of income-related behaviors among its participants than exists in the overall population (Lavrakas, 1993). The loss of representativeness from this type of sampling methodology is one of many trade-offs inherent in survey research and must be considered, in addition to sampling error, when extrapolating to the larger population.

3.1 Sample Characteristics

Five hundred completed surveys formed the working data set for this study. On the whole, in comparison with city demographics and the 1991 census, the sample achieved a high degree of representativeness. Out of the five hundred respondents, two-hundred and seventy-five (55.0%) were female and two hundred and twenty-five (45.0%) were male. From Figure 1, the age distribution of survey respondents and the age distribution of residents of the city of Prince George are relatively comparable following a similar bell-shaped population curve (n=498).

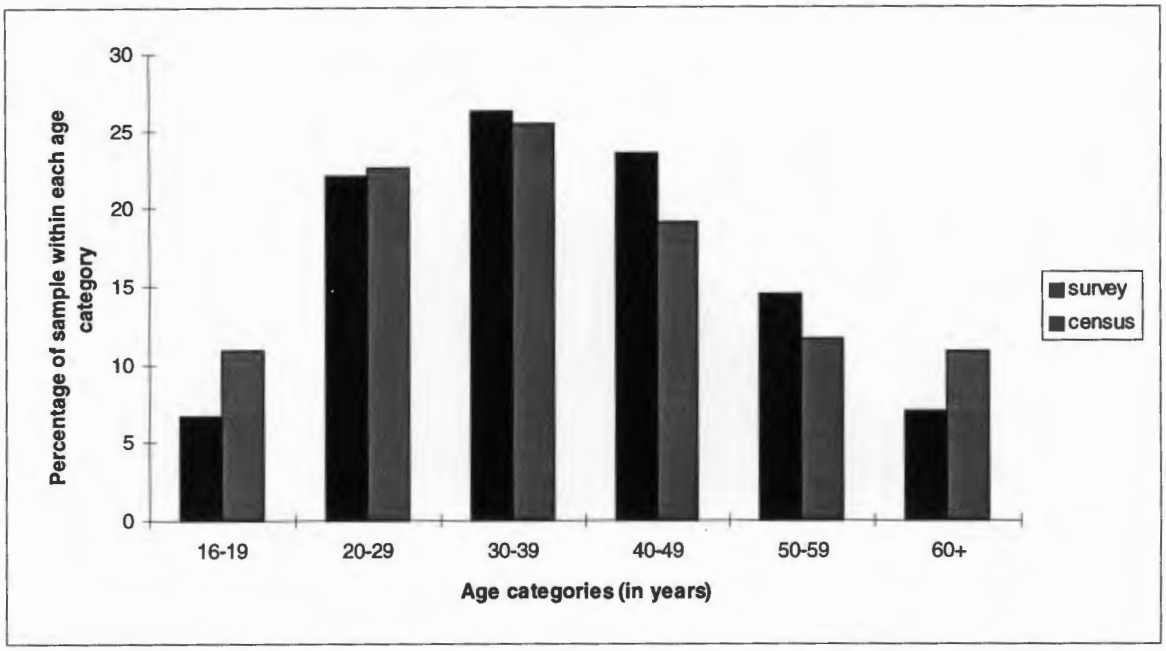

Figure 1. Age distribution of survey respondents (n=498) in comparison to the 1991 Census data for Prince George (Statistics Canada, 1994b.). *Note: 1991 Census data for the "16-19" age category also include those persons 15 years of age.*

Approximately 75% of respondents (only 494 answered the residency question) have lived in the Prince George area for over 5 years. The average length of residency was 16 years with a range of 1 year or less to 59 years. This distribution is important because of the way it links to critical dates in the city's history. For example, just over ten years ago, the pulpmills introduced new pollution control technology to reduce TRS emissions from their effluent ponds. Residents who have lived in Prince George before that time would have a different experience with the air quality than more recent arrivals to the city. Major improvements to air quality were made, which resulted in decreasing the number of times per year the city experienced occurrences of the "rotten egg" odour.

Table 1. Length of residency in the Prince George area.

Range of Years lived in Prince George n=494	Percent of Respondents
1-5	24.3
6-10	15.8
11-20	23.1
21+	36.7

In addition, respondents were asked what neighborhood they lived in to assess the geographic representativeness of the sample. Table 2 displays the population estimates for different sectors of the city (Pateman, 1996) and the surrounding communities (McEachen, 1996) compared to survey demographics. Four hundred and ninety-seven people responded with 55.2% living in the bowl area (including Cranbrook Hill), 19.0% resided in the North section of the city (Hart Highlands, North Nechako), 14.8% in the Southwest area (College Heights, Parkridge Heights), 8.6% in the East (Blackburn, Pineview) and 2.4% in surrounding communities of Prince George (Beaverly, Miworth).

Table 2. Comparison of survey demographics with Prince George City population estimates for neighborhood residence.

Area of Prince George n=497	Percent of Population	Percent of Respondents
Bowl	54.0	55.2
North	20.9	19.0
Southwest	15.6	14.8
East	7.6	8.6
Surrounding Communities	1.8	2.4

As for educational level, almost thirty percent of respondents had completed high school with an additional 56% who reported they had some post-secondary education or

had completed post-secondary education (see Table 3). In comparison to city demographics, the sample had almost twice as many high school graduates, more respondents (14.5% more) who had some post-secondary education and was less representative of those whose last level of education was elementary school and some high school.

Table 3. Comparison of educational level of survey respondents and population of Prince George.

Educational Level n=491	Percent of Population	Percent of Respondents
Elementary school	9.4	.61
Some high school	28.7	13.4
Completed high school	15.6	29.5
Some post-secondary education	17.5	31.9
Completed post-secondary education	28.9	24.4

Survey respondents were also asked to state their occupation. Seventy-nine different occupations (from 491 responses) were recorded and broken down into categories adopted from the 1980 Standard Occupational Classification system (Statistics Canada, 1994a.). Table 4 compares percentages of occupations from the sample and the population of Prince George and Table 5 breaks down the category "Not in the Labour Force" from Table 4. Teaching and related occupations were over-represented in the survey sample (by 4.3%) while Clerical and Sales and Service occupations were slightly under-represented (Prince George Region Development Corporation, 1994). Those persons who stated that they owned their own business were categorized separately because the field of their work was unknown which could explain why some of the occupations are slightly under-represented.

It should be noted that errors can occur when classifying occupations. Occupational duties and responsibilities can overlap causing a conflict as to which category an occupation should be placed. The information summarized on occupations should be viewed with discretion and is being used in this study to assess sample representativeness in general terms.

Table 4. Comparison of occupations of survey respondents and population of Prince George (Adopted from the 1980 Standard Occupational Classification system, Statistics Canada, 1991a).

Occupational Category n=491	Percent of Population	Percent of Respondents
Managerial, Administrative and Related	6.0	4.3
Teaching and Related	3.4	7.7
Medicine and Health	3.3	5.1
Technological, Social, Religious and Artistic	4.7	7.1
Clerical	12.9	8.9
Sales and Service	17.5	13.6
Primary and Processing	8.1	7.3
Machining, Product Fabrication, Assembling, Repairing	5.9	4.5
Construction	5.2	3.1
Transportation	4.3	3.3
Other	3.4	3.1
Own business	N/A	5.3
Not in the Labour Force	25.1	26.7

Note: This table includes data for those persons 15 years and older in the labour force and those persons 15 years and older not in the labour force. Occupational data for the city provided by the Prince George Region Development Corporation (1994).

Table 5. Breakdown of respondents categorized "Not in the labour force" from Table 4.

Participants "not in the labour force" n=131	Percent of "not in the labour force"
Students	41.9
Housewives	29.0
Retired	20.6
Unemployed	6.2
Volunteer	2.3

In comparison with city demographics and the 1991 census, the survey achieved a high degree of representativeness on the whole. According to the 1991 census, 49.6% of the city's residents (15-60+ years of age) were female which corresponds well with survey results. Age distribution was also similar and respondents were distributed proportionally in relation to city and regional population estimates. Those more educated were over-represented in the survey sample, which could indirectly be a result of the sampling methodology as those with higher incomes (who therefore are more likely to have a telephone) tend to be more educated (Lavrakas, 1993). In addition, respondents with an educational vocation may have had a greater willingness to participate in a research project, resulting in that factor being over-represented in the sample as well.

4.0 RESULTS AND DISCUSSION

The following discussion highlights the main findings and trends identified from the survey analysis. Section headings follow the original questionnaire format which were created to determine perceptions of air quality issues that could have management implications for the city.

4.1 Public Satisfaction with Air Quality and Public Awareness of Air Quality Issues

The first section of the survey on "Public Satisfaction with Air Quality" used a 5 point Likert-type scale where respondents were asked if they strongly agreed, agreed, were neutral, disagreed, or strongly disagreed to five statements assessing overall satisfaction with the outdoor air quality in the city over the past year. The purpose of this section was to find out if residents thought there was a problem with the air quality in the city and to measure the extent to which they perceived the problem existed. Awareness of issues concerning air quality was also addressed in this section to determine how informed the general public felt on the issues. For a complete breakdown of responses in percentages for this section of the results, please refer to Exhibits 1-7 of Appendix C.

When asked directly if respondents were satisfied with the outdoor air quality over the past year, 65% of the 500 respondents surveyed disagreed or strongly disagreed with being satisfied with the condition of the airshed. Looking at differences in satisfaction with air quality between men and women, more women were dissatisfied with the quality

than men. Approximately 75% of women disagreed or strongly disagreed when they were asked if they were satisfied with air quality compared to approximately 54% of male respondents. Age of survey participants did not seem to factor into this issue as responses were similarly distributed across age groups. As for location in the city, those respondents who lived in the "bowl" area of Prince George were the least satisfied with air quality. Seventy-one percent of respondents who lived in the "bowl" disagreed or strongly disagreed to being satisfied with air quality compared to 59.5% from the North and 54.7% from the Southwest. Other areas (e.g., East and Surrounding Communities) were not analyzed due to the relatively small numbers of respondents from those locations. Finally, looking at length of residency in the city, respondents who have lived in Prince George eleven years or more reported that they were more satisfied with air quality (by about 14%) than respondents who had been here ten years or less.

A majority of respondents (71%) agreed or strongly agreed that the outdoor air quality in the city affected their quality of life. Additionally, over fifty percent of respondents agreed or strongly agreed that they should personally make changes to improve the air quality in Prince George, although 24.4% of responses were "neutral." This finding could possibly suggest that many people still feel unsure about committing to actions that might affect their personal life and level of convenience.

When survey respondents were asked if they thought that their health had been negatively impacted as a result of the outdoor air quality in the city the response was equivocal with 39.4% agreeing or strongly agreeing and 39.2% disagreeing or strongly

disagreeing. This result might reflect a low awareness on the health impacts of air pollutants and the fact that some people felt poor air quality is more of a nuisance rather than a serious health concern. Looking at gender differences, more women than men (approximately 10% more) thought that their health had been negatively impacted by poor air quality. Respondents who were 40 years of age or more also reported that they felt their health had been negatively impacted compared to respondents who were 39 and younger. Of those participants who thought that their health had been impacted, results suggested that as age increased, so did the percentage who agreed or strongly agreed to the statement that their health had been negatively impacted. It is interesting to note that only 5.7% of respondents who were 50 years old or older were "neutral" compared to 25.9% of the 16 to 29 year olds who responded "neutral" to the question. This finding could suggest that it is possible the younger generation is not as concerned or aware of the short and long-term health impacts of poor air quality.

Residential location also affected respondent perceptions of negative health impacts of poor air quality. Those respondents who lived in the North section of Prince George felt that their health was less impacted by poor air quality than those who lived in the "bowl" or in the Southwest part of town. Only 29.7% of respondents who lived in the North agreed or strongly agreed that their health had been negatively impacted compared to 40.2% from the "bowl" area and 44.2% from the Southwest section of the city. Length of residency in Prince George was also a factor. Of those respondents who have lived in the city 21 years or more, almost half (48.9%) agreed or strongly agreed that their health had been negatively impacted compared to 37.5% of those who lived in Prince George 1-

5 years, 33.3% of respondents in the city 6-10 years and 32.5% in Prince George 11-20 years.

Next, respondents were asked if they thought the outdoor air quality in Prince George was getting better. Over half of the 500 people asked (53.4%) disagreed or strongly disagreed with the question, with 19.8 % responding "neutral." Looking at gender differences, more women (59.6%) than men (45.8%) disagreed or strongly disagreed to the statement that the air quality was getting better. Where respondents lived in the city, and their age, did not seem to dictate whether or not they thought the air quality was getting better. However, those who were between the ages of 16 to 29 were twice as likely to respond "neutral" to the statement (13.1% to 16.9% higher than participants who were older). Again, it could be that a proportion of the younger generation in the city is not sure or is unaware of issues concerning air quality. It is interesting to note that survey participants who lived in Prince George eleven years or longer generally thought that the air quality was getting better compared to more recent arrivals. This finding could be due to the fact that in the late 1980's, reductions of effluent pond emissions (primary source of TRS) from the pulpmills in Prince George were made, causing a decline in the number of times TRS emissions exceeded air quality objectives (Prince George Airshed Technical Management Committee 1996).

The next two questions in the survey addressed public awareness of air quality issues. First, respondents were asked to indicate the degree to which they felt informed

on air quality issues and 76.4% responded feeling only "somewhat" informed. This sense of feeling only somewhat informed could account for neutral responses where some people felt like they did not have enough information to comment. The last question in this section asked respondents if they had heard about air quality advisories which are warnings issued by the province when air contaminants exceed air quality objectives for an extended period of time. Over half (54.4%) of the people surveyed had heard the warning through the radio with an additional 16% who received the information through the television and 12% through the newspaper. It should be noted that attempts to increase awareness on air quality issues should be made through these media avenues, especially the radio. According to survey results, only 6.8% of survey respondents were unaware of the last air quality advisory issued by the Ministry of Environment, Lands and Parks (4.6% could not remember) which demonstrated that if information on air quality is made available through the media, most citizens were aware of it.

In general, survey results suggested that residents were not satisfied with the air quality in the city (65%), they felt that it was not going to get better (53.4%) and that it affected their quality of life (71.2%). On the whole, more women than men were not satisfied with air quality as well as those who were more recent arrivals and participants who lived in the "bowl" area of the city. Although there was strong agreement among respondents, these results are subject to various potential sources of error since not all data are accurate measures of the phenomenon of interest (Lavrakas, 1993). Defining indicators to represent a concept such as *air quality* is a difficult process because what defines the concept for one individual does not necessarily work for another. This

introduces a measurement problem and the reliability and validity of the results can be diminished. Providing several indicators to measure a concept can help reduce the severity of this problem because there is a higher chance that respondents can relate to at least one of the indicators when defining the concept in their minds (de Vaus, 1991). In this section, several indicators were used to assess overall satisfaction with air quality (e.g., quality of life, health impacts) to make conclusions on perceptions towards air quality in general.

4.2 Air Quality as a Priority in the Community

This section of the survey asked respondents to comment on whether or not they thought the six issues listed in Table 6 were important to the community. Respondents scored each issue individually on a scale of 1 through 10, where "1" was not important, "5" was in between and "10" was very important (percentages in the second to last column represent participants who responded "don't know"). For example, referring to Table 6, 15.6% of the five hundred respondents thought that unemployment scored a "7" on a scale of "1-10," 25.8% gave it an "8," etc., which indicated that those respondents thought this issue was relatively important to the community (total for each row = 100% of respondents). This information was requested from participants to assist policy-makers in supporting issues that are perceived to be important to the residents of the city. With this information, the allocation of time and resources can reflect the needs of the community as a whole.

Table 6. Percent of respondents scoring each community issue on a scale from "1" to "10" to indicate the importance of the issue to the community.

Scale from "1" to "10":	*<Not important>*				*<In between>*					*<Very important>*		
Community Issue n=500	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	Don't know	Total
Crime Prevention	0.4	0.4	0.4	0.4	4.2	2.4	6.8	17.2	18.2	49.0	0.6	=100
Unemployment	0.0	0.2	0.4	0.4	5.2	5.2	15.6	25.8	16.0	31.0	0.2	=100
Air Quality	0.8	0.0	1.4	1.8	7.6	5.4	17.2	22.6	17.6	25.4	0.2	=100
Road Maintenance/ Snow Removal	0.2	0.4	1.0	1.0	11.2	7.2	17.4	27.2	12.8	21.2	0.4	=100
Downtown Renewal	4.8	3.8	5.6	10.0	16.6	12.6	15.6	14.0	4.2	11.2	1.6	=100
Parks/Recreational Facilities	0.6	1.4	4.8	3.6	17.4	23.0	17.6	15.2	4.6	9.8	2.0	=100

As indicated by Table 6, crime prevention appeared to be the most important community issue. Almost half the respondents gave it a "10" and nearly 90% gave this issue an "8" or above. Unemployment received one-third of the responses in the "10" category, about 70% gave it an "8" or above. Air quality ranked third on this list of issues with 25% of the responses in the "10" category and 65% of respondents gave air quality an "8" or above. Road maintenance and snow removal came in closely behind air quality with 21% in the "10" category and 61% "8" or above. Parks and recreational facilities and downtown renewal were considered less important in the community on the whole (about 10% of respondents gave these issues a "10" and only 30% gave them a "8" or above). Ranking issues on a scale of this type does introduce a certain amount of error

(e.g., how one person defines importance on a scale may not correlate with another person's definition) so any specific conclusions should be made with discretion.

4.3 Perception of Sources of Outdoor Air Pollution

The following section called for respondents to determine how large a contributor they thought a particular source of air pollution was to the airshed. There were ten sources listed and they are displayed in Table 7 along with the results in percentages. Each source was labeled by respondents as either a small contributor, a medium contributor or a large contributor to air pollution in the city. For example, Table 7 indicates that 34.4% of the five hundred respondents thought road dust was a small contributor, 41.6% thought it was a medium contributor, 22.6% thought it was a large contributor and 1.4% did not know (for a total of 100%). In addition to the sources listed in the table, respondents were given the opportunity to identify additional sources of air contaminants. Eleven additional sources were identified by respondents and those sources can be found in Exhibit 8, Appendix B. The purpose of this section was to potentially identify unknown sources of air pollution and to generate a data set that would help the Airshed Committee analyze the local impacts of poor air quality and examine whether or not perceived sources of poor air quality reflected actual source contributions in the emissions inventory. This information can also provide insight into the areas where there are opportunities for increased public education on air quality issues.

Table 7. Percent of respondents perceiving each source of air pollution as a small contributor, a medium contributor or a large contributor to poor air quality.

List of Air Pollution Sources: n=500	SMALL	MED.	LARGE	Don't Know	Total
The pulp mills	1.4	12.4	86.0	0.2	=100
Exhaust from vehicles	3.8	32.4	63.2	0.6	=100
Beehive burners	11.0	22.0	59.6	7.4	=100
The oil refinery	7.4	35.8	42.6	14.2	=100
Road dust	34.4	41.6	22.6	1.4	=100
Slash burning or burning from land clearing	37.8	36.2	21.4	4.6	=100
Woodstoves and wood fireplaces	43.4	41.6	13.4	1.6	=100
Backyard burning	62.4	27.4	9.2	1.0	=100
Exhaust from small engines (e.g., lawnmower)	67.8	25.0	4.6	2.6	=100
The railroads	50.6	32.8	4.4	12.2	=100

There is a strong general agreement (86%) that the pulp mills in Prince George are thought to be large contributors of air pollution to the airshed. The next largest source identified was exhaust from vehicles (63.2%), followed by beehive burners (59.6%) and then the oil refinery (42.6%). Three of the four largest perceived sources were industrial and when respondents were asked if they believed that the outdoor industrial air emissions in Prince George were adequately regulated, 38.0% said yes they were, while 48.6% believed that they were not adequately regulated (13.4% said they did not know). Several people added that it was not the regulations themselves that needed refinement, but it was the enforcement of those regulations that needed more support. With the degree of industrialization in the city, these results are not surprising but the fact that exhaust from vehicles was perceived to be a large contributor is interesting in the sense that, although vehicles are not the primary polluters in the city, the awareness of their potentially increasing impact on the airshed is apparent.

Comparing perceptions of sources of air pollution to actual emissions from the emissions inventory for the Prince George airshed show that the residents of the city have a good idea about where sources of air pollution originate. From the "Estimated Emissions Inventory for Prince George," permitted sources (industries that release contaminants under a permit from the Ministry of Environment, Lands and Parks "Waste Management Act") account for 81% of PM_{10} emissions (not including road dust) and 94% of emissions of sulphur dioxide, which is formed from the incineration of TRS (Prince George Airshed Technical Management Committee, 1996). Respondents identified the pulpmills, beehive burners and the oil refinery as large contributors to poor air quality and all three are permitted sources. Exhaust from vehicles was also identified as a large contributor of air pollution, but according to the emissions inventory, only three percent of PM_{10} and six percent of sulphur dioxide comes from exhaust. It is the contribution of mobile road dust that seems to be more of a problem caused by vehicles than exhaust emissions. High levels of PM_{10} may be caused by the mobilization of fine silt associated with winter street sanding and elevated hourly levels have occurred during high traffic periods in late February and March (Prince George Airshed Technical Management Committee, 1996).

In order to help identify local effects of air pollution, respondents were asked if they had ever experienced poor outdoor air quality in their neighborhood in the past year. Seventy-six percent stated that they had experienced poor air quality and 430 descriptions were collected and categorized. By far, most people (69%) complained about a strong, unpleasant odor. These occurrences are not uncommon to Prince George as exceedances

of the Level A and Level B Objective for Total Reduced Sulphur, responsible for the "rotten-egg" sulphur smell, typically occur in the fall and winter. Other effects of poor air quality described locally were smoke (from burning wood, garbage or leaves), haze, particulates like road dust, residues on cars, smoky emissions from cars and chemical spills (See Exhibit 9, Appendix B for a complete breakdown of these responses in percentages).

Although gender did not seem to dictate whether or not respondents experienced poor air quality in their neighborhood (only 7.6% more women than men had experienced poor air quality), age of respondents, how long they have lived in the city and where their neighborhood was located were factors that seemed to affect responses. Contrary to previous trends, a higher percentage of respondents who were 39 years of age and younger had experienced poor air quality than those who were 40 and above. Approximately 80% of 16-39 year olds said they experienced some type of air quality problem in their area compared to 73.5% of 40-49 year olds and about 68% of those respondents who were 50 and older. Recent arrivals in the city (between one and five years) were also more affected by poor air quality in their neighborhood than residents who have lived in Prince George six years or longer. Looking at location of residence, a higher percentage of those who lived in the "bowl" area of Prince George (88.4%) experienced poor air quality compared to the North (68.9%) and the Southwest (57.9%) sections of the city. On the whole, the downtown area (or "bowl") is the most affected by poor air quality from TRS emissions, especially the residential areas closest to the Fraser River where the pulpmill effluent ponds are located. For PM_{10}, all monitoring stations

located in the "bowl" are equally affected, but the Southwest area can be as well (Prince George Airshed Technical Management Committee, 1996). Currently, there is not a monitoring station located in the North section of Prince George so actual levels of pollutants in this area is unknown.

In addition to requesting information on the occurrence of poor air quality in the neighborhood, respondents were also asked to comment on how they thought this poor air quality affected them. There were three-hundred and eighty responses recorded which ranged from "no significant effect" to one respondent who attributed a heart attack to air pollution. Referring to Table 8, over half (56%) complained of direct health effects (lower and upper respiratory effects, poor health in general and other) experienced as a result of poor air quality in their neighborhood. Many respondents commented on the psychological effects caused by air pollution and the restricted behavior that results from trying to avoid exposure to the "polluted downtown area." On the whole, there was a sense of worry and stress when it came to discussing this topic.

Table 8. Percentage of respondents describing the effects experienced as a result of poor air quality in neighborhoods.

Description of Health Effects n=380	Percent of Responses
Lower respiratory effects (adults and children): asthma, bronchitis, difficulty breathing in general	27.3
Causes psychological effects: dislike, discomfort, annoyance, bothers me, embarrassment, depression, its offensive, a nuisance, inconvenience	17.0
Poor health in general: cancer, respiratory disease, long term effects, shortens life expectancy	13.4
Upper respiratory effects: allergy symptoms, sinuses, makes eyes and nose water, itch and/or run	11.0
Do not know, not sure	9.8
Affects activity/ ability to work	5.8
Do not know, but are sure it can not be good	4.7
Other health effects: headaches, skin rashes, nausea, heart attacks	4.3
No significant effect	2.7
Reduces visibility	2.2
Aesthetics: dirty, bad for business and tourism	1.8

4.4 Woodstove and Fireplace Inventory

The information from this section of the survey will be used by the Ministry of Environment, Lands and Parks to assist in completing a residential woodburning emissions inventory for the Prince George airshed. Additionally, data collected on wood-stove usage will help the Prince George Airshed Technical Management Committee select the appropriate management strategy to deal with the local effects of woodsmoke.

Sixty-nine (13.8%) out of the five hundred people surveyed had a wood-stove on their property. When wood-stove owners were asked if they used their wood-stove as

their main source of heat, 23.2% reported that they did, while 14.5% said they used it as a main source of heat "sometimes." Wood-stove use during the months of October to March varied with 11.6 % who used their stove once a week, 15.9% used it several times a week, 33.3% reported using their stove every day, 18.8% never used their stove, and 14.5% reported occasional use (5.8% were not sure). The average age of woodstoves was 9.4 years (standard deviation = 5.4), with a range of 1 to 22 years. Owners were also asked to estimate how much wood they burned in their woodstove in a year. Wood burned ranged from 0 cords to 15 cords per year with the average wood burned in woodstoves being about 2 cords per year.

One hundred and seventeen respondents out of 500 (23.4%) stated that they had a wood-burning fireplace. Fireplace use during the months of October to March ranged from less than one percent who reported every day use, approximately thirty percent reported occasional use, to almost half who said they never used their fireplace. Fireplace owners were also asked to estimate how much wood they burned and, of those who burned wood and could make an approximate estimation (17.9%), wood use ranged from one tenth of a cord to three cords with most people saying they burned about one cord of wood in their fireplace in a year.

Thirty- six (7.2%) of the 500 people surveyed own a wood-burning fireplace insert. For a complete breakdown of fireplace insert usage, age and amount of wood burned, please refer to Exhibit 10 of Appendix B.

For management purposes, respondents were asked if they supported restricting wood burning in the city if it would improve air quality. Sixty-six percent stated that they supported restricting wood burning "*if*" it would improve the air quality (about 5% said they did not know). With the inventory information collected in this study, the Ministry of Environment, Lands and Parks will be able to more accurately assess the contribution of residential wood burning to the airshed and to call for measures to reduce the impact of woodsmoke if deemed necessary.

4.5 Transportation Issues

Information on local modes of transportation derived from this section of the survey was collected to assist airshed managers address the impacts that mobile sources can have on the airshed and to identify alternatives to the use of personal vehicles. Questions in this section included asking respondents how they got around town, what would they do if they did not have their car for the day and if they would support a vehicle emissions inspection program if it would help to improve the air quality in the city.

Out of 500 respondents, 87.2% use a personal vehicle as their primary form of transportation. When asked what they would do if they did not have their vehicle for a day, 24.1% of the respondents opted to stay at home. Carpooling was the next popular choice (20.2%), followed by taking the bus (19.0%) and then walking (16.6%). Other

respondents said they would take a taxi (8.4%) or use a bicycle (6.9%) if they did not have their car. The remaining responses were found in the "other" category where 3.6% of surveyed residents would borrow or use their second car and 1.3% would rent a vehicle if they did not have their car for the day. These results indicate a high reliance on the automobile, possibly because of the extreme weather conditions residents experience over the long winter which can make alternative forms of transportation undesirable.

When the four hundred and thirty-six respondents who were personal vehicle users in Prince George were asked if they would be willing to put their car through an emission inspection once a year if it would improve the outdoor air quality here, 87.8% said they would be willing to do so. An emission control program implemented in Prince George could be one proactive strategy that significantly reduces the impacts of pollutants from mobile sources. The implementation of such a program that has community support could be an efficient method used to alleviate some of the current and future transportation problems.

Sixty-four respondents did not use a personal vehicle to get around town. The following distribution in Figure 2 displays the modes of transportation used instead of a personal vehicle. Over half (52%) depended upon public transportation to get around town. Another 19% of respondents walked as their primary form of transit with others bicycling, carpooling or using a taxi to get around the city.

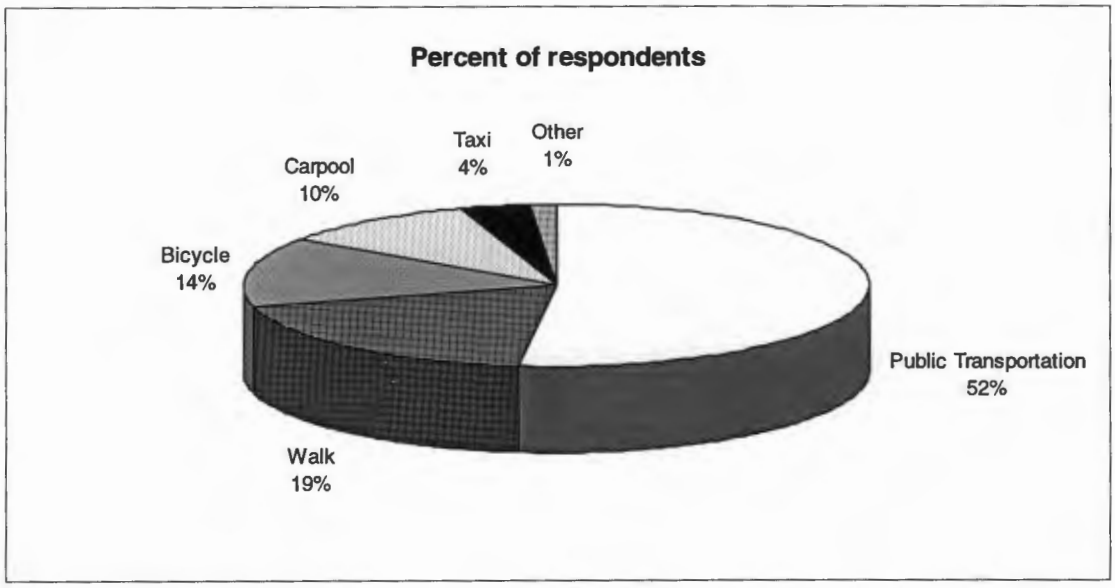

Figure 2. Percentage of respondents (n=64) utilizing various modes of transportation other than a personal vehicle.

4.6 Public Participation and Education

The first topic in this section focused upon the respondent's willingness to participate in five activities that could possibly improve the outdoor air quality in Prince George. Secondly, respondents were asked to comment on what things they thought could be done to improve public education on air quality issues. Support of these measures could lead to campaigns to promote pollution-reduction activities in the city while increasing public education as well.

The following table summarizes the responses to the first topic of the section, public willingness to participate in pollution-reducing activities. A list of pollution-reducing activities was given to respondents and they commented on whether they were

"very willing," "somewhat willing" or "not willing" to participate in each activity (the second to the last column indicated the percent of respondents who stated "don't know").

Table 9. Percent of survey respondents indicating their willingness to personally participate in five activities that could possibly improve the outdoor air quality in Prince George.

Activity n=500	VERY WILLING	SOMEWHAT WILLING	NOT WILLING	Don't Know	TOTAL
Stop backyard and lawn burning	68.9	20.5	10.2	0.4	=100
Carpool	54.6	33.1	11.5	0.4	=100
Walk	51.8	32.2	16.0	0.0	=100
Bicycle	45.4	24.0	30.4	0.2	=100
Use public transportation	29.7	36.6	33.4	0.2	=100

By far, most respondents were "very willing" to stop backyard and lawn burning (68.9%). Over half were also very willing to carpool, as well as to walk, if it would improve the air quality in the city. The least popular activities from Table 9 were bicycling and using public transportation. Approximately one-third of the people surveyed said they were not willing to participate in those two activities. These results are not surprising as many people commented on the impracticality of using the bus or a bicycle as a means of transportation and criticized the city for not supporting these activities better. Additionally, Prince George's harsh winter climate could be a strong deterrent to using these alternate forms of transportation.

It is important to note that using this information for management strategies has limitations. There are many factors that can affect an individual's willingness to participate in activities that could reduce air pollution. Babbie (1995) explains that

"*social desirability*" is a common problem in this type of research as respondents may have a tendency to give the politically correct response to a question rather than answer it truthfully. Social desirability describes an inherent bias in responses on the account of human nature as people will answer a question through a filter of what will make them look good. Everyone wants to look environmentally responsible, so when respondents were asked if they were willing to participate in activities that could improve air quality, what they said they were willing to do versus what they actually will do may differ.

The next topic in the survey was an open-ended question which focused on perceptions of public education and what respondents thought could be done to improve education on air quality issues. Over three-hundred and fifty suggestions were recorded on how public education in the city could be improved. Most people (45.7%) suggested an increase in media coverage and exposure (television, radio, and print) as well as more advertising on billboards and bus stops. A regular, weekly feature in the local paper with user friendly language and impartial, accurate reporting on air quality problems and solutions was requested in addition to an air quality newsletter containing current information on issues and alternatives. It was also suggested that local television stations give daily reports on air quality along with the weather and that they encourage open-house/call-in type programs with experts in the field present to discuss the issues.

The second most popular recommendation was to increase education in schools (21.3%). Respondents commented that more focus should be placed on activities that families can do together to get involved in the issues. Next, 8.6% asked for more

education on individual contributions to air pollution and more information on alternatives and preventative measures. For example, one respondent commented that information on the impacts of backyard burning and alternatives to burning could be distributed by the City Fire Department when approvals for burning are requested. About six percent want public meetings, open houses, town halls, seminars and workshops to be conducted at local schools, the college or the university. Some said that more information on specific health effects as well as more research and surveys are needed to increase awareness and keep people informed on the real consequences that result of poor air quality in the city.

There was a strong sense of needing to get the public more involved in the community if public education was to improve. One person commented that more support and emphasis needs to be placed on events such as "Clean Air Day" to increase participation. The development of an "Air Pollution Resource Unit" or an information booth at the mall were recommended as impartial sources of information for citizens. There were several respondents who said that they did not trust government or industry to report all the facts so the creation of an independent source could alleviate this concern.

Other respondents (about ten percent) expressed the concern that public education was not the solution to the air quality problems in Prince George. Most commented that there was not a need for education because it "does not work, people do not care, and nothing can be done." Others said that there was "plenty of education, we need more action" and that "industry should be educated, its not up to the public." The rest of the

comments ranged in nature from one respondent who said that "more citizens need to be motivated to take action against industrial polluters" to another who commented that "Prince George has to live with industries, people will have to do more on their own."

The last question in the survey asked respondents if there was anything else they would like to say about the air quality in the city. Two hundred and nineteen people responded with a total of 264 comments. Again, comments varied greatly demonstrating concerns from a wide variety of perspectives. Some common trends were:

- 54 respondents (20.5%) said air quality could be improved and to clean it up before it ruins the city.
- 28 respondents (10.6%) said to improve the public transportation system.
- 24 respondents (9.0%) said that it is bad, they are worried about future and their kids and wished that there was no pollution.
- 20 respondents (7.6%) said there should be no more industry in the bowl and to cut it back or fix it.
- 19 respondents (7.2%) felt that their health was being compromised by living here.
- 12 respondents (4.5%) said to stop breaking regulations and put in stricter controls.

These kinds of open ended survey questions and answers gave the public an opportunity to express opinions they may have had concerning air quality issues that were not addressed by the standardized survey questions. Such responses also give airshed managers the opportunity to consider issues that were perhaps previously left unexamined. There were many other unique comments in response to this question and they can be found in Exhibit 11 of Appendix B.

5.0 CONCLUSIONS AND RECOMMENDATIONS

By analyzing and addressing the patterns of public response to these questions, while considering individual arguments, airshed managers now have a framework that they may use to help determine management strategies and a set of data to assist in the incorporation of public sentiment into the Air Quality Management Plan. Briefly highlighted are some of the more salient findings of the survey and the following conclusions have been made:

- 65% of residents were not satisfied with the air quality in the city.
- 71% agreed or strongly agreed that the air quality affected their quality of life.
- 76% felt only "somewhat" informed on the issues.
- Three of the four largest perceived sources of air pollution in the city originated from industrial sources.
- 76% of respondents had experienced poor air quality in their neighborhood.
- 13.8% of respondents had a woodstove on their property and 23.4% had a wood-burning fireplace.
- 87.2% use a personal vehicle to get around town and of those respondents, 87.8% would support a vehicle emissions inspection program.
- To improve the outdoor air quality in the city, respondents were most willing to stop backyard and lawn burning, to carpool and to walk. They were least willing to bicycle and to use public transportation.
- Almost half of the people surveyed stated that increasing media coverage in the city would help improve public education on air quality issues.

These results suggest that the issue of air quality is important to people living in the Prince George airshed. Some of the mixed results reported for neighborhoods and other

respondent characteristics suggests a further need to record and compare resident perceptions of air quality issues. For example, surveys may be conducted annually in conjunction with "Clean Air Day " events in the city. This "triangulation" of results from different studies will be important in contributing to the continuing evaluation of resident perceptions of air quality as emissions standards change and public awareness and education increase. In addition, a continued effort to collaboratively address air quality issues and concerns in the city should be encouraged and supported by the Prince George Airshed Technical Management Committee and by the organizations that they represent.

From these conclusions, a number of recommendations can be made. The recommendations listed below address the need for action with respect to industrial activity, residential activity and public education.

- **Encourage Pollution Prevention Programs for current and future industry in Prince George.**

Survey respondents perceived industrial sources to be large contributors of pollutants to the airshed. In addition, 69% of respondents who had experienced poor air quality in their neighborhood complained of a strong, unpleasant odour which is also caused by industrial sources. A focus should be placed on measures to reduce emissions from industries currently operating in Prince George. One option is to replace "end of pipe" permits with regulations and pollution prevention plans. "Pollution Prevention" is a concept that means avoiding, eliminating and reducing pollution at the source rather than treating or containing it after it has been created. It is the most effective and efficient

approach to environmental management and will become the fundamental authorization for major industrial sites in B.C. (B.C. Environment, 1996). This concept highlights the importance of a preventative approach to maintaining air quality which if taken, could possibly ameliorate current and future industrial air pollution problems.

- **Voluntary actions to reduce the local effects of woodstove use.**

Results from the survey indicate a much lower use of woodstoves, 11.2% (only 56 of the 69 woodstove owners use their stove) versus the provincial average of 38% and considerably less than rural area figures of 77% (B.C. Environment, 1989). In that case, any management actions to restrict woodstove use is unlikely. An emphasis should be placed on voluntary actions, as opposed to regulatory measures, to reduce the local effects of smoke caused by woodstoves and to reduce woodstove use during episodic periods.

- **A vehicle emissions inspection and maintenance program.**

A possible movement towards addressing the contribution of vehicle emissions to the airshed is the implementation of the lower mainland's AirCare program- a provincial vehicle emissions inspection and maintenance program that requires all light duty vehicles to pass an annual emissions inspection as a condition of licensing (Ministry of Environment, Lands and Parks, 1995). Currently, there are no regulations on tailpipe emissions in Prince George and serious reductions of carbon monoxide, carbon dioxide, nitrogen oxides, hydrocarbons and particulates could be made with an emissions control program.

Since its introduction in 1992, the AirCare program has had the single largest impact of any measure in reducing vehicle emissions in the lower mainland (Ministry of Environment, Lands and Parks, 1995) and a 1994 Radian Corporation audit of the program found it to be one of the most effective programs currently in operation (Mennell, 1995). Although the proportion of pollutants contributed to the emissions inventory from transportation is lower in Prince George than in the lower mainland, the implementation of this program would definitely be beneficial from a reduction standpoint. Almost 90% of the personal vehicle users in Prince George were supportive of a yearly emission inspection program if it would improve the outdoor air quality. A cost-benefit analysis for the extension of AirCare to the north needs to be conducted so the implementation of this program can be fully considered.

- **Promote alternative forms of transportation.**

An innovative approach will be necessary for a successful promotion of alternative transportation. Only 19% of survey participants would be willing to use public transportation if they did not have their vehicle for a day, indicating a high reliance on automobile use in Prince George. In addition, the least popular activities that respondents were willing to participate in were bicycling and using public transportation. Approximately one-third of the people surveyed said they were not willing to participate in those two activities with many additional respondents who replied that they were willing to use them *"if"* improvements were made.

The finding that some respondents were unwilling to use public transportation could be caused by the fact that the system currently present in Prince George is inadequate in their opinion with many areas not serviced by bus lines. This criticism is valid, but the city itself does not have the volume of users needed to expand the service and currently, the public transportation system is a heavy financial burden on the resource base. Respondents qualified their unwillingness to use a bicycle as an alternative form of transportation to the city's lack of bike lanes and commented that overall Prince George is not a "bike friendly" city. It is possible that in order to make any significant improvements to air quality, the public will have to participate in reducing air pollution by changing those behaviors that cause it. Further study should be done to identify an effective means to increase the usage of both public transportation and bicycles as alternative forms of transit.

- **Increase public awareness and promote education on air quality issues.**

The public's awareness and level of education on environmental issues most important to the local ecosystem must be examined. An uninformed individual will have a difficult time participating in finding practical solutions to local problems because of a lack of understanding of his or her own particular role in environmental problems and solutions. In this study, 76% of the respondents felt only somewhat informed on air quality issues. This finding is similar to a provincial study which found that 66.5% of the 800 people surveyed felt only somewhat informed on environmental issues (Viewpoints Research, 1994). Another survey on public attitudes found that 75 percent said they believe the province should be doing more to reduce air pollution (Ministry of

Environment, Lands and Parks, 1995). The combination of these results should inspire a provincial initiative to educate the citizens of British Columbia and to increase awareness of environmental issues through the use of media avenues since 46% suggested that more media coverage and advertising would improve public education on these issues. The public would also benefit from a weekly feature in the local newspapers highlighting current air quality issues and identifying alternatives available to individuals to reduce their contribution to pollution.

This study has helped gather information and identify relevant issues important to the community. By directly asking the citizens, this survey has addressed the needs of the community and has uncovered the unique concerns of Prince George residents. This information then can be used by policy makers to develop plans whose implementation would have public support and cooperation. Without such public intervention at the community planning stage, officials would not be able to encourage the programs that the community supported and any success requiring broad public partnership would be unlikely. Through consultation and input from those affected, it is believed that a stronger commitment towards approaching practical solutions will result.

Using survey results to understand public perceptions towards air quality in the Prince George area will arm the Prince George Airshed Technical Management Committee with the information it requires for policy development and implementation of The Air Quality Management Plan. More importantly, however, this research has given the public the opportunity to participate in a decision and policy making process

that will directly effect the environment in which they reside and their own personal quality of life. This kind of empowerment can not only change the physical quality of life for Prince George residents inhaling too much PM_{10} or sulfur dioxide but can change the perception these citizens have on how provincial government, when given unique opportunities to combine forces with local government, research institutions and the public, can collaboratively find solutions to local environmental problems.

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APPENDIX A: Description of Air Pollutants

	Description of Pollutant	Common Sources in Prince George
PM_{10}	Fine particulate matter with a maximum diameter of 10 microns or less. 1 micron = one millionth of a meter 2000 microns = the size of a raindrop	Particulate matter varies in its chemical composition and can contain toxic trace metals such as lead, cadmium and nickel. Industrial emissions, beehive burners, road dust, wood burning, backyard burning, forestry practices and wildfires are common sources.
TRS	"Total Reduced Sulphur" is a group of sulphur compounds containing hydrogen sulphide, dimethyl sulphide, dimethyl disulphide and methyl mercaptan.	Released primarily as a by-product of the pulping process. Other sources include the processing of oil and gas and catalytic converters in automobiles.
SO_2	Sulphur dioxide is formed primarily by the combustion of material containing sulphur. It is a colorless gas and can have a pungent odour at high concentrations.	Sources include the Husky refinery and the pulpmills.
NO_2	Nitrogen oxides are formed from the reaction between oxygen and atmospheric nitrogen gas during high temperature combustion.	Primary sources are from automobiles, residential heating, industrial processes and waste incineration.
O_3	"Ground level ozone" is formed from the reaction of nitrogen oxides and volatile organic compounds in the presence of sunlight. This detrimental type of ozone is sometimes confused with the stratospheric ozone layer which protects the earth from harmful ultraviolet radiation.	Nitrogen oxides and volatile organic compounds cause the formation of ozone. Volatile organic compounds are released from automobile combustion and occur naturally in vegetation.
HCHO	Formaldehyde is a by-product of wood combustion.	Major sources are beehive burners, vehicle exhaust and natural vegetation.

APPENDIX B: Additional Survey Results

PUBLIC SATISFACTION WITH AIR QUALITY
PUBLIC AWARENESS OF AIR QUALITY ISSUES

Exhibit 1. Over the past year, I have been satisfied with the outdoor air quality in Prince George.

Response	Percent n= 500
Strongly Agree	1.2
Agree	24.4
Neutral	9.2
Disagree	47.8
Strongly Disagree	17.4

Exhibit 2. I think the outdoor air quality is getting better in Prince George.

Response	Percent n= 500
Strongly Agree	1.6
Agree	25.2
Neutral	19.8
Disagree	42.0
Strongly Disagree	11.4

Exhibit 3. I believe that the outdoor air quality in Prince George affects my quality of life.

Response	Percent n= 500
Strongly Agree	20.8
Agree	50.4
Neutral	12.0
Disagree	16.0
Strongly Disagree	0.8

Exhibit 4. I think that my health has been negatively impacted as a result of the outdoor air quality in the city.

Response	Percent n= 500
Strongly Agree	12.6
Agree	26.8
Neutral	21.4
Disagree	36.2
Strongly Disagree	3.0

Exhibit 5. I feel that I personally should make changes to improve air quality.

Response	Percent n= 500
Strongly Agree	6.6
Agree	50.0
Neutral	24.4
Disagree	17.6
Strongly Disagree	1.4

Exhibit 6. How informed do you feel overall about the outdoor air quality in Prince George? n=500

12.0%	❒ *very informed*
76.4%	❒ *somewhat informed*
11.2%	❒ *not informed at all*

Exhibit 7. The Ministry of Environment, Lands and Parks issues warnings when the air quality is poor. Do you remember how you heard about the latest one? n=500

16.2%	❒ TV
54.4%	❒ the radio
5.8%	❒ by word of mouth
12.0%	❒ the newspaper
6.8%	❒ you did not hear about it
4.6%	❒ can't remember
0.2%	❒ other (1 person sees it at work)

PERCEPTION OF SOURCES OF OUTDOOR AIR POLLUTION

Exhibit 8. Are there any other sources you would like to add? Number of respondents labeling each additional source of air pollution as a small, medium or large contributor to the airshed.

List of air pollution sources identified by respondents: n=29	Small	Medium	Large	Don't know
1. Airport testing with fire crews (tires, oil)	1		4	1
2. Cigarette smoke	1	1		
3. Smoke from bug control	1			
4. Recreational vehicles		1		
5. Dump burning				2
6. Chicken farm (ammonia smell in Blackburn)	1		2	
7. Diesel fumes		1	1	
8. Forest fires				1
9. Sewage treatment, H_2S producer		2		1
10. Pavement production, cement	2			
11. Spills at railroads				6

Exhibit 9. Can you describe the poor air quality in your neighborhood for me?

Description n=430	Percent of Responses
it stinks	69.2
smoke from burning wood, garbage, leaves	7.7
hazy	6.3
particulates, road dust	5.8
residue over cars	3.0
smoky emissions from cars	2.8
spills (chlorine, turpentine)	1.9
oil refinery	1.0
burns eyes/nose	0.7
gas leak at BCR	0.5
can't describe it	0.5
clear cut across river	0.2
sewage plant odor	0.2
industrial	0.2

FIREPLACE INSERT INVENTORY

Exhibit 10. Do you have a wood-burning fireplace insert? (n=36)

7.2% ❒YES
92.8% ❒NO

10A. How often do you use it during the months of October to March? (n=36)

25.0% ❒ *once a week*
27.8% ❒ *several times a week*
5.6% ❒ *every day*
33.3% ❒ *never*
8.3% ❒ *occasional use*

10B. Can you estimate how much wood you burn in a year?

Amount of wood in cords	Percent n=36
0.0	33.3
0.10	2.8
0.12	2.8
0.25	5.6
0.50	13.9
1.0	11.1
5.0	2.8
Don't know	27.8

10C. Do you know approximately how old your insert is?

Years	Percent n=36
2-5	13.9
6-10	22.2
11-15	22.2
16-20	16.7
21-30	5.6
Don't know	19.4

Average age of insert: 12.41 years

10D. Do you use it as your main source of heat? (n=36)

13.9% ❒ *yes*
69.4% ❒ *no*
16.7% ❒ *sometimes*

Exhibit 11. Is there anything else you would like to say? (n=99)

Responses	Number of Respondents
Pulp mills should get penalized before public	8
No complaints- its good where I live, but don't like to come to town	7
Nothing we can do, its a trade-off	7
Promote more options and alternatives	6
Keep working on it	5
Feel healthier in other places- air is better there	5
Don't think we have a problem, its ok	5
Worse in other places	5
Road dust a problem, sweep sooner	5
Cars should be tested	5
We have bigger problems	3
Better in other places	3
Going to leave	2
Bad for business, tourism	2
Need better warning system, coverage why it happens	2
Want to see government and industry working together	2
Increase monitoring	2
Pulpmill is cheating and putting kerosene in lagoons	1
Need global education	1
Government not doing enough	1
Quicker reporting of problems	1
Hope it doesn't get any worse	1
Chicken farms stink	1
Get pulpmills to publish emissions	1
Don't discourage industry	1
Pollute at night	1
City vote on standards for pollution control and vote on more industry or not	1
Pulpmills getting bad rap	1
Have incentives, bonuses	1
Same as Vancouver, thought it would be better here	1
People are too used to it	1
"Prince George is the armpit of B.C."	1
"People have to remember that this community was built on forestry so some compromises just have to be made."	1
"For an industrial city, I think PG has no real problems with air pollution."	1
"People live in the north because of the fresh air. We should take care to protect that but industry and pollution are also vital for the community."	1
"In the beginning it used to bother me but now I am used to it."	1

"Husky oil is the culprit for much of what the pulp mills are blamed for- they are the worst polluters.	1
"How do you evaluate/estimate concentrations? Water quality and MDF are big concerns. Why are the tax-payers paying for new water mains for pulp mills? Beehive burners and wood smoke are not important, car emissions are much worse. Peden Hill area is bad for the smell. Industry should be kept to the perimeter of city. Sweep earlier in the spring for road dust."	1
"Government should stop backing down from toughening regulations- no backing down on the beehive burners. Our health is more important than profits- millions could be saved on health care and I'm mad about this. Fines should be higher for environmental spills. Grant money should be going to research."	1
"I came from Mexico. PG is better. Seen pollution kill people and lots of dead birds. They should be trying to clean things up here. In Mexico, they have a big screen that displays what the air pollution monitors are reading in the various areas."	1
"Would like to see environmentalists, government and industries get together and solve the problems. Very concerned about children's future in town."	1
"Children at school shouldn't be doing PE on bad air days- keep them inside. Schools need to teach and be more aware of poor air quality."	1