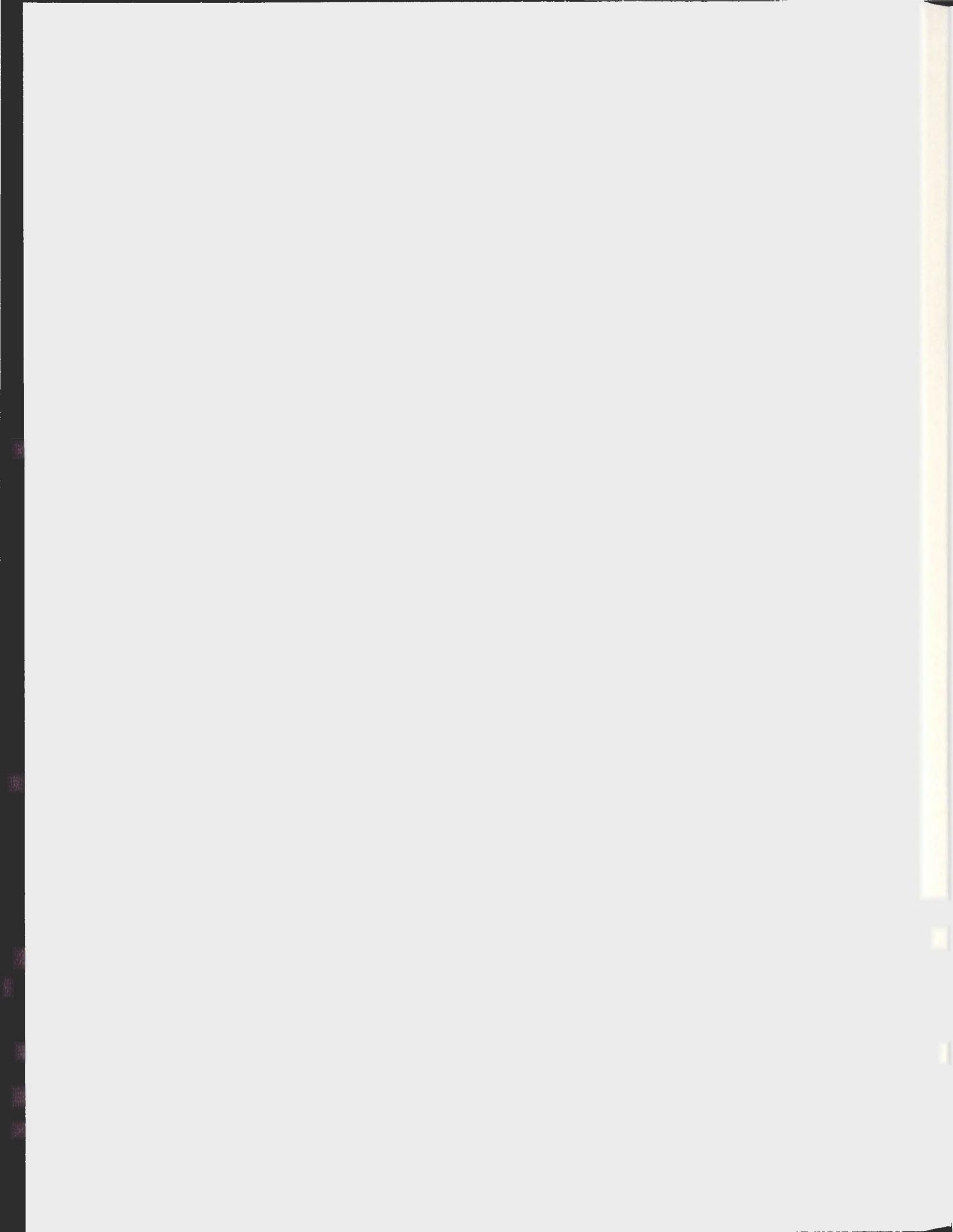


PERCEPTIONS OF PUBLIC DRINKING WATER IN
NEWFOUNDLAND AND LABRADOR:
A MIXED METHODS STUDY

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PERCEPTIONS OF PUBLIC DRINKING WATER IN NEWFOUNDLAND AND
LABRADOR: A MIXED METHODS STUDY

By

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ABSTRACT

From a health promotion perspective, it is important to understand what water sources the public is using and why, and to address any potential health risks relating to public and alternative water sources before negative health outcomes relating to water-borne contaminants are experienced. This study examined perceptions of public drinking water in Newfoundland and Labrador (NL) including factors that influence public drinking water consumption patterns, reported reasons for alternative water use, and the expressed need for information on drinking water. Three focus groups were conducted in October 2006 and a telephone survey in March and April 2007 with residents of NL. Consumers appeared to use water aesthetics as a proxy measure of water safety for tap water and alternative water sources. When participants were unsure about the quality and safety of their tap water, they tended to find an alternative drinking water source. Low compliance with boil water advisory notifications was also observed, which may increase risk of waterborne illness in this population. Transparent communication enhanced trust and general perceptions by public water consumers. In general, public tap water consumers in NL felt that more information about their household drinking water quality would provide more confidence in the product. Enhanced information dissemination may improve perceptions of the safety of drinking water, and minimize health risks to the general public. No single information dissemination method was found to be extensive enough to communicate with the entire population; a combination of distribution methods is recommended to ensure widespread and timely information transfer. A health

promotion framework was used to make upstream recommendations for changes in drinking water policy and programs in NL.

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"I not only use all the brains that I have, but all that I can borrow."

~Woodrow Wilson

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LIST OF ABBREVIATIONS

BWA	Boil water advisory
WQI	Drinking water quality index
<i>E. coli</i>	<i>Escherichia coli</i>
GI illness	Gastrointestinal illness
NL	Newfoundland and Labrador
WHO	World Health Organization

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CHAPTER 1: INTRODUCTION AND OVERVIEW

"The best way to get something done is to begin."

~Author Unknown

1.1 Introduction

Water is important; we require it to live and we use it every day. Drinking water quality has been of increasing concern in the media. Highly publicized public water supply problems such as the *Escherichia coli* (*E. coli*) outbreak in Walkerton, Ontario in 2000 and the *Cryptosporidium* outbreak in North Battleford, Saskatchewan in 2001 highlight the importance of safe drinking water to the public (Charrois, Graham, Hrudey, & Froese, 2004; Holme, 2003; Hrudey, Payment, Huck, Gillham, & Hrudey, 2003; Stirling, et al., 2001; Waterborne outbreak of gastroenteritis associated with a contaminated municipal water supply, Walkerton, Ontario, May-June 2000, 2000). Less published in the national press are the over 200 boil water advisories (BWAs) that are in place in Newfoundland and Labrador (NL) every year (*Drinking water safety in Newfoundland and Labrador*, 2007). Although BWAs are an important tool to ensure drinking water safety, they can increase consumer anxiety and alter perceptions about public drinking water. Reduced confidence in public drinking water can lead consumers to select alternatives to their public tap water, such as bottled water or various in-home treatment methods (D. C. Jones AQ, Doré K, Majowicz SE, McEwen SA, Waltner-Toews D, Henson SJ, Mathews E., 2007). Officials in charge of public water supplies may counter this reduced confidence with drinking water reports, however; there may be a disconnect between information provided by water operators and the self-reported

knowledge of the average consumer (Johnson, 2003). Although many studies have focused on the quality of drinking water, few studies have addressed the issue of public perceptions. By identifying key issues or concerns of participants, the results of this thesis have the potential to be used in the development of drinking water policies and publications, including but not limited to, drinking water safety, BWA communication and acceptable uses of public drinking water during a BWA, or the regulation of water treatment.

The purpose of this mixed methods study was to examine perceptions of public drinking water in NL. The main research objectives were to identify:

1. the perceptions of the quality and safety of public tap water;
2. the factors that influence public drinking water consumption patterns;
3. the reported reasons for alternative water use; and
4. the expressed need for information on drinking water.

1.2 Drinking Water Regulation in Canada

Health Canada's Water Quality and Health Bureau publishes the Guidelines for Canadian Drinking Water Quality. The Federal-Provincial-Territorial Committee on Drinking Water establishes these guidelines. The committee is made up of jurisdictional members (ten provinces, three territories, and the federal government), as well as representatives from the Committee on Health and Environment, Environment Canada, and the Canadian Advisory Council on Plumbing. The guidelines help to prevent disease and protect the health of Canadians by setting maximum acceptable concentrations for substances found in drinking water. The guidelines are based on scientific research that

pertains to exposure levels of contaminants, aesthetic effects and operational considerations (Federal-Provincial-Territorial Committee on Drinking Water, 2008).

In Canada, the provision of safe drinking water is the responsibility of the individual provinces and territories. The Guidelines for Canadian Drinking Water Quality are voluntarily used by every jurisdiction in Canada, and are the basis for establishing drinking water quality requirements for all Canadians.

1.3 Public Water Systems in NL

“Water supply system” is the term used to describe the entire infrastructure (e.g. pumps, pipes, valves, water treatment units) used to transport water from a water supply source to the consumer (*Drinking water safety in Newfoundland and Labrador*, 2006). A “public water supply system” is a water supply system operated by a community, whereas a “private water supply system” is a water supply system that is not operated or maintained by a community (*Drinking water safety in Newfoundland and Labrador*, 2006). Examples of private water supplies include private water wells or water cisterns. There are 535 public water supply systems that serve 599 communities in NL (*Drinking water safety in Newfoundland and Labrador*, 2007).

1.3.1 Government Departmental Roles in NL. The NL Inter-Departmental Safe Drinking Water - Technical Working Group is made up of representatives of four departments: Environment and Conservation, Health and Community Services, Government Services and Municipal Affairs. There are also representatives from the Public Health Laboratory and Medical Officers of Health from each of the province’s four Regional Health Authorities. This working group supports the Committee of Deputy

Ministers, which is made up of the Deputy Ministers of each of the four governmental departments (*Drinking water safety in Newfoundland and Labrador, 2007*).

Monitoring the chemical and physical parameters of public drinking water is the responsibility of the Department of Environment and Conservation, while the Department of Government Services is responsible for monitoring bacteriological tap water quality and residual chlorine concentrations (*Drinking water safety in Newfoundland and Labrador, 2007*). The province of NL adopted the Guidelines for Canadian Drinking Water Quality guidelines in 2001.

1.3.2 Boil water advisories. BWAs are issued for a variety of reasons. For example, in 2007, the year pertaining to this thesis, 215 BWAs affected 146 communities and 31,116 people in NL (*Drinking water safety in Newfoundland and Labrador, 2007*). The BWAs were issued for the following reasons: residual chlorination problem (36.3%), no disinfection system (25.6%), broken system or no chlorine (10.7%), operational problem in the distribution system (9.3%), disinfection system that was turned off by the operator (8.8%), or failed microbiological tests (8.8%). The procedures for issuing a BWA in NL are proactive and conservative for disease prevention; a BWA is issued at the slightest possibility of increased risk to the community. Thus, the number of BWAs is not necessarily indicative of the water quality in NL (*Drinking water safety in Newfoundland and Labrador, 2007*).

When an unsatisfactory drinking water test result is determined, the standard protocol is for repeat samples to be taken upstream and downstream of the flagged sample within 24 hours to reduce the possibility that there was an error in the sampling

procedure. Sampling errors can be related to a contaminated sample specimen bottle or bacteria on the tap from which the sample was drawn. If these repeat samples cannot be taken, a BWA is issued as a precautionary measure.

In the event of an unsatisfactory drinking water test result, the Regional Medical Officer of Health and the community official responsible for the water supply are notified immediately by telephone, and a BWA is recommended. It is the responsibility of the owner/operator of the water supply system to implement the BWA; the community officials must immediately notify all water consumers (Department of Health and Community Services, 2005).

Corrective measures appropriate to the identified problem are initiated by the owner/operator of the water supply. The BWA continues until two consecutive samples show the absence of total coliform and *E. coli*. In addition, there must be adequate disinfection as defined by the presence of disinfectant residuals, that is, the chlorine left over at the end of the chlorination process. When these indicators have returned to normal, the BWA is lifted. Again, it is the owner/operator of the water supply who notifies water consumers that public water in their area is safe to drink (Department of Health and Community Services, 2005).

1.3.3 Drinking water reports. Each year, the Government of NL publishes a Drinking Water Safety Annual Report. These reports and other information on drinking water quality are available on the Department of Environment and Conservation website (Department of Health and Community Services, 2005). The sixth annual report covers the fiscal year April 1, 2006 to March 31, 2007 (*Drinking water safety in Newfoundland*

and Labrador, 2007), the time period during which this research was undertaken. That report (2007) highlights the progress and accomplishments of the NL government for ensuring safe drinking water in NL (*Drinking water safety in Newfoundland and Labrador, 2007*).

Annual and quarterly reports are also provided to individual NL municipal offices in which drinking water has been routinely sampled. These reports may include information about sampling results of source water supplies or tap water, as well as summary tools, such as the Drinking Water Quality Index (WQI).

The WQI produces a single score from the scope, frequency and amplitude of water quality, and produces a number between 0 and 100 to represent the overall water quality (Khan, Paterson, & Khan, 2004). The same variables are used in calculations for each water system, and scores are produced for each season. This is to ensure a systematic approach for comparing drinking water quality data among communities in NL. It allows for the communication of water quality information to the general public, without the technical language of the formal public water supply reports. It is possible for a water supply system to rank favourably in the WQI index even if the water is not suitable for human consumption. As such, WQI scores are not produced for water systems that have a BWA in place, or exceed the Drinking Water Quality Guidelines for contaminants (Khan, et al., 2004).

1.2 Significance and Scope

Water quality evidence, such as bacteriological, chemical, and physical parameters, has obvious importance in the development of national, provincial and

municipal drinking water policies. It is also important to understand community-level perceptions in order to effectively inform residents on topics pertaining to drinking water. This project, the first of its kind in NL, collected data using a province-wide telephone survey and focus groups from three communities. By identifying key issues or concerns of participants, the results were used to make recommendations for future research, programs, policy and practice in NL and Canada.

This project focused solely on the public drinking water systems and was limited to the province of NL. Although private drinking water systems are outside the scope of this research project, another study conducted in tandem with this research project addressed public perceptions of private drinking water in NL.

1.3 Overview

Chapter two provides an overview of health promotion and disease prevention as a framework for examining perceptions of drinking water in NL, and the research questions that guided the investigation of this mixed methods study. An introduction to waterborne disease is followed by a review of what is currently known about public perceptions of drinking water.

The methods of the mixed method approach are described in chapter three. The chapter includes a discussion of the research design and the rationale for using a mixed methods approach.

Chapter four presents the findings of each component of the mixed methods study: focus groups completed on the Avalon Peninsula, NL, and results from the quantitative, province-wide, telephone survey.

The fifth chapter is a discussion of the overall results and a synthesis of the qualitative and quantitative findings using the Ottawa Charter as a framework for a health promotion perspective. The recommendations are intended for government agencies (provincial, regional and municipal), specifically those departments responsible for public drinking water distribution systems and policy decisions.

CHAPTER 2: LITERATURE REVIEW

"We don't live in a world of reality; we live in a world of perceptions"

~Gerald J. Simmons

2.1 Health Promotion and Disease Prevention

Health is more than the absence of disease. The World Health Organization (WHO) describes health as, "a state of complete physical, mental and social well-being. An individual or group must be able to identify and to realize aspirations, to satisfy needs, and to change or cope with the environment. Health is, therefore, seen as a resource for everyday life, not the objective of living" (World Health Organization, 1986).

The WHO defines health promotion as, "the process of enabling people to increase control over, and to improve, their health" (World Health Organization, 1986). Health promotion includes providing the knowledge base to make informed drinking water choices, including providing information on the drinking water source and treatment device use. For a level of complete physical, mental and social health, consumers should have access to safe drinking water, and also perceive their drinking water as safe. From a health promotion perspective, it is important to understand what water sources consumers are using and why, and to address any potential health problems relating to public and alternative water sources before they experience negative health outcomes relating to water-borne contaminants. This upstream approach to health involves identifying risk factors and at-risk populations.

Disease prevention is concerned with both upstream and downstream approaches to

health and disease. As defined by the WHO, “disease prevention covers measures not only to prevent the occurrence of disease, such as a risk factor, but also to arrest its progress and reduce its consequences once established” (World Health Organization, 1998). There are three categories of disease prevention: primary, secondary, and tertiary prevention. Primary prevention aims to avoid the development of disease. Most population-based health promotion activities are examples of primary preventive measures. For example, public awareness campaigns designed to promote informed decision-making about drinking water are primary prevention strategies. Water treatment such as chlorination is another example. Secondary prevention aims at early disease detection such as testing water for pathogens. Such strategies increase opportunities for early interventions such as implementing a BWA that would prevent the emergence of illness in the population. Tertiary prevention aims to reduce the negative impact of an already established disease by restoring function and reducing disease-related complications. For example, if a population experiences a waterborne outbreak, the appropriate corrective action would be to treat the waterborne illness, reduce secondary transmission, and perhaps post a sign warning others not to drink from that water source. Addressing water quality issues has been an important move forward for public health.

2.2 Waterborne Disease

2.2.1 The burden of enteric illness. Gastrointestinal (GI) illness can be caused by a variety of organisms transmitted via a variety of routes including, but not limited to, food, environmental agents and drinking water. When enteric illnesses occur on a large scale, the personal and community economic impact can be significant, especially when

associated with high mortality and morbidity rates as was the case in Walkerton, Ontario (Charrois, et al., 2004; Holme, 2003; Hrudehy, et al., 2003; Stirling, et al., 2001; "Waterborne outbreak of gastroenteritis associated with a contaminated municipal water supply, Walkerton, Ontario, May-June 2000," 2000).

Several studies have estimated the burden of GI illness in Canada. A cross-sectional study in Hamilton, Ontario found an incidence of 1.3 cases of self-reported acute GI illness per person-year, a mean duration of illness of 4.23 days, and a 71.0% average probability for an individual to develop acute GI illness during the year (Majowicz, et al., 2004; Schuster, et al., 2005). These results were substantiated by a second cross-sectional telephone survey in British Columbia that found an incidence of 1.3 cases of self-reported acute GI illness per person-year, a mean duration of illness of 3.7 days, and a 71.6% average probability for an individual to develop acute GI illness during the year (Thomas, et al., 2006).

Although the above studies do not distinguish among GI illness causes, the contribution of waterborne causes should not be ignored as a potential cause for acute GI. Schuster et al. (2005) presented data on Canadian waterborne disease outbreaks from 1974-2001 to gain a picture of the burden of disease on the public health system in Canada (Schuster, et al., 2005). They found that out of 288 outbreaks linked to a drinking water source, 34% were linked to public water systems (Schuster, et al., 2005). Severe weather, nearness to animal populations, treatment system malfunctions, and poor maintenance and treatment practices were associated with reported waterborne disease outbreaks (Schuster, et al., 2005).

2.2.2 Highly publicized outbreaks. Highly publicized waterborne outbreaks are a reminder of the potentially significant morbidity and mortality associated with unsafe drinking water. There were over 2,300 people ill and 7 deaths associated with the *E. coli*.0157:H7 contamination of the drinking water in Walkerton, Ontario in May 2000 (Hrudey, et al., 2003). Also, between 5,800 and 7,100 residents and visitors were sick from the drinking water contaminated by *Cryptosporidium parvum* during the May 2001 outbreak in North Battleford, Saskatchewan (Stirling, et al., 2001). These are just two examples of the adverse health consequences caused by unsafe drinking water. Heightened awareness, particularly via the news media, of unsafe drinking water associated with waterborne outbreaks can alter public perceptions of public drinking water (Doria, Abubakar, Syed, Hughes, & Hunter, 2006).

2.3 Public Perceptions of Drinking Water

The discussion of perceptions of drinking water quality is complicated. A review of the literature cites aesthetic characteristics, chlorine, odour and flavour, information sources, including the media, and trust in utility workers as dynamic factors that may influence consumer attitudes towards public water quality (Burlingame & Mackey, 2007; Doria, et al., 2006; Driedger & Eyles, 2003; Johnson, 2003; D. C. Jones AQ, Doré K, Majowicz SE, McEwen SA, Waltner-Toews D, Henson SJ, Mathews E., 2007).

2.3.1 Aesthetic characteristics. Mineral content can alter the aesthetics of drinking water, while remaining below the maximum health and safety standard limits of the Guidelines for Canadian Drinking Water Quality established by the Federal-Provincial-Territorial Committee on Drinking Water (Azoulay, Garzon, & Eisenberg,

2001; Dietrich, 2006). If consumers are not informed about, or do not understand, this characteristic, they may perceive aesthetic variation as an indication of poor drinking water quality. Aesthetically unpleasing drinking water may elicit concerns that the water is unsafe or undesirable to drink (Doria Mde, Pidgeon, & Hunter, 2009; D. C. Jones AQ, Doré K, Majowicz SE, McEwen SA, Waltner-Toews D, Henson SJ, Mathews E., 2007). This perception may lead to increased use of treatment devices and tap water alternatives (Jones, Dewey, Dore, Majowicz, McEwen, Waltner-Toews, et al., 2006).

2.3.2 Chlorination. Other water quality indicators, such as residual chlorine levels, may also impact consumer perception. In two studies conducted in 1994 and 2001 in Quebec, Canada, consumers living nearest to a water treatment plant, where residual chlorine levels are highest, perceived the most risk and least satisfaction with the quality of their drinking water (Turgeon, Rodriguez, Theriault, & Levallois, 2004). Mackey *et al.* (2004) tested consumer sensitivity to free and combined chlorine in seven different demographic and geographic locations across the United States. Contrary to the Quebec study, they found that, although individual sensitivity varied widely, very few participants were able to recognize the chlorine flavour, even at concentrations close to the US maximum contaminant level (Mackey, Baribeau, Crozes, Suffet, & Piriou, 2004). Furthermore, there was no statistically significant difference in sensitivity threshold to chlorinous flavours among tap, bottled, and filtered water drinkers. This study concluded that consumers did not switch to alternative tap water solutions based solely on their detection of free chlorine in the water (Mackey, et al., 2004). Environmental factors,

such as exposure to industrialization or pollution, may also affect attitudes about chemicals, including chlorination of drinking water (Doria Mde, et al., 2009).

2.3.3 Information sources. Perceptions of risk from drinking water are influenced by information sources (Doria, et al., 2006). In a study conducted in the United Kingdom in 2001/2002, it was found that people were more likely to perceive waterborne contamination as the cause of enteric illness if the information came from the media or friends than if it came from other information sources (19). Consumers were also more likely to view water as the cause of enteric illness if the information came from a health professional; but consumers did not associate a specific cause with enteric illness if their information source was the Internet or leaflets (Doria, et al., 2006). However, in a study conducted in the United States, quantitative water quality reports did not shift consumers' perceptions of water quality and utility performance at all (Johnson, 2003).

2.3.4 Media. Doubts and fears about drinking water may be exacerbated by stories in the media or by commercial advertisements featuring alternative drinking water options or treatment devices. Chlorine disinfection of drinking water saves lives and prevents significant morbidity by reducing enteric illness, but chlorine by-products have also been suggested to be carcinogens (Johnson, 2003). Media presentations of linking chlorine disinfection and cancer can shape lay risk perceptions (Johnson, 2003). While microbiological contamination would cause far greater morbidity, the public views any exposure to a potential risk of cancer as unacceptable (Fawell & Nieuwenhuijsen, 2003; Johnson, 2003).

2.3.5 Trust in utility workers. Trust in water utility performance can attenuate risk perceptions in the public drinking water supply (Doria Mde, et al., 2009; Johnson, 2003). In a study conducted by Jones *et al.* (2007) in Hamilton, Ontario Canada in 2003, participants felt that their scepticism about a public water system might be offset by a newsletter that highlighted employee dedication (D. C. Jones AQ, Doré K, Majowicz SE, McEwen SA, Waltner-Toews D, Henson SJ, Mathews E., 2007).

In summary, perceptions of water quality are affected by a variety of factors; these perceptions may play a role in drinking water consumption patterns and choices. When consumers have negative perceptions about their public drinking water, they may look for alternative choices such as bottled water or various water treatment devices. This tendency to use other methods of obtaining drinking water can alter health risks, perhaps negatively in cases where the alternative source is inferior.

2.4 Alternative Sources of Water

2.4.1 In-home treatment. In a study conducted in Hamilton, Ontario in 2001/2002, 49% of 1,752 respondents reported using an in-home water treatment method (Jones, Dewey, Dore, Majowicz, McEwen, & Waltner-Toews, 2006). The top three in-home treatment devices reported were jug filter (66%), tap filter (16.3%), and boiling water (6.8%) (Jones, Dewey, Dore, Majowicz, McEwen, & Waltner-Toews, 2006). Additionally, 2.5% of respondents used two treatment methods (Jones, Dewey, Dore, Majowicz, McEwen, & Waltner-Toews, 2006). Similarly, a study in British Columbia in 2002/2003 reported that 47% of 4,610 respondents used in-home water treatment methods to treat their tap water (Jones, et al., 2007). The use of water treatment devices

was associated with an increase in the amount of water consumed per day, by both sexes (Jones, et al., 2007). Both the Hamilton, Ontario and British Columbia studies reported that household income was not associated with the use of water treatment methods, but was associated with the specific type of treatment method (Jones, Dewey, Dore, Majowicz, McEwen, & Waltner-Toews, 2006; Jones, et al., 2007).

2.4.2 Bottled water. In Canada, bottled water is not subject to the same regulations as public drinking water. It is federally regulated as a food under the federal Food and Drugs Act and falls under the authority of the Canadian Food Inspection Agency (Health Canada, 2008b). Under this regulation, the microbiological safety requirements for bottled water are very limited: fluoride, arsenic and lead are the only chemical contaminants for which testing is required (Health Canada, 2008b). Although manufacturers can enforce extra monitoring and testing measures, these are not widely regulated for consistency.

Bottled water is produced by a variety of manufacturers. A variety of brand names, treatment types, additives and supplements, and labelling, as well as inconsistent terminology, may mislead or confuse consumers (Pip, 2000). In Canada, fluoride concentrations are not required on bottled water nutrition labels (Department of Justice Canada, 1999). If such information is not provided on the nutrition labels, the only way to determine the levels of certain minerals, such as fluoride, is to have the water tested or to contact the manufacturer (Lalumandier & Ayers, 2000), however; bottled water testing may be expensive and impractical for individual consumers.

Drinking water may be an important source of mineral intake, especially if the water is from a mineral-rich source (Azoulay, et al., 2001). Waterborne minerals are easily absorbed into the gastrointestinal tract. Daily mineral intake can depend on the individual, the water source and treatment method, and the amount of water consumed (Mahajan, Walia, Lark, & Sumanjit, 2006). The recommended dietary intake of minerals can vary with age, sex and underlying conditions or diseases (Azoulay, et al., 2001). Those with specific dietary mineral restrictions should be hyper-aware of the mineral intake from drinking water and should select drinking water with an optimal mineral profile (Azoulay, et al., 2001). Thus, choice of drinking water can impact individual health because of lower levels of minerals in some bottled water compared to tap water. Individuals may need mineral supplements if bottled water is the only drinking water source (Azoulay, et al., 2001; Lalumandier & Ayers, 2000; Mahajan, et al., 2006).

Different brands may contain varying mineral levels (Lalumandier & Ayers, 2000), and some mineral waters may actually have low mineralization (Azoulay, et al., 2001; Pip, 2000). A study conducted in Amritsar, India in 2006, found that some bottled waters were over-treated and therefore deficient in certain minerals according to the recommended limits of the WHO and the United States Environmental Protection Agency (Mahajan, et al., 2006). Over-treatment occurs when non-harmful components of water such as minerals are removed to alter the aesthetic properties of the water.

There may also exist differences in water quality between tap and bottled waters. A study conducted in Quebec City, Canada in 1992 found that water tested from commercial bottled water coolers in participants' homes was significantly more

contaminated than that from the first streams of public tap water (Levesque, et al., 1994). The quality of bottled drinking water may deteriorate through handling, transport, storage, bottling and packaging (Pip, 2000). Further, the advertised analyses of bottled water are typically done at the source of origin and may not adequately represent the quality of the water by the time it reaches the consumer (Pip, 2000). A study by Levesque *et al.* (1994) concluded that the bacterial quality of public tap water is superior to that of water dispensed by residential water coolers, as these coolers can promote a multitude of bacteria, and the microbiological standards that exist for bottled water are generally not applied once the bottle is installed on the dispenser (Levesque, et al., 1994).

CHAPTER 3: MIXED METHODS

"It is water, in every form and at every scale, that saturates the mind"

~National Geographic, October 1993

3.1 Research Design

3.1.1 Mixed methods. This project used a mixed method approach: a qualitative research component (focus groups) and a quantitative research component (province-wide telephone survey). Using two methods to explore the research questions increased the validity of the data that served as the foundation from which recommendations were derived.

The analysis of survey data collected from a representative sample can reveal trends and patterns in a social issue. Findings from focus group analyses may express how individuals make meaning of that social issue. Complementary research methods can strengthen the overall study by reducing the limitations of each approach. Qualitative results may lack the generalizability, reproducibility and applicability gained with larger population samples used in quantitative methods (Abusabha & Woelfel, 2003). However, quantitative surveys may lack the richness of detail that can be captured with focus groups. Detailed discussions and group interaction in focus group interviews tend to generate understanding at the individual level, while a telephone survey can identify broad trends and issues at the population level (Abusabha & Woelfel, 2003). In this way, mixed methods can be especially useful for producing richer and more reliable data from which a researcher can gather evidence for policy recommendations.

Focus groups, one form of qualitative research, can be especially useful when conducted in tandem with other strategies. For instance, data gathered from focus groups can help researchers develop culturally specific survey instruments (Abusabha & Woelfel, 2003; Halcomb, Gholizadeh, DiGiacomo, Phillips, & Davidson, 2007; Stevens, 1996). Group discussion can add depth to survey responses, and can suggest new directions for future research (Stevens, 1996; Webb & Kevern, 2001). Policy makers can benefit by understanding the reasons behind perceptions, thereby making improvements to current and new program developments, information dissemination or legislation (Abusabha & Woelfel, 2003).

3.1.2 Focus groups. The first method used to collect data for this study was focus groups. Focus groups are used extensively in marketing research for collecting consumer attitudes toward products, perceptions of programs, purchasing behaviour, opinions, beliefs, range of ideas and needs for services (Halcomb, et al., 2007; Stevens, 1996; Webb & Kevern, 2001). Research on health services, resource needs, and behaviours allow for an in-depth understanding of public health problems in a population (Stevens, 1996). The focus groups in this study provided an opportunity for participants to discuss community-specific problems and resolutions on water quality issues.

Focus groups use group interviews to explore community interpretations and experiences (Stevens, 1996). The semi-structured nature of the group discussion encourages a deeper level of meaning (Halcomb, et al., 2007), as group interaction facilitates exploration and clarification of participants' views (Abusabha & Woelfel, 2003; Halcomb, et al., 2007; Webb & Kevern, 2001). Individual opinions are affected by

other experiences and group dynamics, which simulate behaviours in a normal social environment (Stevens, 1996; Webb & Kevern, 2001). Participants are stimulated by what others say; their opinions may be confirmed, reinforced, or contradicted (Halcomb, et al., 2007; Stevens, 1996; Webb & Kevern, 2001).

Another benefit of using focus groups for this study was that they provided an opportunity to interpret a meaning behind the words, resulting in a meaningful insight into Newfoundland-specific language and traditions related to drinking water. Culturally and linguistically, diverse populations have adapted to their environment and have traditions related to their culture represented in language, words, and actions (Abusabha & Woelfel, 2003; Halcomb, et al., 2007). In this study, through the interactions with the participants, it was possible to identify words and phrases specific to the NL dialect. This was particularly useful when it came to revising the telephone survey for the Newfoundland-specific population.

Some limitations associated with focus groups must also be recognized. A sampling bias may be introduced as participants must volunteer time and choose to participate in the discussion. The opinions of more vocal focus group members may also be overrepresented in the dialogue, or they may better articulate their feelings and ideas. In these cases, the data may be biased towards the more articulate or outspoken speaker; however, a well-trained facilitator can mitigate this bias (Abusabha & Woelfel, 2003; Halcomb, et al., 2007; Stevens, 1996). Focus group results cannot be generalized to an entire population because representative sampling techniques are not used. However, the

results are not necessarily untypical of what one might find in the general population (Abusabha & Woelfel, 2003; Halcomb, et al., 2007).

3.1.3 Telephone survey. The second method used to collect data for this thesis was a telephone survey. By surveying a larger portion of the population, the data have the potential to be more representative of the general population and provide information to public health policy makers, thereby providing significant community benefits.

Surveys can be conducted by mail, telephone, or face-to-face. Telephone surveys maximize interviewer time and available resources (Barriball, Christian, While, & Bergen, 1996). They generally have a lower cost than face-to-face surveys and allow for surveying over a wide geographical area in a limited amount of time (Barriball, et al., 1996). Mail surveys are poor tools in communities with low literacy rates (Siemiatycki, Campbell, Richardson, & Aubert, 1984).

Researchers in Montreal, Canada in 1979 conducted a study that compared mail, telephone and home interview strategies for household health surveys (Siemiatycki, et al., 1984). The study concluded that for non-sensitive questions, there was no difference between response rates in mail and telephone questionnaires, however; response to sensitive questions, such as income level, was slightly lower in the telephone questionnaire (Siemiatycki, et al., 1984). Other studies have concluded that overall response rates were similar among telephone and mail survey respondents (Feveile, Olsen, & Hogh, 2007; Hawthorne, 2003). Feveile *et al.* in 2007 reported that the rate of missing responses was higher among mail survey respondents than among telephone survey respondents (Feveile, et al., 2007). This finding is at odds with a study conducted

in Australia in 2002 that found no significant difference in the rate of missing data in telephone versus mail-out questionnaires. Telephone survey respondents however, responded more positively than mail survey respondents (Feveile, et al., 2007; Hall, 1995). This may be due to a perceived need among participants for socially desirable responses during an interview that is not felt with the anonymity of a mail-in questionnaire.

The telephone survey method allows for greater generalization over the focus groups by having a larger sample size. It is possible to cover a large sampling area quickly and conveniently. These factors were especially important in a population such as NL, where a small population is spread over a large land mass and where literacy rates are lower than the national average in some rural communities. Thus, a telephone survey was an appropriate tool for our purposes.

Random digit dialling was used in this study. It allows for random sampling of participants in a defined geographical area (providing that the majority of the population have phones) because there is the same probability of subject selection (Hartge, et al., 1984). Due to the nature of random digit dialling, the researcher must confirm that the residence fits in the desired sampling frame (Hartge, et al., 1984). Telephone directories are also widely used because the telephone numbers are confirmed residential numbers, which saves time as business and fax numbers can be excluded. However, telephone directories can be poor sampling frames because they omit those with unlisted numbers, and accuracy is limited by the publication date (Hartge, et al., 1984). Details about

recruitment, questionnaire design and data analysis performed in this thesis are provided in subsequent chapters.

Imperfect response rates are a challenge in any survey study (Barriball, et al., 1996). Low response may indicate a geographical or demographic response bias. A comparison with the demographics of the population can alert the researcher to a potential bias and care can be taken when interpreting the results. The nature of telephone surveys selectively biases towards residents who are home more often than others, however; this bias can be minimized by calling back multiple times, on different days of the week, and at different times of day (Hartge, et al., 1984), as was done in this study.

The study described in the following chapters involved a collection of participants' daily water consumption behaviours. Food diaries are considered the most accurate representation of consumption patterns because they reduce the possibility of recall bias (Robertson, et al., 2000). However, short-term drinking water-intake diaries may not capture cyclical trends in consumption patterns, such as weekly or seasonal intake variations (Robertson, et al., 2000). Retrospective questionnaires may provide less accurate results than food diaries as participants are subject to problems with recall bias, especially when asked to recall a routine act such as drinking water (Robertson, et al., 2000). Because of limited time and financial resources, this study opted for the retrospective questionnaire method.

3.1.4 Focus group methods. Qualitative data were collected from residents on the Avalon Peninsula in NL via focus groups in October 2006. Communities were

selected from within a 200 km radius of St. John's, due to time and financial limitations. St. John's was chosen because it is the capital city of NL. The communities of Harbour Grace and Trepassey were chosen because they have a public water supply and are centrally located among surrounding, sparsely populated communities. The radius around these communities allowed for a broad sample of participants.

The NL Department of Environment and Conservation provided a database with all communities in NL, categorized by the type of water source with which they are supplied (public or private water supply system). Community names were cross-referenced with the residential telephone exchanges, and a list of community names with corresponding telephone exchanges for residences with public water supplies was created. The last four digits of the telephone numbers were generated using random-digit dialling for recruitment purposes, and there is only one area code for the entire province. Participants were then recruited from this sampling frame.

A trained interviewer from the Health Research Unit at the Memorial University of Newfoundland made the participant recruitment calls. Phone calls were made at various times throughout the day and evening to ensure a thorough sampling of the population. Recruitment calls to randomly generated phone numbers continued until thirteen people were recruited for each of the three focus groups, with a goal of between six and ten participants, per group. Inclusion criteria included the following: valid phone service, 18 years of age or older, the ability to communicate in English, and current residency in the chosen community or nearby surrounding area. Secondary calls were made two days prior to the focus groups to remind potential participants of the groups

and to confirm attendance. In some cases, additional participants were recruited because cancellations were numerous. Three and five additional participants were recruited for the St. John's and Trepassey focus groups, respectively. With help from the NL Department of Health and Community Services, focus groups were held in public or government buildings central to the sampled communities.

A trained moderator (Dr. Andria Jones) and an assistant moderator (Kelly Butt) led each focus group. The moderator led the semi-structured discussion based on a pre-tested questioning route that included a combination of structured questions and pre-planned probes designed to improve detail and understanding (Appendix 1). The assistant moderator noted key points and direct quotes, and recorded her reflections on group interaction. Information was collected on perceptions of the participants' water quality, individual water concerns and experiences, alternative water use, testing and treatment of public tap water, and current sources of information on drinking water. Participants were also given an opportunity to discuss any additional, related topics and to ask questions. All focus groups were digitally audio-recorded. The focus groups each ran for approximately two hours, after which the moderators discussed any key points or concerns regarding the discussion. All participants were provided with refreshments during the discussion, as well as a small monetary reimbursement for time and travel expenses.

Thematic analysis was used to analyze the data. This is a method of qualitative research where similar elements of data are grouped under a common category. Thematic elements were selected from the transcripts, and sentences and phrases were

manually categorized and coded. Themes were revised with each transcript and then each transcript was re-read before coding. The themes were based on perceptions of public water as presented throughout the discussion. As themes were not mutually exclusive, some themes were collapsed to reduce phrases repeatedly coded under two or more themes.

3.2 Telephone Survey Methods

Bristol Omnifacts Research, a marketing research company in St. John's, NL, was contracted to administer a telephone survey in March and April 2007 to residents living in NL that received public water; our target sample size was 500 participants. The NL Department of Environment and Conservation provided a database that categorized all communities in NL by the type of water source supplied (i.e. public or private supply). The community names were then cross-referenced with the NL residential community telephone exchanges (Bell Aliant Regional Communications, L.P., St. John's, NL). A list of community names with corresponding telephone exchanges for residences with public water supplies was created. Constrained by the public water supply telephone exchanges, telephone numbers were randomly selected using ASDE Survey Sampler, a commercial database that excluded unlisted and "do not call" phone numbers (ASDE Survey Sampler); this list served as the sampling frame for the telephone survey.

Professionally trained interviewers conducted the telephone survey using computer-assisted telephone interviewing software. The questionnaire was based on one previously used in a similar study in 2004 in Hamilton, Ontario (Jones, Dewey, Dore, Majowicz, McEwen, Waltner-Toews, et al., 2006). Phrasing of some questions was

modified to incorporate NL vocabulary, phrases, and definitions, as reflected in the findings collected during three focus groups conducted prior to this study. The questionnaire, included in Appendix 2, was pre-tested on 49 households in the NL population to assess appropriate length and language. The data from the pre-test interviews were not included with the data collected in the survey.

Forty-four closed-ended questions were designed using five-point Likert scales, check-all-that-apply, and yes-no response options. Data were collected on participants' perceptions of their household tap water quality and safety, water concerns and experiences, alternative water use, experiences and issues surrounding boil water advisories, and general demographics (Appendix 2). To maximize detail and improve our understanding, participants were also given opportunities to elaborate on responses using open-ended questions. The interviews took an average of 20 minutes to complete. All participants were entered into a draw for a chance to win one of three \$250 cash prizes.

Phone calls were made every day of the week, and at various times throughout the day and evening to reduce non-response bias. The interview was conducted with the person who was identified as being most responsible for drinking water decisions in the household. Other inclusion criteria were: a valid phone service at a residential household, 18 years of age and older, living in a residence supplied with a public water source, and the ability to communicate in English.

The data were entered into a statistical software package, SPSS Statistics 16.0 (SPSS Inc., 2009) for analyses. The data presented were analyzed using descriptive

statistics, and chi-square tests were used to compare the demographics of the study population with the demographics of the general population of NL, using a significance level of 5%.

3.3 Confidentiality and Ethical Considerations

The Human Investigations Committee, the research ethics board of the Memorial University of Newfoundland, approved the study prior to initiation of the project.

Informed consent forms can minimize confidentiality issues that arise in research (Halcomb, et al., 2007). In this study, participant confidentiality was maintained by securing all paper copies in a locked cabinet in a locked, private office. Computers were password protected and data files were encrypted. All identifying information in the transcripts was deleted or modified to ensure anonymity. All members of the research team, including the survey company who completed the survey calls, signed an oath of confidentiality.

Participant confidentiality was ensured in two ways: participants were not required to provide their name to participate in the study, and no identifying information was included in the questionnaire responses.

Participants in both the focus groups and telephone survey were told that participation was voluntary and that they were free to withdraw from discussion, without penalty, at any time. The focus group moderator was trained to ask questions in a sensitive and professional manner. At the end of each focus group, the participants were offered an opportunity to ask questions regarding public drinking water in NL, and information was provided to those interested. Contact information for the moderator was

provided to both the telephone survey and focus group participants, in the event that participants had questions or concerns that they would have liked addressed.

Audio recordings were professionally transcribed. Participant confidentiality was maintained by securing all paper copies in a locked cabinet in a private, locked office. Computers were password protected and data files were encrypted. All identifiable participant information in the transcripts was deleted or modified to ensure anonymity. All members of the research team signed an oath of confidentiality.

CHAPTER 4: RESULTS

"In time, and with water, everything changes."

~Leonardo da Vinci

4.1 Focus Group Results

Focus group interviews were carried out in three communities. The focus groups were composed predominantly of females, older than 40 years, with children living at home, who reported a household income in the low to middle range (Table 1). Information about the focus group communities' geographical locations and public water systems is shown in Tables 2-4.

The three communities were quite different from one another: Harbour Grace is a small, semi-urban community with no BWA at the time of the study; St. John's is a large urban community with no BWA at the time of the study; and Trepassey is a small rural community that was under a BWA at the time of the study. The findings of each community are presented separately based on seven themes that emerged from the analyses: safety, water comparisons, fear, trust, knowledge, communication, and behaviour/implications of water use. The themes do overlap; they are not discrete.

4.1.1 Harbour Grace. The first focus group was conducted in Harbour Grace. Located on one of the largest harbours of the Avalon Peninsula, 100 km west of St. John's and 33 km from the Trans-Canada Highway, Harbour Grace has a population of 3,074 and a land area of 33.71 square km (Statistics Canada, 2008b). Three Harbour Grace participants attended and ten people, who had previously confirmed, did not attend or provide an explanation for not participating. Of the three attendees, there were two

females and one male. Participants were in the age category of 40-59, and one participant had children living at home (Table 1).

Harbour Grace has five public water sources; since June 23, 2000, there has been a total of nine BWAs issued in Harbour Grace (Table 2). The procedures for issuing a BWA in NL are proactive and conservative in terms of public health; a BWA is issued if there is any possibility of risk to the community. Thus, the number of BWAs may not indicate the actual water quality in Harbour Grace. The characteristics of the water sources for Harbour Grace, including the WQIs, are summarized in Table 2. At the time of the focus group, there were no BWAs in effect for any of the Harbour Grace water supplies and the WQI rating was “excellent” (values of 95-100).

None of the participants in this group used their tap water for drinking; bottled water was their main source of drinking water. Tap water was used for cooking and making hot beverages. There was group agreement that this trend was common among the Harbour Grace community residents. Other drinking sources for adults and children alike were carbonated beverages, milk, and juice.

One participant described how no one in her place of work drank the building’s tap water, specifying that even visitors were encouraged to drink from the water cooler. When asked to explain, she said,

And even if a [visitor] came in that wanted a glass of water, we’d give it to him from our own water [cooler] [...]. I guess we wouldn’t give a client something that we wouldn’t drink ourselves.

Safety / Quality. Participants in the Harbour Grace focus group expressed very negative perceptions about the public tap water and described it as unsafe, even when there was no BWA in effect. They believed the water was not “fit to drink” and described their water as “gross” and “a bit yellow”. One participant was concerned about the smell and taste of chlorine in the Harbour Grace public water, which she likened to laundry bleach.

I mean, you use Javex to clean your clothes, you know? So it’s going to turn you off if you have to drink it. It’s the same kind of thing or maybe I’m wrong.

Chlorine is the same as Javex? It pretty much smells the same.

Despite concerns about their own drinking water, participants were in agreement that Harbour Grace public tap water was better than the St. John’s (“city”) water. One participant described the water in St. John’s: “It smells mousty.¹ St. John’s – I can’t stand that water.”

Fear. Participants were asked for the first thing that came to mind when thinking about their household drinking water. The idea of water contamination from the old town incinerator was introduced in response. Toxins from the old incinerator were at the forefront of this focus group discussion and were a predominant and recurring theme throughout. All participants suspected that perceived high cancer rates in Harbour Grace might be caused by the drinking water.

[...] the incinerator was up there close to the water, it makes you wonder if the water in Harbour Grace is polluted, right? Makes you scared. And then there’s

¹ NL colloquialism: Old and mildewy

so many cases of cancer in Carbonear² and [Harbour Grace]. It makes you wonder if there's something in the water that causes cancer.

All participants repeatedly referred back to the release of toxins into the water from the now out-of-use incinerator located near the water supply in Harbour Grace. According to participants there was a story about the incinerator and water contamination in the local newspaper in 2002 and it was this media report that led to present-day concerns for the local residents.³ Even though the incinerator is no longer in use, the participants were still worried about the lingering effects on the water supply. Participants agreed that it was this fear about the possible incinerator contamination that led them to begin drinking bottled water instead of their public tap water.

Alternative Water Use. Participants reported regular use of alternative water sources, including commercial jug filters and bottled water. Commercial jug filters typically employ activated carbon filtering. Two of the participants who lived in Harbour Grace explained that they initially bought a commercial jug filter because the advertising claimed it makes the water cleaner. As one participant put it, "I guess you feel a little bit more secure about whatever is coming out of that tap."

However, the jug filter did not provide the sense of security in the drinking water for which they had hoped; participants doubted manufacturer claims of the jug filter and questioned its effectiveness. As one participant put it, "I wonder is that doing the trick?"

² Carbonear is a community 10.8 km from Harbour Grace.

³ This article was not found, despite an exhaustive search, including discussions with the editor of the local paper.

Other treatment devices, such as filters on the main water line to the house, were regarded as necessary for drinking water safety, but concern was expressed over the accessibility and affordability of these alternative options. Participants acknowledged that treatment devices were a comfort for those who could afford them, because drinking tap water without the use of a treatment device was viewed as unsafe.

While participants commonly used bottled water, concern was expressed about the water source of the bottled water. Mainland water was described as “recycled sewage”. Bottled water, however, from a mainland source was still seen as safer than the Harbour Grace tap water. Exasperated at the lack of drinking water choices, one participant said, “I think it’s just the lesser of the two evils, for some reason. The bottled water: not that you trust it that much, you just trust it a little bit more.”

Trust. Trust was an important theme and tied in closely with communication, specifically regarding BWAs. Trust also captured the idea of “us” (residents of the community who drink from the water supply) versus “them” (those who maintain the water supply). The participants felt that there was a poor level of communication between these two groups.

Participants were concerned about the perceived lack of information surrounding the cause of BWAs. Poor communication about drinking water evoked feelings of suspicion and mistrust, as community residents believed that information was purposely withheld.

As far as I’m concerned they should have the authority to tell us why they did this, and why they did that, and this is what they [did], and this is the result, and

this is exactly what it was [...]. Well they have [the authority], but why they don't do it or exercise it, I don't know.

All participants were familiar with the *E. coli* drinking water contamination in Walkerton, Ontario in 2000 ("Waterborne outbreak of gastroenteritis associated with a contaminated municipal water supply, Walkerton, Ontario, May-June 2000," 2000). *E. coli* was referred to as "poison in the water". They believed that the residents of Walkerton were not told about the water issues, and that people died before anyone knew about it. The participants in the Harbour Grace focus group compared this to their own situation, where they often felt uninformed about issues surrounding their drinking water. Participants expressed concerns that a similar situation might occur in their community.

You get a scare every time you [get] this boil water advisory. You wonder if that's what's in the water, poison or something [...]. And then you're half afraid to drink it when it comes back on [...] because of the pipes. You know, how much went in the pipes [and will now come] to your house?

The Walkerton situation was brought up as an example of what can happen when there is misplaced trust in the water supply system compounded by a lack of communication. One participant expressed her views: "Even if the government informed [you], who's to say that you trust that too? After what happened in Walkerton. The government knew all about that. So who's to say you trust [them]?"

There seemed to be a lack of confidence in those in charge of distributing drinking water information. One participant shared his concerns about the local town

council's knowledge pertaining to drinking water safety: "Everybody could call the council [...]. But who over there knows the science?"

Fears arising out of these unanswered questions were enough for these participants to avoid drinking their tap water as much as possible: "I'm not drinking tap water; I don't trust it."

Knowledge. Participants felt that their knowledge regarding the drinking water policies and procedures was very limited. When asked what is included in drinking water testing, the participants had more questions than answers. The moderator prompted the participants to discuss what is added to the water (e.g. fluoride or chlorine). Again, there was a lack of familiarity and much uncertainty about how safety was maintained.

The participants in the Harbour Grace focus group felt that their lack of knowledge was directly linked to a perceived lack of communication regarding the public water supply. There was a definite desire for more information: "I'd certainly like to know more about it. The more you know, the more educated a choice you can make about drinking it or not drinking it."

Communication. Participants were frustrated with the level of communication about their drinking water. Specifically, they expressed concern with the way BWA information was distributed saying that it was often too late and not widespread enough to prevent residents of the community from drinking unsafe water. Participants referred to instances where BWAs or water shut-offs were reported with little detail on the news. This perceived lack of information left the participants of this focus group with many questions and few answers regarding BWAs and their drinking water.

As for water testing, participants in this focus group said that they didn't know of any published water test reports available to the public. One participant put it: "[It's] not for me to know unless you phone a councillor or something."

Participants were also troubled by how little they were told about BWAs. One participant explained that the lack of communication led to feelings of unease about drinking the tap water, "There's no results. Why do they have that boil order? What caused it? Is it safe to drink it again and what did you find when tested it? I could go on and on, I don't know."

One participant explained that there was comfort in the knowledge that low lake water caused a BWA, compared to not knowing the reason for other advisories that were issued. Knowing exactly what was wrong with the water was better than being uninformed about the reasons behind BWAs, because the participant would "worry more not knowing what the cause is."

All participants in the group agreed that it was not an issue of understanding what a BWA is, but rather why it was issued. Furthermore, the participants stressed not the importance of small details, such as specific laboratory results, but rather what caused the BWA and how the problem was resolved: "[...] mostly you care what caused it and is it fixed."

Information Dissemination. One participant suggested that local newspapers and radio would be effective means of communication for information regarding BWAs - specifically reasons behind the advisories, outcomes of testing, what was done to fix the

problem, and the current status of tap water safety. Another participant said individual notification was his preference:

Well, of course, I mean, if they sent something individually to each household that would be the best [...] because I don't buy [the local newspaper [...]] and half the time I don't listen to the radio.

Another participant added, "Not everybody has the Internet, so then we can't all search, right?"

The participants were eager for more information but specified that it would have to be written in an easy-to-understand manner, or else it would be useless: "And would that be in layman's terms? You're reading it and you don't know what the [heck] you're reading." Participants stated that the water quality information should be in lay language, inviting to read, and specific for each community. One participant described the daunting look of a previous available drinking water report:

[...] but it was about as thick as this and it was for [the entire province] [...] and the common person is not going to take the time to [read] that. It's going to be easier to go out and buy your water.

Participants felt that the act of going to the store to purchase bottled water for drinking was easier than finding the information to satisfy unanswered questions regarding their public drinking water. This raises an important question about the effectiveness of current information dissemination methods.

4.1.2 St. John's. The second focus group was held in St. John's, the capital of NL. It has a population of 100,646 and a land area of 446.04 square km (Statistics

Canada, 2008a). St. John's and the surrounding metropolitan area, with a population 181,113 on 804.64 square km, accounts for approximately 36% of the provincial population of 505,930 (Statistics Canada, 2008c). Of the 16 metropolitan St. John's residents who agreed to participate, only four attended the focus group. The remainder did not provide an explanation for their absence. Two of the attendees were females and two were males. Participants were in the age categories of 18-39 and 50-69, and two of the attendees had children living at home (Table 2). The characteristics of the three water sources in the St. John's area, including information on BWAs and WQI are summarized in Table 3.

At the time of the focus groups there was no BWA in effect. According to participants, there was one BWA "a few years back" but that was the only one they could remember. Indeed, only one BWA has been issued by the City of St. John's since 1991.

Contrary to the situation in Harbour Grace, all participants in this focus group used tap water for drinking purposes. One female participant also drank bottled water but did so for convenience purposes.

Another participant recalled seeing a lot of people at work drinking bottled water, but he chose to drink the public tap water available from his home. He did not think there was anything wrong with the St. John's tap water, and he based his opinions on his past experiences: "I don't hear of anything wrong with the water, I don't see anything wrong with the water, I don't feel bad, and I drink a lot of tap water."

Safety / Quality. Participants from St. John's felt that their water was the safest in the province. They felt safer drinking their tap water than private well water or water from other rural communities across the province.

Respondent 1: [...] I'm confident in the St. John's regional area.

Respondent 2: I completely agree.

One participant compared her current tap water in St. John's to the private well water supply she had in the community where she lived as a child. She preferred the public tap water in St. John's because of decreased concerns of bacterial content.

I don't have any issues with our water; I think it's great. After coming from a rural community and growing up on well water where you had to boil your water before you drank it because we had a very high content of coliform bacteria, I think the water here is great.

When comparing drinking water, participants often used aesthetics as the parameter of evaluation.

I think the tap water here is pretty good compared to some. That was from what I've experienced. You don't get any odour most times; in the middle of the summer you can get a little bit of odour from it. It can be chlorine or it can be some other odour. It looks clear; it's not discoloured at all.

One participant believed that there was a recall bias regarding past perceptions of drinking water. He explained that his memories were shaped by his current perceptions.

Our memory is best about what we are experiencing and have experienced recently. And this past year has been a good year in our water supplies and in our house and for the water levels in our reservoirs.

The other participants agreed they could find reassurance in the lack of BWAs in the St. John's region.

Fear. Participants felt that the popular commercial jug filter advertisements were marketing ploys designed to induce fears in the general public, and had nothing to do with the actual quality of the St. John's public tap water. One participant explained:

The [jug filter commercial] seems to be playing on people's paranoia. Especially the commercial where there's this lady and she's coming out of the washroom and you hear the toilet flush and then you see the water drain out of her glass and it says, 'Would you drink the water out of your toilet?' You know, making it seem to people that the water going into their toilet is dirty so the water coming into your sink must be dirty as well. But, I mean the toilet itself is what would be dirty, not the water going in to it. They're just making it seem like the water's not safe, so buy [their product].

This comment illustrates how she thought the inaccurate depiction in the advertisement might negatively affect public opinion of water quality. Another participant described the jug filter commercials as "just marketing tricks". All participants, including those who used a jug filter, agreed that the jug filter advertising was misleading.

Anecdotal evidence evoked fears about drinking water in some instances. When asked about tap water consumption patterns, one participant responded that she preferred to filter her tap water before drinking because of stories she had heard about the water supply. Specifically, she imagined the water source as contaminated by decaying fish, which could then enter the drinking water supply.

A problem I've heard people say in the [town] council [is] that they found fish caught against the grate where the [water] force is [such] that they can't get out. So, you think about [the] drinking water and [the fish] are there rotting away.

The same participant expressed concern about the old piping in St. John's, that it could possibly leach lead into the water or be penetrated by tree roots and allow dirt into the water line.

I heard people talking about lead and stuff being in the water. It's not so much the water itself but I'm in an older area of town where there's great big old iron pipes that used to be [made] with lead. So that's what [has] me kind of leery about drinking our water now. I use a water filter.

Alternative water use. Two participants drank their tap water without treating it with an in-home treatment device, and two used a commercial jug filter. No other treatment devices were used by this group.

The jug filter was used by participants more as a container to keep the water cold in the fridge, rather than for its filtering purposes. One participant who reported using a jug filter explained, "I don't think that the tap water is bad [...]. I like it cold from the fridge. And as much as anything, that's the reason [...], the incentive to have a jug." He

went on to say that he originally bought the jug filter because “ [...] my mother had a [jug filter] and it seemed like the thing to do. It becomes a fad.”

Another participant said that she used the jug filter for aesthetic reasons: “I just find... it just tastes a little different. There’s no taste when you put it through the [jug filter]. ... the chlorine has a smell that will evaporate out.”

Regarding bottled water, one participant explained that his family kept bottled water in the house because it was convenient: “We usually have a case or so of bottled water that I’ll just have a few in the fridge for if we’re going out for a drive or something like that.”

Trust. From the participants’ point of view, there was a definite difference between St. John’s tap water and the tap water in the rural communities with drinking water problems. Participants perceived that St. John’s, being bigger and better resourced, would not have the same problems that a smaller community could have.

The city can afford to have a higher level of education and training for the people running the system, and so the residents of St. John’s can have a higher level of trust and assurance in the water quality.

All participants agreed that they had a high level of trust in the St. John’s public water system. There did not seem to be any concerns about BWA issues. They felt confident that BWAs were merely a precautionary measure rather than an actual problem with the water. The participants shared a trust in the public water system, as following comment illustrates.

I don't really have any concerns about [BWAs]. It seems like they're usually on top of it. Whenever there's any issue, they're testing. They let you know right away and continue to let you know if there's anything wrong. I can only recall one boil order we've ever had to do and that was only for a couple of days. So it seems like they're pretty on top of it.

This trust was amplified by a confidence in the lack of past negative experience. I'm satisfied with the way the system is right now, personally. I'm confident that the city and the regulators are doing the watchdog function that they are supposed to do, as long as they maintain the resources to be able to do that and they maintain their vigilance.

Knowledge. Trust and knowledge were closely related in this focus group discussion. Participants were generally satisfied with their level of knowledge regarding their tap water. The participants had some unanswered questions, such as where to go if there was a problem with the water, or who could answer their drinking water questions. However, the participants agreed that their level of trust for people managing the water system was high enough that the unanswered questions were not actually a concern to them.

Participants referred to the people maintaining the drinking water system as "they". It appeared that the St. John's participants used "they" as a way of indicating that they did not know specifically who looked after their drinking water. When prompted to identify the source of "they", another vague response was given.

Respondent 1: 'They' being the city, I guess.

Respondent 2: I guess it's the city employees?

The St. John's participants seemed to be comfortable with this gap in their knowledge unlike the Harbour Grace participants who used "they" when referring to those managing the water supply as well as government officials and other authority figures whose trust they questioned.

All participants agreed that their confidence in the St. John's public drinking water system was enough to curb any doubts about their water. They felt that the city would ensure that all necessary information would be communicated appropriately, as they felt had been done in previous situations. They agreed that knowing that information was available (even if they had to actively seek it) was enough to maintain their trust in the water system.

Communication. All participants agreed that the city gave adequate notices about BWAs and took measures to ensure that all residents were aware of the beginning and end of the advisory: "Within the town they'll make sure the residents know [...]. I think the major communication is they have a problem, probably."

However, as the discussion progressed, participants emphasized that confidence was more important than detailed information.

Respondent 1: I don't need to know the details.

Respondent 2: I don't need to know what the levels are or [anything] like that. As long as I know-

Respondent 3: It's being checked and how often.

Respondent 2: [That] somebody's in charge and somebody's accountable.

Although participants agreed that they did not need to know the details of the water system; they acknowledged that they would like to know whom to call if they did encounter a problem or had questions.

Not that we need to know every week but they could send [drinking water information] once every six months or a year and tell us how often the water is checked... But if there was anything wrong with the water who do you go to complain to? [...] Knowing the group that would be responsible for it would be okay.

In this regard, St. John's participants expressed opinions that were very similar to those offered by the participants in the Harbour Grace focus group.

Information Dissemination. On the whole, participants in St. John's were very content with the communication about BWAs in the community. They felt that the communication was widespread enough to reach everyone without alarming those not affected.

Respondent 1: [the BWA announcements were] on the radio, [...] the news. They had bulletins and they actually had pamphlets go out [...]. I got one in my mailbox.

Respondent 2: I think that was very public at the time: papers, radio, TV, and information things that came to the households. And I guess if it [were] the whole city it would be a mass mail-out, but if it [were] just localized then in a zone or area, then it would be more focused to where they would distribute the

information. They wouldn't want to get everyone concerned if it really didn't apply to them.

The participants felt that flyers in the mail with information pertaining to the water system were adequate to curb any mistrust in the city water. However, one participant said that too many flyers in the postal mail might cause him to discard important drinking water information by mistakenly identifying it as junk mail.

The thing is you get a lot of stuff come in the mailbox. Some of it from City Hall, you might scan it, you might flick it, you hang on to it or the garbage schedule [...]. It's all part of a full bundle of information that comes from the city. And we sometimes lose those things or we say, 'I don't want any more of that stuff.'

4.1.3 Trepassey. The third focus group was held in Trepassey. The 2006 census population in Trepassey reported 763 people living on 55.81 square km (Statistics Canada, 2008d). Trepassey has two public water sources which are described in Table 4. A BWA has been in place since June 23rd, 2000 on the Millar's Pond source, due to insufficient chlorine residuals and total coliform counts (Department of Environment and Conservation, 2007). This BWA was still in effect at the time the focus group was conducted. The WQI is not provided for water supplies that are issued a BWA; as such, there is no WQI for Millar's Pond (2007). Broom Cove Pond has never had a BWA issued (Table 4).

Importantly, Trepassey is the site of a commercial bottled water factory. The water source is a private underground spring located 1.5 km from the centre of Trepassey (Discovery Springs Natural Spring Water, 2006). When the plant is not bottling the

water, the run-off is expelled from the factory via a pipe. This water is available for the Trepassey residents at no cost; the water is neither treated nor monitored. In the focus group discussion, the company's run-off was referred to as "spring water".

There were 14 participants in the Trepassey focus group (Table 2); there were nine females and five males, most participants were in the age category of 50-69, and six participants had children at home while eight did not. One attendee was from Ferryland, a community 70 km from Trepassey.⁴ Residents from communities surrounding Trepassey were called and invited to the focus group, but the Ferryland participant was the only attendee from outside Trepassey.

Tap water use by the participants in this focus group was varied, but no respondents used it for drinking. One participant summed it up: "I don't think there's anybody in Trepassey that actually drinks tap water.". The majority of the participants in the group drove the few kilometres around the harbour approximately once a week in order to fill large jugs with the company's run-off water. This activity has been happening for so long that members in the group considered it to be the norm, referring to it as a "ritual" and a "way of life".

When asked about other uses for tap water, participants were quick to reply.

Respondent 1: Toilets. That's it.

Respondent 2: And showering, you know. Don't usually have a bath in it. It's full of sand.

⁴ The 2006 census population in Ferryland is 529 people living on 13.62 square km. The WQI for Ferryland was not ranked at the time of the focus group, due to the presence of trihalomethanes exceeding the policy guidelines.

Respondent 3: Close your eyes until you get the towel.

Respondent 4: You don't realize when you shower how dirty the water is until you put it in the bathtub, right?

A hairdresser claimed that the high amounts of chlorine turned her clients' hair green. Some used it for washing clothes while others said they washed only dark clothes with tap water.

Safety / Quality. Participants seemed to base their water quality perceptions on the aesthetics of the water. If the water was clear and did not have an unpleasant odour or taste, then it was considered safe to drink. As one participant put it, "But you assume by the taste of the water if it's not good or not."

For instance, despite a year-round BWA, some participants considered their tap water safe to drink in the winter. When the ground was predominantly frozen, the water ran clear and the unpleasant odour and taste were absent. While participants seemed to dislike commercially bottled water, it was still used as a standard to which tap water was compared. Some considered the clear tap water in the winter to be as good as, or better, than bottled water.

Respondent 1: We really have good water in the wintertime. Really.

Respondent 2: Yes, it's good in the wintertime.

Respondent 1: Yeah, it's just as clear as that [bottled water].

Respondent 3: Yeah, it's not brown.

Participants were asked how they determined the quality of the spring water company's water, given that the run-off was neither regularly monitored nor tested.

When asked how they knew the “spring water” was safe to drink the answer was simple: “We don’t!” One participant figured that if the water was good enough for her fish to survive, then it must be good enough for her to drink: “If you have fish in a bowl and [they are] living in it all the time, it has to be good. They’d be dead, wouldn’t they?”

Another participant suggested that if the water was not safe to drink, people in the community would display ill effects.

I guess where everybody is drinking the spring water there’d be a lot of people sick if there was a problem. So I guess that’s how you know. If everybody is drinking it then we can drink it too.

The group’s perceptions about the drinking water available in the community were markedly optimistic, despite the tap water having been on a BWA for several years and not foreseeing a time when the BWA would be lifted. Although they initially described their tap water as “yellow”, “gross”, “terrible”, “horrible”, and “no good”, they felt that they had such easy access to good drinking water (the spring water company’s run-off) and they were not at all concerned by the state of their tap water.

The perceptions of the company spring drinking water were largely positive. When asked to describe the run-off water from the water plant, the participants had positive things to say such as, “Best water in all of Canada!” They considered it to be “natural” and “good to drink”. “Natural” or “nature” water was used to describe drinking water that was not treated.

It’s what’s coming through nature. [...] the [spring water] is not treated.

[Commercial] bottled water is treated. Everything is treated. [The tap] water is

treated too. Something added to it. But the spring water, it's just coming right out of the ground.

The participants did not like water from "town" (St. John's). Some described an unknown, unpleasant taste; others specifically cited chlorine as the problem.

Respondent 1: City water is a different [kind of] water. I can't drink city water.

Respondent 2: It's a different taste.

Respondent 3: I think it's the chlorine you can taste.

Fear. The fear associated with drinking water in this group was limited to concerns with store-bought bottled water. On several occasions throughout the discussion, cancer was brought up as a side effect of drinking store-bought bottled water; some participants believed the theory while others dismissed it.

Respondent 1: Yes, we're told we're not to drink bottled water. Now, I never touch it.

Respondent 2: They talk that [the bottled drinking water] caused all the cancer here in Trepassey.

Respondent 3: The people talk that [the bottled water is] what's causing all the cancer. You know, so many people, young people especially, with cancer. Caused with the water.

Respondent 4: Yeah, I've heard that before.

Respondent 5: Yeah I've heard that too but I don't believe in that.

Respondent 6: No, God no.

Alternative water sources. All participants liked the water plant run-off better than most other water sources because they regarded it as “natural water”. They preferred it to any treated water, including boiled water.

Respondent 1: It’s not a very nice taste off it when it’s boiled.

Respondent 2: No, I don’t like it at all.

Respondent 3: It’s far from nature.

Furthermore, the participants in the focus group expressed distrust in commercial bottled water because of lengthy expiration dates on bottled water. The participants said that collected water from the factory run-off lasted approximately a week before being considered “expired”.

Respondent 1: How long [is] that water you buy in the stores - how long [is it on the shelves], I wonder?

Respondent 2: I don’t think I’d be happy with it off of that shelf after that long.

Participants wondered what was added to the water to extend the shelf life, and questioned if this additive had any harmful health effects.

Respondent 1: What’s in that?!

Respondent 2: There must be some chemicals. Imagine spring water that we have and putting it in something and leave it there for a couple of weeks. You know what it would come out like, don’t you? Slime and everything. Look at that!

[Gesturing to the expiry date on a bottle of water on the table] Look - until 2008.

What is in that?!

Respondent 1: I don’t touch it.

When store bought bottled water was used for drinking purposes, it was because it was convenient, and not necessarily because it was considered to be better water. As one participant put it, "I haven't got patience for boiling water and cooling it. I'd rather go to the fridge and get a bottle of water." Participants also "keep the bottled water on hand" for guests.

Trust. Trust in various sources of drinking water was prevalent throughout the focus group discussion. In particular, some participants trusted companies who sold bottled water. One participant described an automatic trust associated with a purchased product. The participant assumed adequate testing on products sold to the public.

I just assume that if you buy bottled water, it's good for you. It should be, right?

There's enough people testing stuff; they're not going to send a supply of water that would kill people, so you just assume it's going to be good to drink.

Participants did not expect that they would ever trust the tap water in Trepassey to be safe enough to drink. This was not stated in a negative manner; it was a fact that had long been accepted.

No, it's not a colour thing. It's just that when you have a boil order on your water for so long and you're kind of thinking, you know, must be something about the water; shouldn't drink it. I don't think ever in Trepassey it'll come to where people will trust to drink the [tap] water [...]. And I think everybody here is well used to going over [to the factory run-off] and getting the water.

All participants had heard about the widely publicized outbreak of *E. coli* in Walkerton, Ontario in 2000 ("Waterborne outbreak of gastroenteritis associated with a

contaminated municipal water supply, Walkerton, Ontario, May-June 2000," 2000). Concerns focused on a perceived cover-up by water treatment and government officials rather than the water quality issues. Although the participants acknowledged that a similar cover-up could happen again elsewhere, they felt confident that it would not happen in Trepassey. Knowing the persons responsible for maintaining the water supply in this small community relieved any insecurity regarding their drinking water.

Although the participants in this group said they would never drink their public tap water, the community is small enough that they know the people who look after the drinking water testing and this provided a sense of trust and security. Residents of the community were on a first-name basis with the town manager of water. One participant said that he would have less trust in a community that was larger where you didn't know the person looking after the water. This comment was supported in the group.

Respondent 1: You know if I was living in Mount Pearl or St. John's I would be kind of concerned about who would be looking after the water? More so than here [...]. It's such a small place, such a small community [...]. [There is comfort in knowing] who looks after the water.

Respondent 2: We put our trust in them.

Respondent 3: We trust them anyway. We put our trust in them.

This is significant in that trust in those managing the water system was seen as important and reliable, and not directly influenced by the actual quality of the water.

Knowledge. Residents knew the source of their public tap water but acceptable use of the tap water during a BWA was unclear to some. Although residents knew not to

drink the tap water while under a BWA, there was uncertainty about activities such as cooking or brushing teeth. In the absence of known guidelines, participants made their own personal decisions and judgements.

Well, we have water from a pond, right? It's brown all year 'round. We don't drink it but we use it to cook. So I suppose hopefully when it's boiled or something [it's okay to use]. I don't know.

Two participants were very familiar with the community's water policies and testing procedures. Other participants often directed questions toward these two people.

The conversation turned to what tests are done on the public water; there were more questions than answers. The participants lacked knowledge about testing procedures and who was in charge of water testing. When asked what the water would be tested for, the responses were vague and posed as questions.

Respondent 1: What are TMGs, TMJs? THMs maybe? It's a bacteria in the water? I think it was TMG or TMJ. TNCs it's called, don't ask me what it stands for. I just remember [someone] coming and checking our water.

Respondent 2: Well, I'd imagine it'd be tested.

Respondent 3: I have no idea. Chloroforms [*sic*]?

Respondent 4: I think a little bit of everything. 'Cause I know when I was there, [there were] pages and pages so there must be a lot of things they're checking for, right? [...] I wouldn't know how to read [the test reports].

Although the focus group session raised many unanswered questions, this group felt that they knew all they needed to know about their public tap water. All participants

agreed that they were satisfied with their knowledge. One participant explained why unanswered questions were not troubling for residents of Trepassey: "I don't think it would make a difference if people in this community knew it or not, you're not going to drink the water anyway."

Communication. The majority of participants agreed that the communication surrounding the BWA was not an issue because the BWA had been in effect for years.

Respondent 1: No, nobody drinks the water in Trepassey. It's always a boil order.

Respondent 2: We don't drink it anyway.

Respondent 3: I think this boil water thing has been on for about five years. So, I mean, everybody who has been here for a little while knows it.

One participant discussed the lack of communication for individuals visiting the community. This concern was minimised by the prospect that most people should know not to drink the water just by looking at the colour.

We were [at] a concert a couple of weeks ago and [a woman] from [a nearby community] was out and I [saw] her going into the bathroom. She had a bottle [...] and she came out and [the water] was just like pee, it's true. And I had to stop her. I had to say, 'Ma'am, please don't drink that water.' She said, 'Why, [I've had] three bottles now!' I nearly died. She thought she'd have a sip of water and she didn't know, see? She's from another town, so why would you? But you think she'd know just by the colour of it not to drink it.

Information dissemination. When the conversation turned to how information should be distributed to the public, one participant felt that door-to-door flyers were unnecessary in Trepassey.

[There are] some places [in NL] that's [advised of a BWA] by flyers but it's so unusual for [there] to not have a boil order here [in Trepassey].

The woman from Ferryland expressed the most concern about the lack of communication surrounding BWAs: "But I have to tell you pretty often I [will have] been drinking water for three or four days and [...] there was a boil order on."

She also explained however, that notices on the television were not enough to reach everyone in the community.

[...] When they put it on the cable TV, whichever TV channel you put it on [...] I don't have that [satellite] dish. And I don't ever get those programs; notices.

And not only me, more than me in the harbour, you know. And they don't let you know, they don't ever let you know.

A male in the group agreed that another method of notification was necessary for communities that are not on a constant BWA. Posters at local businesses were not enough to get the message out to everyone.

I don't go to the post office every day. I don't go to [the local grocery store] every day either. And the boil water - you know, I wondered if there is some other way they could notify people. Distribute flyers or something, door-to-door?

The participant in Ferryland acknowledged that she was able to contact the council office to alleviate her worries: "I call the council office for anything. They

always say the water's good; not to worry about it, you can drink it. I don't drink it without asking, you know."

A participant familiar with town council policies raised the point that the water quality information for each community was available on the Internet: "But you can actually go in on Internet. There's a site in on the net that you can go in all the time and check the water in your community. I don't know what it is."

Although this person confirmed the availability of information, he noted that it was not easy to understand. Other participants were not aware of any available information, which suggests a problem with information dissemination.

Similar to the two other focus groups, although all of the information was available to the public, the participants explained that having reports that were difficult to understand was just as bad as having no reports available.

4.2 Telephone Survey Results

4.2.1 Response rate. A total of 3,424 telephone calls were made. Calls that were inadvertently made to businesses, faxes, or invalid lines did not meet our inclusion criteria and were excluded from the study and response rate calculations. Additionally, people who asked to be called back were excluded if they were unreachable after four or more call back attempts. Of the 3,424 calls, only 2,172 numbers were eligible and were included in the denominator of the response rate calculation; the numerator included calls where questionnaires were completed. There were a total of 563 study participants, yielding a response rate of 25.9% (563/2,172). Not all questions were fully answered by all respondents, so some analyses were conducted with smaller sample sizes, as noted.

The demographics of the survey population were compared with those of the census population to assess the potential for sampling bias. The survey participants did not significantly differ from the NL 2006 census population in terms of income level, but did significantly differ with respect to other demographic variables (Table 5). Specifically, women were over-represented, and survey participants were more highly educated, had greater access to the Internet, and had fewer children living at home. Further, those in age categories corresponding to ages between 40 and 69 years of age were over-represented, and those in the 18-29 and 70 years and older age groups were under-represented (Table 5).

4.2.2 Results. *General perceptions.* Almost all survey participants responded that taste (98.2%; 552/562), smell (97.5%; 549/561), colour (96.6%; 544/563), clarity (98.6%; 551/559), and safety (99.5%; 560/563) were “important” or “very important” factors in considering the quality of their public tap water. Participants were asked to rate various characteristics of their public tap water. Approximately 59.5% (335/545) rated the taste of their tap water as “good” or “very good”, whereas 29.5% (166/545) rated the taste as “poor” or “very poor”. Approximately 8.1% (44/545) has neutral opinions regarding the taste. Most respondents rated the smell, colour, and clarity of the tap water as “good” or “very good” (72.0% (402/558), 76.9% (431/560), and 77.7% (435/560), respectively).

Approximately 75.5% (407/539) of respondents rated the safety of their tap water as “good” or “very good”, 18.2% (98/539) rated it as “poor” or “very poor”, and 6.3% (34/539) had neutral opinions of tap water safety. Approximately 76.9% (430/559) of

respondents reported being “concerned” or “very concerned” about the overall safety of their household tap water, while 17.5% (98/559) were “unconcerned” or “very unconcerned”, and 5.5% (31/559) reported neutral opinions. Further, 55.4% (310/560) reported being “sure” or “very sure” that their household tap water was safe to drink, while over one-third (34.8%; 195/560) reported that they were “unsure” or “very unsure”.

Included in the questionnaire were ten closed-ended questions, using a five-point Likert scale, asking participants to indicate their level of concern with a list of ten potential drinking water safety concerns. The aggregate results of respondents are described in Table 6.

Most common source of drinking water in the home. The most common source of drinking water in the home varied among participants. Approximately 27.9% (157/561) of participants reported public tap water without further treatment with an in-home treatment method; 26.9% (151/561) reported public tap water after further treatment with an in-home treatment method; and 29.8% (167/561) reported store-bought bottled water to be the most common source of drinking water in the home. Approximately 5.9% (33/561) of participants reported water from ponds, rivers or roadside springs, and a further 4.3% (24/561) reported water from ponds, rivers or roadside springs that was treated with an in-home water treatment method, as the most common source of drinking water in their homes. Approximately 5.2% (29/561) of participants reported “other” drinking water sources as their most common source of drinking water in the home.

The above describes the proportions of participants for whom the specific sources of water were the single most common source of drinking water in the home. The following three sections relate to the use of treatment methods, bottled water, and water from ponds, rivers and roadside springs, for drinking water in the home in general (i.e. not just the most common source of drinking water in the home). Further, the sources of water described in the following three sections are not mutually exclusive; participants could consume water from all three different sources (home treated tap water, bottled water, and water from ponds, rivers and roadside springs) in the home.

Use of In-home water treatment methods. Approximately 46.4% (261/563) of respondents reported that they treated their household public tap water for drinking purposes, using an in-home water treatment method. The types of treatment methods used were varied, and included jug filters, tap filters, inline filters, boiling, and other methods (Figure 1). The term “other” includes reverse osmosis (5/261), ultraviolet light (3/261), candle filters (1/261) and other devices (9/261).

The level of importance that participants placed on various potential reasons for treating their drinking water is summarized in Table 7. The three reasons rated as being important by the most number of participants were improvement in taste (86.5%; n=260), and a perceived a reduction in bacteria (85.7%; n=258) and chemicals (85.3%; n=259), compared to regular tap water (Table 7).

Bottled water use. Approximately 61.1% (342/560) of participants reported that they had sometimes consumed bottled water instead of their public tap water in their homes. The level of importance that participants placed on various potential reasons for

this behaviour is summarized in Table 8. The three reasons rated as being important by the most number of participants were the same as the three most common reasons for treating tap water: a perceived a reduction in bacteria (86.9%; n=335); a perceived improvement in taste (85.8%; n=337), and a perceived reduction in chemicals (84.8%; n=336), compared to regular tap water (Table 8).

Use of water from roadside springs, ponds and rivers. In addition to bottled water and tap water treated with in-home methods, other alternative water sources in this population included water from roadside springs, ponds and rivers. Approximately 20.5% (115/562) of participants reported having consumed water from these sources instead of their public tap water while at home. Of these participants, 24.3% (28/115) reported that they treated the water with an in-home treatment method prior to consumption. The treatment method most commonly used in this regard was the jug filter (75%; 21/28), followed by boiling (32%; 9/28), “other” methods (10.7%; 3/28) and the addition of chlorine bleach (3.6%; 1/28). The number of treatment methods used exceeds the number of participants that treated the water from these sources due to multiple methods per respondent. The level of importance that participants placed on various potential reasons for drinking water from these sources is summarized in Table 9. The three reasons rated as being important by the most number of participants were improvement in taste (95.7%; n=115); a perceived reduction in chemicals (87.8%; n=115), and a perceived improvement in smell (85.1%; n=114) compared to regular tap water (Table 9).

Drinking water information dissemination. The majority of participants reported that it was “important” or “very important” to them that they receive more information about a variety of issues pertaining to public tap water (Table 10).

Participants also indicated their likelihood to use various different media to receive this information (Table 1). While no single information dissemination method was identified as providing complete coverage for all survey participants, the top three methods that participants reported they would be “likely” or “very likely” to use were: flyers mailed to the home (90.5%; 506/559), television (86.8%; 488/562), and radio (81.0%; 456/563) (Table 10).

Boil water advisories. Approximately 64.1% (343/535) of respondents reported having experienced a BWA in their community, and a further 2.4% (13/535) said their community was currently under a BWA; hence, a total of 356 participants (66.5%) had experienced or were currently experiencing a BWA. Participants were asked to identify from a list the household activities, if any, for which they boiled public tap water before use during a BWA. The following represent the proportions of participants that boiled the tap water (and thus, complied with BWA recommendations) for the described activities: drinking - 74.4% (232/312); cooking - 74.3% (249/335); brushing teeth - 56.3% (191/339); making ice cubes - 56.5% (170/301); mixing juice - 64.1% (191/298); washing ready-to-eat fruit and vegetables - 61.5% (203/330), and making baby formula - 47.0% (94/200). The latter included a “not applicable” option for those households not partaking in the activity.

Participants were asked how they learned that the BWA had been issued, and had been lifted, in their community from a list of different media for information dissemination (Table 12). Approximately 74.1% (254/343) of respondents were satisfied with the information provided to them concerning the BWA in their community; however, nearly all participants (98.3%; 551/560) reported that it was “important” or “very important” to them that they receive more information on the reasons for BWA implementations. After the BWA had been lifted, 59.1% (195/330) felt it was safe to use their public tap water.

Table 1 Demographic profile of focus group participants from three communities:

Harbour Grace (HG), St. John's (SJ), and Trepassey (TR), NL, October 2006

	Sex		Age Group (years)							Children living at home	
	Male	Female	18-29	30-39	40-49	50-59	60-69	70+	Unknown	Yes	No
HG	1	2	0	0	1	2	0	0	0	1	2
SJ	2	2	1	1	0	1	1	0	0	2	2
TR	5	9	0	0	2	3	6	2	1	6	8

Table 2 Boil water advisories and drinking water quality index summary for Harbour

Grace, NL public water supplies, 2000-2007

Water Source	Population Served	BWA Date	Reason	WQI
Bannerman Lake	Majority	October 20-30, 2006	Total coliform <i>E. coli</i> detected; repeat samples could not be taken.	96 ^δ
#1 Thicket Susie Galway Well	1%	June 23rd, 2000 – April 18th, 2002	The disinfection system was off due to maintenance or mechanical failure.	N/A ^φ
#2 Thicket New Well	1.2%	June 23rd, 2000 – April 18th, 2002	The disinfection system was off due to maintenance or mechanical failure.	N/A ^φ
		June 29 – July 13, 2005	No free chlorine residual detected in the water distribution system	---
Mercer's Road Well	1.6%	June 23rd, 2000 – April 18th, 2002	The disinfection system was off due to maintenance or mechanical failure.	N/A ^φ
		February 27th – March 28th, 2006	No free chlorine residual detected in the water distribution system	---
Southside Well	2.7%	June 23rd, 2000 – April 18th, 2002	The disinfection system was off due to maintenance or mechanical failure.	N/A ^φ
		April 28th – May 17th, 2006	Total coliform <i>E. coli</i> detected; repeat samples could not be taken.	---
		December 12th, 2006 – April 26th, 2007	No free chlorine residual detected in the water distribution system	---

^δ “Excellent: Water quality is protected with a virtual absence of impairment; conditions are very close to pristine levels; these index values can only be obtained if all measurements meet recommended guidelines virtually all of the time.”¹¹

^φ Not a surface water source; no WQI value.

Table 3 Boil water advisories and drinking water quality index summary for St. John's, NL public water supplies, 2000-2007

Water Source	Population Served	BWA Date	Reason	WQI
Windsor Lake	60,000	July 29, 2001 – August 17, 2001	Higher than acceptable levels of coliforms present in routine water samples; at no point was <i>E. coli</i> detected	94 ^γ
Bay Bulls Big Pond	80,000 ^ψ	July 29, 2001 – August 17, 2001	Higher than acceptable levels of coliforms present in routine water samples; at no point was <i>E. coli</i> detected	95 ^δ
Petty Harbour Long Pond (PHLP)	NIS ^ε	July 29, 2001 - August 17, 2001	Higher than acceptable levels of coliforms present in routine water samples; at no point was <i>E. coli</i> detected	N/A ^φ

^γ “Good: Water quality is protected with a slight presence of impairment; conditions are close to pristine levels.”¹¹

^ψ St. John's west, Mount Pearl, Conception Bay South, Paradise, Kilbride and Portugal Cove St. Phillips.

^δ “Excellent: Water quality is protected with a virtual absence of impairment; conditions are very close to pristine levels; these index values can only be obtained if all measurements meet recommended guidelines virtually all of the time.”¹¹

^ε Not in Service (NIS): Removed from service after this event since it was believed (but never proven) that this source was where the contaminated water may have originated. This decision was made because the water treatment plant for PHLP did not have any filtration. It currently remains unused.

^φ Not a surface water source; no WQI value.

Table 4 Boil water advisories and drinking water quality index summary for Trepassey, NL public water supplies, 2000-2007

Water Source	Population Served	BWA Date	Reason	WQI
Millar's Pond	Majority	June 23, 2000-current	Insufficient chlorine residual; Higher than acceptable levels of coliforms present in routine water samples	--- ^Δ
Broom Cove Pond	20 people	N/A	N/A	94 ^γ

^Δ Not ranked due to the presence of a boil water advisory issued.

^γ "Good: Water quality is protected with a slight presence of impairment; conditions are close to pristine levels."¹¹

Table 5 Demographic comparisons of the telephone survey population (March-April 2007) and the 2006 NL census population, with associated significance

	Survey Population # (%)	Census Population # (%)	p-value
Household Income (\$)			p>0.05
<10,000	14 (3.2)	9,690 (4.9)	
10,000 – 14,999	20 (4.5)	12,465 (6.3)	
15,000-19,999	22 (5.0)	15,015 (7.6)	
20,000-29,999	57 (12.9)	26,985 (13.7)	
30,000-39,999	72 (16.3)	25,050 (12.7)	
40,000-49,999	63 (14.3)	21,185 (10.7)	
50,000-59,999	52 (11.8)	18,970 (9.6)	
60,000-69,999	29 (6.6)	15,010 (7.6)	
>70,000	112 (25.4)	52,795 (26.8)	
Highest level of school completed			p<0.05
No certificate, diploma or degree	98 (17.5)	141,575 (33.5)	
High School certificate or equivalent	133 (23.8)	93,330 (22.1)	
College or Technical School	195 (34.8)	125,480 (29.7)	
Some University	4 (0.7)	14,310 (3.4)	
University certificate, diploma or degree	130 (23.2)	47,690 (11.3)	
Age Group (Years)			p<0.05
18-29	48 (8.6)	73,524 (17.9)	
30-39	93 (16.7)	66,920 (16.3)	
40-49	148 (26.5)	84,254 (20.6)	
50-59	137 (24.6)	81,898 (20.0)	
60-69	102 (18.3)	54,809 (13.4)	
70+	30 (5.4)	48,432 (11.8)	
Number of people in household			p<0.05
1	63 (11.3)	39,830 (20.2)	
2	224 (40.1)	73,295 (37.2)	
3	116 (20.8)	39,835 (20.2)	
4	111 (19.9)	31,985 (16.2)	
5	35 (6.3)	9,370 (4.8)	
6+	9 (1.6)	2,875 (1.5)	

Table 5 (CONTINUED) Demographic comparisons of the telephone survey population (March-April 2007) and the 2006 NL census population, with associated significance

	Survey Population # (%)	Census Population # (%)	p-value
Number of children			p<0.05
0	331 (58.8)	61,950 (39.8)	
1	162 (28.8)	48,825 (31.4)	
2	64 (11.4)	35,100 (22.5)	
3+	6 (1.1)	9,850 (6.3)	
Internet Access			p<0.05
Yes	428 (76.2)	61.1 (61.1)	
No	134 (23.8)	38.9 (38.9)	
Sex			p<0.05
Male	218 (38.7)	248,819 (49.1)	
Female	345 (61.3)	257,640 (50.9)	

Table 6 Participants' level of concern with potential contaminants/characteristics of public tap water in NL, March-April 2007

	Very Concerned or Concerned # (%)	Neither Concerned nor Unconcerned # (%)	Very Unconcerned or Unconcerned # (%)
What the water is tested for (n=555)	462 (83.2)	20 (3.6)	73 (13.2)
Condition of pipes used to transport water (n=560)	451 (80.5)	20 (3.6)	89 (15.9)
Government regulation of water treatment (n=540)	434 (80.4)	31 (5.7)	75 (13.9)
Frequency of water testing (n=537)	429 (79.9)	18 (3.3)	90 (16.8)
Treatment of public water (n=555)	440 (79.3)	22 (4.0)	93 (16.7)
Results of public water testing (n=553)	435 (78.7)	32 (5.8)	86 (15.5)
Watershed contamination by humans (n=559)	427 (76.4)	20 (3.6)	112 (20.0)
Water treatment plant work training (n=541)	412 (76.1)	34 (6.3)	95 (17.6)
Current watershed protection measures (n=544)	405 (74.4)	36 (6.6)	103 (18.9)
Watershed contamination by animals (n=559)	393 (70.3)	26 (4.7)	140 (25.0)

Table 7 Level of importance participants placed on specific factors in their decision to treat public tap water with an in-home treatment method, March-April 2007, NL

	Very Important or Important # (%)	Neither Important nor Unimportant # (%)	Very Unimportant or Unimportant # (%)
Improved taste (n=260)	225 (86.5)	7 (2.7)	28 (10.8)
Improved smell (n=257)	199 (77.4)	12 (4.7)	46 (17.9)
Reduced germs/bacteria/ <i>E. coli</i> (n=258)	221 (85.7)	7 (2.7)	30 (11.6)
Reduced metal or minerals (e.g. arsenic, iron, lead) (n=254)	214 (84.3)	9 (3.5)	31 (12.2)
Reduced chemicals (n=259)	221 (85.3)	8 (3.1)	30 (11.6)
Reduced cloudiness of water (n=258)	190 (73.6)	14 (5.4)	54 (20.9)
Reduced hardness of water (n=253)	140 (55.3)	25 (9.9)	88 (34.8)

Table 8 Level of importance participants placed on specific factors in their decision to drink bottled water instead of tap water in their homes, March-April 2007, NL

	Very Important or Important # (%)	Neither Important nor Unimportant # (%)	Very Unimportant or Unimportant # (%)
Improved taste (n=337)	289 (85.8)	9 (2.7)	39 (11.6)
Improved smell (n=336)	264 (78.6)	18 (5.4)	54 (16.1)
Reduced germs/bacteria/ <i>E. coli</i> (n=335)	291 (86.9)	8 (2.4)	36 (10.7)
Reduced metal or minerals (e.g. arsenic, iron, lead) (n=335)	278 (83.0)	13 (3.9)	44 (13.1)
Reduced chemicals (n=336)	285 (84.8)	8 (2.4)	43 (12.8)
Reduced cloudiness of water (n=337)	264 (78.3)	13 (3.9)	60 (17.8)
Reduced hardness of water (n=335)	203 (60.6)	26 (7.8)	106 (31.6)
Better safety testing/control than tap water (n=330)	266 (80.6)	17 (5.2)	47 (14.2)
Convenience (n=332)	235 (70.8)	29 (8.7)	68 (20.5)

Table 9 Level of importance participants placed on specific factors in their decision to drink water from roadside springs, ponds and rivers while in their homes, March-April 2007, NL

	Very Important or Important # (%)	Neither Important nor Unimportant # (%)	Very Unimportant or Unimportant # (%)
Improved taste (n=115)	110 (95.7)	3 (2.6)	2 (1.7)
Improved smell (n=114)	97 (85.1)	6 (5.3)	11 (9.6)
Reduced germs/bacteria/ <i>E. coli</i> (n=112)	87 (77.7)	10 (8.9)	15 (13.4)
Reduced metal or minerals (e.g. arsenic, iron, lead) (n=115)	90 (78.3)	6 (5.2)	19 (16.5)
Reduced chemicals (n=115)	101 (87.8)	6 (5.2)	8 (7.0)
Reduced cloudiness of water (n=115)	92 (80.0)	6 (5.2)	17 (14.8)
Reduced hardness of water (n=114)	63 (55.3)	15 (13.2)	36 (31.6)
Convenience (n=115)	69 (60.0)	13 (11.3)	33 (28.7)

Table 10 Level of importance participants placed on receiving information on specific topics for public drinking water systems, March-April 2007

	Very Important or Important # (%)	Neither Important nor Unimportant # (%)	Very Unimportant or Unimportant # (%)
Reasons for boil water advisories (n=560)	551 (98.4)	1 (0.2)	8 (1.4)
Results of public water testing (n=560)	526 (93.9)	7 (1.3)	27 (4.8)
Treatment of public water (n=562)	520 (92.5)	15 (2.7)	27 (4.8)
What public water is tested for (n=520)	520 (92.4)	12 (2.1)	31 (5.5)
Watershed protections measures (n=559)	515 (92.1)	9 (1.6)	35 (6.3)
Frequency of water testing (n=555)	509 (91.7)	13 (2.3)	33 (5.9)
Condition of pipes used to transport water from water treatment plant (n=563)	510 (90.6)	16 (2.8)	37 (6.6)
Government regulation of water treatment (n=560)	507 (90.5)	15 (2.7)	38 (6.8)
Source of public water (n=558)	485 (86.9)	13 (2.3)	60 (10.8)
Water treatment plant worker training (n=559)	479 (85.7)	25 (4.5)	55 (9.8)

Table 11 Proportion of participants who reported they would be likely or very likely to use specific media for information on their public water supply in NL, March-April 2007

Mode of Information Dissemination	Participants Likely or Very Likely to use # (%)
Flyer in the mail (n=559)	506 (90.5)
Television (n=562)	488 (86.8)
Radio (n=563)	456 (81.0)
Newspaper (n=560)	433 (77.3)
NL Government Website (n=556)	271 (48.7)

Table 12 Information dissemination medium by which participants who had experienced a boil water advisory (BWA) in their community learned that the BWA had been issued, and had been lifted (March – April 2007, NL)

Information Media	BWA Issued # (%) n = 356	BWA Lifted # (%) n = 343
Radio	179 (50.3)	174 (50.7)
Television	98 (27.5)	88 (25.7)
Word of mouth	80 (22.5)	82 (23.9)
Poster at local business	49 (13.8)	36 (10.5)
Mail flyer delivered to home	47 (13.2)	32 (9.3)
Newspaper	27 (7.6)	29 (8.5)
Totals ⁵	480 (134.9)	441 (128.6)

⁵ Totals exceed the number of participants due to use of multiple media per respondent.

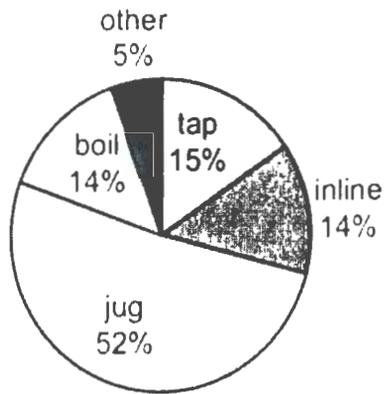


Figure 1 Frequency distribution of 330 in-home treatment methods⁶ used by 261⁷ participants to treat their tap water for drinking purposes in NL

⁶ Legend of in-home treatment types: jug = jug filter; tap = tap filter; inline = inline filter; boil = boiling; other = other method

⁷ Total number of devices exceeds total number of respondents because of multiple devices per respondent

CHAPTER 5: DISCUSSION AND POLICY RECOMMENDATIONS

“Without continual growth and progress, such words as improvement, achievement, and success have no meaning.”

~Benjamin Franklin

5.1 Overview

This final chapter presents a synthesis of the five key findings that emerged from the focus groups completed on the Avalon Peninsula NL in October 2006 and the main results from a province-wide telephone survey conducted across NL in March 2007.

The purpose of this mixed methods study was to examine perceptions of public drinking water in NL. The main research objectives were to identify:

1. the perceptions of the quality and safety of public tap water;
2. the factors that influence public drinking water consumption patterns;
3. the reported reasons for alternative water use; and
4. the expressed need for information on drinking water.

Data were collected and analyzed on participants' perceptions of their household water quality, water quality in general, water concerns and experiences, alternative water use, testing and treatment of tap water, issues surrounding boil water advisories (BWAs), current information sources, and general demographics. The source populations for the focus groups and telephone survey varied in population size, geographic location, and water quality (based on WQI values). Despite these differences, the study outcomes were surprisingly consistent, with some community-specific exceptions. The consistency of the results using the mixed methods approach enhances the validity of the study and

provides a more in-depth understanding of the perceptions and use of drinking water in NL.

The overall research findings, and community-specific exceptions, are discussed below using a health promotion framework and listed in order of downstream to upstream approaches to health promotion. Most population-based health promotion activities, including the ones listed below, are considered primary (and thus upstream) disease prevention measures. The impact of each intervention depends on the action implemented and also on the approach to change. Moving to the right of the continuum focuses on a more “upstream” approach (e.g. public policy) and would have a greater impact than a mid- or downstream approach (e.g. health education) where the impact may be less. Further upstream approaches are considerably more effective, but are normally more difficult to implement as they may require a more significant dedication to resources as compared to shorter-term action plans. It is important to have actions along the spectrum to ensure that there are broad and multiple solutions to a problem.

The Ottawa Charter for Health Promotion was the result of the First International Conference on Health Promotion. The conference was held in Ottawa, Canada in 1986 and was a response to growing expectations for a global public health movement focusing on health promotion rather than disease prevention. The Ottawa Charter has five Health Promotion Actions: build healthy public policy, create supportive environments, strengthen community action, develop personal skills, and reorient health services (World Health Organization, 1986). The Ottawa Charter for Health Promotion Actions will serve as the framework for the following chapters.

The Ottawa Charter for Health Promotion describes five Health Promotion Actions: develop personal skills, strengthen community action, create supportive environments, build healthy public policy, and reorient health services. Individuals should be enabled, through information and education, to exercise more control over personal health choices (World Health Organization, 1986). Favourable conditions for health advocacy can encourage public participation in health matters. This may include full and continuous access to information, learning opportunities for health, and funding support (World Health Organization, 1986). Supportive environments are created when links are made among people and environment (home, work, community, leisure), including access to health resources (World Health Organization, 1986, 1998). Healthy public policy keeps health on the agenda and considers health consequences in all decisions (World Health Organization, 1986). Although the organization of health services is beyond the scope of this thesis, a shift towards health promotion may increase the communication and collaboration between the health sector and health research (World Health Organization, 1986, 1998). These five actions are described on a health promotion continuum, from least to most likely to have a positive impact on health policy effects.

Recommendations emerging from this discussion are directed to government agencies (provincial, regional, and municipal), specifically those departments responsible for public drinking water distribution systems and policy decisions in NL. Finally, although the intent of this study was not to evaluate programs or policies currently in

place in NL, instances where recommendations overlap existing programs or policies may signify a strong need for evaluation or improvements.

5.2 Summary of Findings and Recommendations

Objective measures of water quality may shape perceptions and affect behaviours, but not necessarily in a linear or predictable way. Behaviour around the consumption of public drinking water was more related to perceptions of water quality than to the actual tested water quality.

Theme #1: Participants judged the safety of their public tap water by the aesthetics (colour, clarity, odour, taste) of the water. The focus group participants in all three communities used the words “safety” and “quality” interchangeably. The participants judged the safety of a water supply by the aesthetics of the water, specifically taste, smell, colour, and clarity, and they based their decisions to consume, or not consume, their public tap water on aesthetic properties rather than chemical and bacterial laboratory results. For example, a permanent BWA did not deter Trepassey residents from drinking their public tap water when it was deemed aesthetically pleasing. Similarly, a WQI rating of “excellent” did not provide assurance to Harbour Grace focus group participants that their public tap water was safe to drink. Despite the consistency between the good WQI value and their positive perceptions of the quality of the St. John’s public tap water, St. John’s participants cited aesthetic reasons, rather than the WQI test results, for their positive perceptions.

Harbour Grace had the highest water quality rating of the three communities, but none of the participants drank their tap water, due to perceived water contamination from

an old incinerator. Trepassey participants' water consumption behaviour was based on their perceived notion of good quality water from the commercial bottled water factory run-off, despite the fact that this water was neither tested nor treated. St. John's residents perceived their water to be of excellent quality, which was consistent with the actual test results; however, this was more coincidental than based on participants' knowledge of those test results.

While majority of telephone survey participants (range 61.5% to 77.0%) gave ratings of "good" or "very good" on a variety of water characteristics including taste, smell, colour, clarity, and safety, 77% still reported being concerned about the safety of their tap water, and only 55% indicated being sure that it was safe to drink. That water quality remains a concern to people even if they currently believe their water is safe is interesting, and possibly reflects the importance the public places on the availability of safe drinking water.

There are situations where aesthetics may be a true indicator of quality: for example, increased turbidity, displayed as cloudy water, may be a sign of an insufficient amount of chlorine mixing (Government of Newfoundland and Labrador, 2007). However, aesthetics alone are not reliable predictors of drinking water safety. For example, certain minerals (e.g. sulphur, iron) may cause the water to have an unpleasant flavour or odour even if the amounts are below the recommended levels for safe consumption (Government of Newfoundland and Labrador, 2007). Therefore, while water may meet all of the standards for drinking water quality, if it is aesthetically unappealing then it may still be unacceptable to consumers. Alternatively, drinking water

may be aesthetically pleasing, but have bacterial or parasitic contamination. In this way, using aesthetic qualities as a measure of safety of drinking water may be misleading, and could pose a potential health risk.

Recommendation #1: The inter-departmental Safe Drinking Water-Technical Working Group develop a provincial education strategy to inform public tap water consumers that water aesthetics, while a factor in water quality, is not necessarily related to water safety.

Recommendation #2: Water Distribution Managers provide information to public tap water consumers to explain how water composition could alter the aesthetic properties of water. This information should be specific to the community and public water source.

Theme #2: Transparency in communications about the public water supply system is positively linked with consumer trust in household drinking water and those who maintain the public water supply. There was a mixed level of trust in water utilities that differed by study community in the focus groups. Where there existed transparent and effective communication in times of water trouble (e.g. St. John's BWA in 1991) or a close level of connection with, and knowledge of, the people in charge of the water supply (as described by Trepassey participants), trust in the drinking water and those who supplied it, was evident. Conversely, in Harbour Grace, where participants felt communication about drinking water was not transparent, trust was less evident.

Participants in all three focus groups tended to use the word "they" to refer to those maintaining the drinking water supply or those who distribute the drinking water

information without further description. This suggests that participants do not identify with those in charge of water safety; it also suggests a distinct lack of a relationship. In Harbour Grace, this relational distance appeared to lead to feelings of mistrust. However, the participants from St. John's and Trepassy were generally satisfied with the drinking water communication in their communities, and had an assumed trust in the unidentified "they". In particular, the transparency of communication in these two communities appeared to enhance the level of trust in the water and those in charge of the public water supply. The participants of these two communities emphasized that they trusted that important information or notices would be adequately communicated if necessary; this implies an overall trust in those who maintain the system and by extension, trust in the public drinking water. In contrast, participants from Harbour Grace felt that communication levels were inadequate; they were suspicious of their water supply and of those who maintained it.

Perceptions of the waterborne outbreak of *E. coli* in Walkerton, Ontario in 2000, differed among the three focus group communities. Perceptions of drinking water seemed to have less to do with how participants perceived their own water quality and more to do with how they perceived the quality of water elsewhere. Moreover, if participants identified culturally, politically, or economically with a community, then they also identified with the water problems associated with that community. For example, Harbour Grace participants believed that their position was similar to that of people in the small Ontario community of Walkerton because they identified with the lack of communication about water quality. They feared a similar experience in their

own community. St. John's participants felt that the lessons learned from the Walkerton outbreak actually enhanced safety in their own community water supply because public water managers would not let that happen. Further, St. John's participants believed the city had the necessary finances and resources to prevent a similar occurrence, something they believed Walkerton did not have. The participants from the Trepassey focus group felt that a similar situation to that of Walkerton could happen again, but not in their community as they knew exactly who looked after the water supply, and trusted them.

Fears surrounding drinking water contamination were raised several times throughout the Harbour Grace and Trepassey focus group discussion, specifically, the topic of cancer resulting from drinking public tap water and store-bought bottled water. These fears were exacerbated in small communities where anecdotal evidence was a valued source of information. Unanswered questions allowed room for discussion of personal ideas and opinions, which revealed people's misconceptions about the public water distribution system. These findings also highlight the power of the spoken word among community members. A transparent communication approach to maintaining a water system could act to enhance feelings of trust and safety among residents of the community. The more transparent the communications were to participants around the water supply system, the more trust the participants had in the drinking water and those maintaining the supply. The perception of ineffective, or a lack of, communication, or the perception that information was withheld (either intentionally or unintentionally), led to fear and mistrust in the public drinking water system. Fear and mistrust may ultimately lead to alternative water choices, such as bottled water or more frequent use of

water treatment devices, which may increase health risk if the alternative water sources are inferior to the public drinking water.

Recommendation #3: The inter-departmental Safe Drinking Water-Technical Working Group develop a provincial education strategy to inform public tap water consumers about national and provincial public drinking water quality standards and regulations, and specifically how these standards are monitored and enforced in NL.

Recommendation #4: The Government of NL offer low-cost programs (or program subsidies) for educational programs in public water learning.

Theme #3: When people doubt their public water safety, they may turn to alternative water sources such as bottled water, roadside springs, or various in-home treatment methods. The most common source of drinking water in the survey participants' homes varied greatly in this study, and was almost equally distributed in thirds among: water straight from the tap, tap water treated with an in-home method, and bottled water. A small proportion of participants in this study also reported their most common source of drinking water to be non-treated water from ponds, springs and rivers (6%), and a further 4% reported it to be water from these sources that was treated in the home. To our knowledge, these alternate sources were not enquired upon in other Canadian studies, hence; direct comparisons with other populations cannot be made.

Almost half of all survey participants (46%) used in-home water treatment methods to treat their public tap water for drinking water consumption. The most common device used was the jug filter, followed by tap filters, inline filters, and boiling. Bottled water use was also very common, with 61% of participants reporting that they

had consumed bottled water instead of tap water in their homes. The degree of alternative water use observed here is similar to that observed in recent studies in Ontario and British Columbia, Canada (Jones, Dewey, Dore, Majowicz, McEwen, & Waltner-Toews, 2006; Jones, et al., 2007; Pintar, et al., 2009).

The reasons for water treatment and bottled water use among our participants varied, with the most common reasons being perceived improvements in taste and a perceived reduction in bacterial and chemical contamination compared to tap water. In cases where focus group participants believed their drinking water was safe (i.e. St John's), alternative water sources and treatment devices were not common, or deemed unnecessary. Harbour Grace participants felt that their drinking water supply was contaminated and they reported bottled water and jug-filtered tap water as the main sources of drinking water in their household. Although this theme was found in some, but not all, focus groups, these reasons for such alternative water use are similar to those reported elsewhere (American Water Works Association Research Foundation, 1993; Auslander & Langlois, 1993; D. C. Jones AQ, Doré K, Majowicz SE, McEwen SA, Waltner-Toews D, Henson SJ, Mathews E., 2007).

The public's belief that water from alternative sources is safer than municipally treated tap water may or may not be warranted. In the current study, 81% of survey participants that drank bottled water over tap water did so because they believed the former had better safety testing and control. In Canada, tap water is regulated at the provincial/territorial level, and the province of NL follows the national Guidelines for Canadian Drinking Water Quality. Current federal regulations of bottled water do not

contain specific, detailed parameters for chemicals and radiological contaminants in bottled water, and while the Guidelines for Canadian Drinking Water Quality are used as a standard to assess bottled water safety, bottled water manufacturers are not obligated to follow them (Health Canada, 2008a). Increased dissemination of comparisons of public drinking water regulations with bottled water regulations may help the public make more informed drinking water decisions.

A small proportion of survey participants reported water from ponds, springs and rivers to be the most common source of drinking water in the home, and approximately 20% of participants reported having consumed water from these sources in their homes instead of their household tap water. These waters are surface water sources that may easily be contaminated; several pathogens can be isolated from animals, birds and from the general environment, including *Salmonella*, *Campylobacter*, and *Cryptosporidium* species (Angulo, et al., 1997). Consumption of untreated water may pose a health risk; without treatment or testing, there is no way to establish the safety of the water consumed.

Only a small proportion of telephone survey participants consuming water from ponds, springs or rivers treated the water prior to consumption. The most common device used in these cases was the jug filter, which typically employs activated carbon filtration. Depending on the chemical or pathogen under study, the ability of these devices to provide protection from microbial and chemical contaminants remains unclear (Pintar, et al., 2009). The fact that manufacturers typically stipulate that these devices should be used only with “microbiologically safe water” should also be borne in mind.

In addition to citing reasons of better aesthetic quality, participants also explained their consumption of water from ponds, rivers and roadside springs due to a perceived reduction in bacterial and chemical contamination compared to regular tap water. This may suggest apparent misconceptions among some of the public regarding the safety of non-tested and non-treated “natural” water sources and their potential to cause waterborne disease. This is of particular concern for vulnerable populations such as infants and young children, pregnant and breastfeeding women, older adults, and people living with disabilities or chronic diseases. Public health education programs on the risks associated with such water consumption may help to inform the public to make less risky water consumption choices.

Most respondents indicated being concerned with various issues of public tap water, with topics spanning the length of the water supply system, from water source to water tap. Concern can be alleviated through public health communication (Rudd, Kaphingst, Colton, Gregoire, & Hyde, 2004). In a previous study conducted elsewhere (Jones, Doré, Majowicz, McEwen, Waltner-Toews, Mathews, Carr, Henson, 2007), and as supported by the focus groups conducted in this study, there was a positive connection between the perceived care and concern that water treatment operators had for delivering a safe water supply and the public confidence in the public water supply system.

Recommendation #5: The inter-departmental Safe Drinking Water-Technical Working Group enhance the provincial education strategy to inform public drinking water consumers of the risk of drinking from ponds/roadside springs, including a description of potential negative outcomes.

Theme #4: There is low compliance with provincial recommendations for safe public water use during a BWA. A relatively small provincial population (505,000 people) spread over a disproportionately large land mass has led to approximately 535 public water supply systems being maintained by small communities in NL (Government of Newfoundland and Labrador, 2007). Between April 2006 and March 2007, there were a total of 215 BWAs in NL, approximately 9% of which were issued due to a failed microbiological test (Government of Newfoundland and Labrador, 2007); these BWAs affected 145 communities and over 31,000 people. Indeed, the majority of our survey participants (66.5%) reported having experienced, or were previously experiencing, a BWA in their community.

BWAs are a precautionary measure meant to protect the health of the public. During a BWA, NL provincial guidelines recommend boiling water for drinking, brushing teeth, cooking, washing fruits/vegetables, and making ice, coffee/tea, infant formula/cereal and juices. There was low compliance (range: 47.0% to 74.4%) with public health recommendations for tap water use during BWAs among the participants of this study, particularly with respect to brushing teeth (56.3%), making ice cubes (56.5%), mixing juice (64.1%) and making baby formula (47.0%). This is consistent with other literature in this area (Angulo, et al., 1997; Karagiannis, Schimmer, & de Roda Husman, 2009; O'Donnell, Platt, & Aston, 2000). Low compliance with BWAs increases the risk for waterborne disease and can have varying degrees of negative effects on the health of the population, particularly when BWAs are implemented for an extended period of time.

The low compliance with BWA recommendations in this study may be related to poor dissemination of the provincial recommendations, such as lack of awareness of the BWA or provincial recommendations for safe use of public drinking water during a BWA. Both Trepassey and Harbour Grace participants raised concerns about the initial notification of a BWA. They felt that notifications were neither prompt nor widespread enough to sufficiently reach the affected community residents. The telephone survey participants in our study reported receiving BWA information from multiple media, the most common of which were radio, television and word of mouth. Although a flyer delivered door-to-door was the medium most participants reported being most likely to use to access general information on drinking water, only 12% of participants issued a BWA reported receiving information on the advisory in this way. The media through which the majority of study participants first learned of boil water events in a community in the United Kingdom and in the Netherlands were a leaflet delivered to homes (85%) and television (50.3%), respectively (Karagiannis, et al., 2009; O'Donnell, et al., 2000). Our study asked about all media through which participants received BWA information, not just how they first learned of the BWA, hence, direct comparisons with these other studies cannot be made. The potential for recall bias in our study should also be noted as participants were asked about any previous BWAs that had happened at any point in their pasts.

Further, although Trepassey focus group participants knew not to drink the tap water while under a BWA, there was uncertainty about the acceptability of certain daily water uses, such as cooking, making coffee or brushing teeth. In the absence of specific

or scientific information about the details of the BWA guidelines, participants made their decisions and judgments based on the aesthetics of the drinking water.

Reasons for non-compliance with boil water advice have been reported elsewhere to include “forgetting” of the BWA, “not believing” the notification, misunderstandings of the advice provided, a perceived lack of personal threat of illness, and the inconvenience of the recommendations (Angulo, et al., 1997; Karagiannis, et al., 2009; O'Donnell, et al., 2000). Compliance with boil water advice was found not to be dependent on sex, age and presence of children in the household in a study in the Netherlands (Karagiannis, et al., 2009); however, participants there were 138.6 times more likely to comply with the advice if someone else in the household was also complying (Karagiannis, et al., 2009). Compliance with the boil water advice has also been shown to be independent from the type of media by which people learned of boil water notices (Karagiannis, et al., 2009; O'Donnell, et al., 2000). However, BWA information sheets that included the rationale and boiling procedures were shown to increase compliance among residents of Missouri, USA (Angulo, et al., 1997). Studies to assess the reasons for non-compliance with BWA recommendations in NL would be useful, and the identification and implementation of strategies to increase compliance with acceptable uses of public drinking water during a BWA are recommended.

Approximately 74% of participants in this study reported being satisfied with the information provided to them during the BWA, however; only 59% felt that the water was safe to drink after the BWA had been lifted, and nearly all participants reported that it was important to them that they receive more BWA information. A study by

O'Donnell and colleagues (2000) in a community recently having experienced a boil water event, asked participants for advice with respect to future boil water notices. Approximately 40% wanted more information at the start of the event, including a description of the potential health effects, and 30% wanted more information provided intermittently throughout the boil water notice. Further, recommendations were made to better accommodate the needs of the elderly, and persons with disabilities who may have more specific needs regarding or understanding a boil water notice (O'Donnell, et al., 2000). Finally, although a door-to-door flyer was positively received, participants felt that a loud speaker could have more alerted residents in a timelier manner, and a billboard along a main street could provide updates of the BWA status (O'Donnell, et al., 2000). Town hall meetings may also provide town officials with an opportunity to distribute information to a larger audience and answer individual questions, and could be used to elicit community-specific suggestions for future information transfer. The engagement of community members, particularly those having previously experienced a BWA, in the development of information dissemination protocols could help to improve public knowledge of, and potentially compliance with, with future BWAs.

Potentially further complicating the issue, provinces and territories in Canada govern their own drinking water regulations. As such, there is no national standard for the terminology or definition of a BWA. This may lead to confusion and misinterpretation of out-of-province media reports, which may report on issues or concerns that are not relevant to NL. Although not examined in this study,

standardization of drinking water terminology and definitions may reduce confusion and increase comparability of provincial drinking water reports.

Recommendation #6: Water Distribution Managers enhance information to public tap water consumers about BWAs, including safe uses of public drinking water during a BWA, and proper boiling procedures, including a description of potential negative outcomes.

Theme #5: Participants wanted more and improved public tap water information. The desire for more information on a wide variety of issues related to drinking water was widespread among our focus group and telephone survey participants. This is similar to the finding of a US study where approximately 90% of participants felt it was important that they receive more information on drinking water quality (American Water Works Association Research Foundation, 1993). The fact that the majority of our participants wanted more information about their municipal drinking water raises questions about the efficacy of current dissemination method used in the province. The desire for currently available information could be due to ineffectual distribution. For example, at the time of the study, the primary means of distributing drinking water information in the province was via published reports on the government website, but few participants in any of the three focus groups were aware of this, and less than half of telephone survey respondents reported that they would use the government website as a source for information. This reluctance to use the website is not likely explained by poor Internet accessibility as the majority of our participants reported having such access.

Poor information accessibility could also be due to inaccessibility of reports due to language or length. In the focus groups, participants considered technical drinking water papers with field-specific jargon as similar to having no information at all. Therefore, great efforts should be made to ensure the language used in drinking water information dissemination is clear and concise. Partnerships between public health, water utilities and members of the general community to develop effective knowledge translation and transfer materials could help in this regard.

Based on the observations from this study, adequate knowledge transfer may enhance consumer confidence in public tap water. These findings could have practical implications for drinking water utilities wishing to increase consumer confidence in their product. For instance, focus group participants in this study stated that their confidence would increase if they knew the reasons for a BWA and how the contributing problems were resolved. Participants from all three focus groups were comfortable with having unanswered questions, as long as they knew general details and whom to contact if they required more information; they felt reassured in having information available, even if it required that they take the initiative to retrieve it.

The knowledge translation and transfer medium deemed most likely to be used by the telephone survey participants in this study to acquire drinking water information were mail flyers, television and radio. Most participants also supported using the newspaper, although to a lesser extent. Community notices were mentioned as helpful, but were not seen as a way to reach the entire community.

The media influenced perceptions as evidenced by the focus group references to the Walkerton incident. Participants from the Harbour Grace group also had many concerns surrounding their drinking water that stemmed from an article in the local newspaper many years ago. These cases (although negative) suggest that the media may be an effective tool when disseminating information about water quality. Calling the town council was a method employed by some focus group participants, however; this method is highly labour-intensive for the consumer and the town council, and is a passive form of information distribution for the provider. Town hall meetings could provide an opportunity for town officials to answer individual questions while still getting information distributed to a larger audience.

Participants in the three focus groups and the survey had different preferences in receiving public drinking water information, and no single dissemination medium was deemed sufficient to communicate information to the entire population. A combination of distribution methods is therefore recommended to reach the bulk of the population.

Recommendation #7: Water Distribution Managers provide regular-interval information to public tap water consumers, including information about source water, testing, and community-specific drinking water test results.

Recommendation #8: Water Distribution Managers ensure that all community-specific, public water-testing results are available to the public in an easy-to-understand format.

Recommendation #9: Local community officials assume responsibility for communicating with public drinking water consumers to identify community-specific means of distributing water quality information.

Recommendation #10: The inter-departmental Safe Drinking Water-Technical Working Group work with Water Distribution Managers to develop community-specific methods for disseminating information about their public tap water.

Recommendation #11: Water Distribution Managers use a variety of information distribution methods, including television, radio, newspaper, town hall meetings, door-to-door flyers, and postings at local community centres.

Recommendation #12: The inter-departmental Safe Drinking Water-Technical Working Group and Water Distribution Managers actively disseminate public drinking water information at the community level.

Recommendation #13: The FPT Safe Drinking Water-Technical Working Group develop national standard terminology and definitions to reduce public confusion, and increase comparability in inter-provincial drinking water reports.

Recommendation #14: Water Distribution Managers formally evaluate currently available public water supply information to ensure appropriate language and literacy levels, length, accessibility and distribution to public drinking water consumers.

Recommendation #15: The inter-departmental Safe Drinking Water-Technical Working Group and Water Distribution Managers ensure that all information disseminated to the public is available in non-scientific language.

5.3 Study limitations

These data are not without limitations: there were too few participants in the focus groups to generalize to the entire NL population, and participants who had a vested interest in drinking water quality may have self-selected to participate in the study, which could have potentially biased the discussion. The focus groups were localized to the Avalon Peninsula and were not completed to saturation. Further focus groups should be conducted in additional communities to determine community-specific issues and concerns that can then be addressed by the community water managers. However, the rich data collected using these focus groups helped to inform the content and vocabulary of the telephone questionnaire and provided valuable insight to explain trends and patterns that were later revealed in the subsequent telephone survey.

The response rate of the telephone survey was 25.9% and may have led to a sampling bias and is likely to affect the generalizability of the results; this is common in most participant-based research. Typical of population-based surveys, our participants were more likely to be female, older, and more highly educated than in the general NL population. They also had greater access to the internet and fewer children at home.

Questions pertaining to BWAs were not just asked of survey participants that had recently experienced a BWA, but rather all participants ever having experienced such an event. The potential for recall bias with the BWA data therefore exists, particularly where long time delays between the advisory and the survey may have existed. Further, the retrospective nature of the studies could have resulted in recall bias and self-reported

consumption, knowledge, and practices could be over- or under-estimated in order to provide socially desirable responses.

This project focused solely on the public drinking water systems and was limited to the NL population. Although private drinking water systems are outside the scope of this research project, another study conducted in tandem with this research project addressed public perceptions of private drinking water in NL.

Although the focus group participants offered personal suggestions for improvements to the content of drinking water quality reports, potential report content was not the objective of the study and was not substantiated by the telephone survey. It remains to be determined how public drinking water reports would best satisfy the reservations expressed by consumers of public water systems in NL. Specifically, future studies need to address the best content and delivery methods to communicate information to a population with lower literacy rates, varied access to electronic information, and language barriers.

Public drinking water program and policy evaluation is necessary to determine if future changes or modifications positively alter existing perceptions of public drinking water in NL. Specifically, study measures ought to include: BWA compliance, whether the public's desire for more information has been satisfied, whether there is greater satisfaction with information availability and ease of understanding (a proxy for appropriate information dissemination), and more consumer confidence.

5.4 Dissemination Methods

To share the knowledge gained from this thesis, one manuscript will be submitted to prominent, peer-reviewed water and health journals. The NL Intergovernmental Drinking Water Working Group has invited me to present at one of their regularly scheduled intergovernmental meetings. A summary of the thesis findings was also presented at the Canadian Institute for Public Health Inspectors conference (NL branch) in St. John's in November 2009. The findings were received with great interest and I was subsequently invited to present in more detail at the 2010 Annual NL Public Water Conference and the 2010 NL Municipalities Workshop.

Dissemination of the findings is not limited to these outlets. Further dissemination opportunities may include various presentations (oral or poster) at relevant Atlantic Canada, provincial or regional conferences.

5.5 Conclusions

From a health promotion perspective, it is important to understand public perceptions of tap water, as well as what water sources the public is using and why. This knowledge can be used to identify and address any potential health risks relating to public and alternative water sources before negative health outcomes relating to water-borne contaminants are experienced.

Overall, survey participants rated their public tap water quality as good/very good, but concerns with various aspects of the public drinking water supply were common. Consumers appeared to use water aesthetics, rather than government drinking water reports, as a proxy measure of the safety of tap water and alternative water sources.

When participants were unsure about the quality and safety of their tap water, they tended to find an alternative drinking water source. Alternative water use was common, and included home water treatment, commercially bottled water, or water from ponds, rivers and roadside springs. The reasons for such water use was primarily due to perceived improvements in taste and safety compared to tap water. However, these alternative water sources were not necessarily better than tap water: they may have been untested, untreated or in the case of in-home water treatment devices, could be used improperly.

Low compliance to BWAs was common, which is concerning, particularly given the high number of BWAs issued each year in NL. These behaviours may subject consumers to an unnecessary increased risk of waterborne illness, despite the perception that the alternative choice is safe. There may exist an increased risk of waterborne illness in this population due to low compliance with BWA recommendations. Further studies to assess the reasons of such non-compliance would be useful, as would partnerships with community members to identify information dissemination methods and other strategies to increase public compliance with acceptable uses of public drinking water during a BWA.

The results of this study suggest that a lack of accurate information can lead to feelings of mistrust concerning public tap water and those who supply it. In the absence of trust, consumers resorted to alternative water sources or use of treatment devices. In several instances, participants explained that transparent communication enhanced their trust and general perceptions. The majority of our participants wanted more information about their household drinking water quality, including all aspects of the public water

distribution system. Dissemination methods were discussed and the essential need for clear, concise language was highlighted. Enhanced information dissemination may improve perceptions of the safety of drinking water, and minimize health risks to the general public. No single distribution method is likely to provide complete community coverage, hence; a variety of methods, including mail flyers, television, and radio, should be used. An increase in public understanding of the quality of public tap water may help to improve perceptions of, and trust in, this essential resource.

A health promotion framework was used to make upstream recommendations for changes in drinking water policy and programs in NL. The validity of the findings was strengthened by the consistency in the results from the mixed methods research.

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APPENDIX 1: FOCUS GROUP QUESTIONING GUIDE

Opening Question

1. "Please tell us your name, and what you like to do in your spare time"

Introductory Questions

2. "What is the first thing that comes to mind then you think of the tap water in <Community Name>? Why?"
3. "Do you drink tap water?" If not, "Why not?"

Transition and Key Questions

Public Perception

4. "Is there anything about the drinking quality of tap water in <Community Name> that you don't like, or that concerns you?"
 - Taste
 - Colour/clarity
 - Smell
 - Other
5. "Do you have any concerns about the safety of tap water in <Community Name>?"
 - Bacteria/parasites/viruses
 - Pesticide residues
 - Dioxins
 - PCBs

- Other
6. “Which of these concerns you most? Why?”
 7. “How do you think the safety of tap water today compares with say, twenty years ago? Why?”
 8. “How do you think the safety of tap water in <Community Name> compares to that in other municipalities in Canada? Why?”
 9. “Have you ever had any bad experiences that you feel were related to drinking tap water? What were they?”
 10. “Do you do anything to deal with your concerns with drinking water? What?”

Alternative Water Use

11. “Do you treat the tap water you drink in some way? How?”
 - Tap/Jug/other filters
 - Heat/light based (boiling, distillation, UV)
 - Ion-based (softener, ozone)
 - Other
12. “Think back to when you started treating tap water in this way. When was this? For what reasons do you treat your water?”
13. “Do you drink bottled water?”
 - Bottled water
 - Water from water coolers
14. “Why do you drink bottled water? When did you start drinking bottled water?”

15. "What is the main type of water you consume in a day?" (tap or bottled?)

16. "What do you use your bottled water for?" "What do you use your tap water for?"

"What do you use your treated tap water for?"

(Premise: Some people have specific uses for different types of water - for instance, they may use bottled water for drinking and tap water for cooking, while other people do not have specific uses.)

Public Knowledge

17. "Are you satisfied with your current knowledge about the safety of tap water in <Community Name>? If not, why not? Where do you get information on the safety of tap water? Would you like more information? Where would you like to get this information?"

- Mail-outs/brochures
- Newspapers
- Radio
- TV
- Websites
- Other

18. "Can you remember hearing anything on the radio or TV, or reading anything in the newspapers in the last few years about water safety?"

- Walkerton/North Battleford/Aboriginal reservations
- Traces of prescription drugs

- PCBs
- Other

19. “When you heard/read about these, did they have any impact on your consumption of drinking water?”

20. “Do you think anyone checks up on the supply of tap water to make sure it is safe to drink? Who does this? What sort of things do you think they check for? How do you think they treat the water? What more do you think they could do?”

Ending Questions

21. <Provide an oral summary of the discussion> “Did I correctly describe what was said?”

22. “Are there any other things you would like to discuss?”

Thank-you for participating in our discussion this evening....

APPENDIX 2: TELEPHONE SURVEY QUESTIONNAIRE

Newfoundland & Labrador Municipal Drinking Water Survey

Introductory Script

“Hello, my name is _____ and I’m calling from the Health Research Unit at Memorial University of Newfoundland. We are currently doing a study on opinions of drinking water in Newfoundland and Labrador. As a resident of the province, your participation in this study is extremely valuable, since it will allow us to better target prevention, education and other public health programs. Your phone number has been randomly selected to be included in this study.

11. Have I called a residential number or is this a commercial number?

Residential

Commercial

INTERVIEWER: If Commercial say: “Thank you very much for your time, but we are only interviewing residences.”

INTERVIEWER: if Residential, continue

12. I would like to interview the adult member of the household who is most responsible for decisions pertaining to drinking water (for instance, decisions related to the use of in-home water treatment devices and/or water testing). Is that person available to talk with me?

Yes

No

I3. May I have <<your/their>> first name?

INTERVIEWER: If NOT AVAILABLE, please ask: “When would be a good time to call back so that I may speak with <<NAME>>?”

INTERVIEWER: If IS AVAILABLE and NOT the person you are speaking with you, please ask to speak with that person now.

INTERVIEWER: If now speaking with a different person, please re-read introductory paragraph describing the study. (i.e. the “Hello, my name is...” paragraph), then continue:

As token of our appreciation for your input, all participants will entered into our draw to win one of two \$250 cash prizes.

Your participation is completely voluntary and you can skip any questions that you are not comfortable with. We expect the survey to take about 20 minutes. We do not anticipate there being any risks to you as a result of your participation, although some people may experience some uneasiness around discussion of drinking water safety. Please note that all attempts will be made to prevent this from happening and we can give you the contact details of the lead researcher who will be happy to discuss any concerns or questions you may have.

Finally, your input will be held in strict confidence. Reports will not include your name, and your input will not be used for any purpose other than that already

mentioned. Once finished, the researchers would be happy to share with you a summary of the results upon your request. May I continue?

I4. "Can I confirm that you are 18 years of age or older?"

Yes

No

I'd like to now ask you some questions about your household drinking water and your opinions of drinking water in Newfoundland and Labrador, as well as some general demographic questions. As I just mentioned, the questions will take about 20 minutes, and you may skip questions or discontinue the interview at any point along the way.

Do you have any questions? [Interviewer: if unable to answer yourself, please provide contact details of Ms. Kelly Butt]

I5. Do I have your permission to interview you?

Yes

No

INTERVIEWER: If NO, please thank the person for their time and end call; if YES, continue

I would first like to confirm that you are on a public water supply. By "public water supply", I mean household tap water that is provided and maintained by your community. [Interviewer: also known as "town water" or "municipal water"]

I6. Is your household on a public water supply?

Yes

No

INTERVIEWER: If NO, please switch to PRIVATE WATER SURVEY; if YES, begin this survey.

Thank you. I will now start the survey by asking you some questions about your opinions of drinking water quality.

1. How important do you consider each of the following when considering the quality of household water from community sources? [Interviewer: please check one box per row]:

CHARACTERISTIC	Very Important	Important	Neither Important nor Unimportant	Unimportant	Very Unimportant
Taste	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Smell	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Colour	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Clarity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Safety	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Other (please specify)	<input type="checkbox"/>				

2. Please rate the quality of your household tap water for the following characteristics. [Interviewer: please check one box per row]:

CHARACTERISTIC	Very Good	Good	Neither Good nor Poor	Poor	Very Poor
Taste	<input type="checkbox"/>				
Smell	<input type="checkbox"/>				
Colour	<input type="checkbox"/>				
Clarity	<input type="checkbox"/>				
Safety	<input type="checkbox"/>				
Other (please specify)	<input type="checkbox"/>				

specify)					

3. Regarding your household tap water, how concerned are you about the possible presence of each of the following? [Interviewer: please check one box per row]:

CHARACTERISTIC	Very Concerned	Concerned	Neither Concerned nor Unconcerned	Unconcerned	Very Unconcerned
Chemicals or industrial pollutants	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pesticides or fertilizers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Metals or minerals (e.g. arsenic, iron, lead)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Germs/bacteria/ <i>E. coli</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Hardness of water	<input type="checkbox"/>				
Smell	<input type="checkbox"/>				
Other (please specify)	<input type="checkbox"/>				

4. Do you think fluoride is added to the tap water from your community water

source? [Interviewer: please check one]:

Yes

No

Don't know

5. In some provinces, but not Newfoundland and Labrador, fluoride is added to town drinking water. Which one of the following best describes how you feel about the lack of fluoride in your household tap water? Please choose one of the

following: Are you <<READ CHOICES>>? [Interviewer: please check one box]:

Very Concerned	Concerned	Neither Concerned nor Unconcerned	Unconcerned	Very Unconcerned
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Could you please briefly describe why you feel this way? [Interviewer:

please enter verbatim response as best as possible]:

6. Is Chlorine added to the tap water from your community source? [Interviewer: please check one]:

Yes

No

Don't know

Interviewer: If no, go to question 8.

7. Which one of the following best describes how you feel about the presence of chlorine in your tap water? Are you <<READ CHOICES>>? [Interviewer: please check one box]:

	Very Concerned	Concerned	Neither Concerned nor Unconcerned	Unconcerned	Very Unconcerned
Chlorine	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

8. Regarding the safety of your household tap water, how much does each of the following concern you? [Interviewer: please check one box per row]:

	Very Concerned	Concerned	Neither Concerned nor Unconcerned	Unconcerned	Very Unconcerned
Condition of pipes used to transport water	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How often the water is tested	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
What the water is tested for	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Results of municipal water testing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Treatment of	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

municipal water					
Water treatment plant worker training	<input type="checkbox"/>				
Government regulation of water treatment	<input type="checkbox"/>				
Current watershed protection measures	<input type="checkbox"/>				
Watershed contamination by humans	<input type="checkbox"/>				
Watershed contamination					

by animals					
Other (please specify)	<input type="checkbox"/>				

9. How concerned are you about the overall safety of your household tap water?

Please choose one of the following. [Interviewer: please check one box]:

Very Concerned	Concerned	Neither Concerned nor Unconcerned	Unconcerned	Very Unconcerned
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Could you please briefly describe why you feel this way. [Interviewer: please

enter verbatim response as best as possible]:

10. How sure are you that your household tap water is safe to drink? Please choose one of the following. [Interviewer: please check one box]:

Very Sure	Sure	Neither Sure nor Unsure	Unsure	Very Unsure
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

11. Have you, or has anyone in your immediate family, ever had an illness that you feel was related to drinking water from municipal water sources in each of the following places? [Interviewer: please check one box per row]:

	Yes	No	Don't Know
Newfoundland & Labrador	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Somewhere else in Canada	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
In another country	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

INTERVIEWER: If all responses are NO or Don't Know, please go to Question

13.

12. Did your illness include any of the following? Please answer “yes” or “no”.

[Interviewer: please read sign/symptom and check as appropriate]:

Vomiting

Diarrhea

Fever

Nausea

Skin problems

Other (please specify) _____

I am now going to ask you a few questions about your drinking water behaviours.

13. How often do you use each of the following as a source of drinking water in your

home? [Interviewer: please check one box per row]:

	Always	Frequently	Neither Frequently nor Infrequently	Infrequently	Never

Water straight from the tap (Not treated with anything in your home)	<input type="checkbox"/>				
Tap water treated with a home treatment device (Jug filters, tap filters, other filters, water softeners, boiling, ultra-violet light, or other devices)	<input type="checkbox"/>				
Store-bought water (Plain/non-carbonated water, like Evian bottled water or that from water coolers)	<input type="checkbox"/>				
Untreated water from ponds, rivers or roadside	<input type="checkbox"/>				

springs					
Water from ponds, rivers or roadside springs that is then treated in your home	<input type="checkbox"/>				

14. Overall, what is your most common source of drinking water in your home?

Please choose one of the following. [Interviewer: please check one]:

Water straight from the tap

Water from your tap, treated with a treatment device

Store-bought bottled water

Untreated water from ponds, rivers or roadside springs that is NOT treated

Water from ponds, rivers or roadside springs that is treated in your home

Don't know

Other (please specify)

15. Does your household treat your tap water for drinking in any way (e.g. by using Brita filters, tap filters, any type of disinfection or by boiling water)? [Interviewer: please check one]:

Yes

No

INTERVIEWER: If NO, please go to Question 18

16. In what ways does your household treat your tap water for drinking purposes?

[Interviewer: Please check ALL that apply]:

Use a jug filter

Use a tap filter

Use an in-line filter

Boil tap water

Use a reverse osmosis device

Use ultraviolet (UV) light disinfection

Use a water softener

Use an iron removal system

Candle filter

Other (please specify) _____

17. How important are each of the following in your decision to treat your household tap water for drinking purposes? [Interviewer: please check one box per row]:

	Very Important	Important	Neither Important nor Unimportant	Unimportant	Very Unimportant
Improves taste	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Improves smell	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reduces germs/bacteria/ <i>E. coli</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Reduces metals or minerals (e.g. arsenic, iron, lead)	<input type="checkbox"/>				
Reduces chemicals	<input type="checkbox"/>				
Reduces cloudiness of water	<input type="checkbox"/>				
Reduces hardness of water	<input type="checkbox"/>				
Other (please specify)	<input type="checkbox"/>				

18. Regardless of whether or not you use a water treatment device, how many glasses of tap water (from your community water source) do you drink in an average day? A “glass” is considered one cup, 8-ounces or a 250mL serving. Please choose one of the following. [Interviewer: please check one]:

None

Less than 1 glass (250mL)

1 to 2 glasses (250mL to 500mL)

3 to 4 glasses (750mL to 1 L)

5 to 6 glasses (1.25 L to 1.5 L)

7 or more glasses (1.75 L or more)

Don't know

19. Do you ever drink store-bought bottled water instead of your household tap water while at home? (Please note "store-bought bottled water" includes water from water coolers). [Interviewer: please check one]:

Yes

No

INTERVIEWER: If NO, please go to Question 21

20. How many glasses of bottled water do you drink at home in an average day? A “glass” is considered one cup, 8-ounces, a 250mL serving, or half of a regular sized bottle of water. [Interviewer: Please check one]:

- Less than 1 glass (250mL)
- 1 to 2 glasses (250mL to 500mL)
- 3 to 4 glasses (750mL to 1 L)
- 5 to 6 glasses (1.25 L to 1.5 L)
- 7 or more glasses (1.75 L or more)
- Don't know

21. How important are each of the following in your decision to drink bottled water instead of your tap water while at home? [Interviewer: Please check one box per row]:

	Very Important	Important	Neither Important nor	Unimportant	Very Unimportant
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			Unimportant		
Improved taste	<input type="checkbox"/>				
Improved smell	<input type="checkbox"/>				
Reduced germs/bacteria/E.coli	<input type="checkbox"/>				
Reduced metals or minerals (e.g. arsenic, iron, lead)	<input type="checkbox"/>				
Reduced chemicals	<input type="checkbox"/>				
Reduced cloudiness of water	<input type="checkbox"/>				
Reduced hardness of water	<input type="checkbox"/>				
Better safety testing	<input type="checkbox"/>				

and control					
Convenience	<input type="checkbox"/>				
Other (please specify)	<input type="checkbox"/>				

22. Do you ever drink water from roadside springs, ponds or rivers instead of your household tap water while at home? [Interviewer: please check one]:

Yes

No

INTERVIEWER: If NO, please go to Question 27

23. How many glasses of water from roadside springs, ponds or rivers do you drink at home in an average day? A “glass” is considered one cup, 8-ounces, a 250mL serving, or half of a regular sized bottle of water. [Interviewer: please check one]:

Less than 1 glass (250mL)

1 to 2 glasses (250mL to 500mL)

3 to 4 glasses (750mL to 1 L)

5 to 6 glasses (1.25 L to 1.5 L)

7 or more glasses (1.75 L or more)

Don't know

24. Does your household treat this water (that is, the water from roadside springs, rivers, ponds) for drinking in any way (e.g. by using Brita filters, tap filters, any type of disinfection or by boiling water)? [Interviewer: please check one]:

Yes

No

INTERVIEWER: If NO, please go to Question 26

25. In what ways do you treat this water (that is, the water from roadside springs, ponds or rivers) for drinking purposes? Please choose all of the following that apply. [Interviewer: please check ALL that apply]:

Use a jug filter

Use a tap filter

Use an in-line filter

Boil tap water

Use a reverse osmosis device

Use ultraviolet (UV) light disinfection

Use a water softener

Use an iron removal system

Use a candle filter

Add chlorine/ Javex

Other (please specify)

26. How important are each the following in your decision to drink this water

instead of your household tap water while at home? [Interviewer: please check one

box per row]:

	Very	Important	Neither	Unimportant	Very
--	------	-----------	---------	-------------	------

	Important		Important nor Unimportant		Unimportant
Improved taste	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Improved smell	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reduced germs/bacteria/E.coli	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reduced metals or minerals (e.g. arsenic, iron, lead)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reduced chemicals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reduced cloudiness of water	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reduced hardness of water	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Convenience	<input type="checkbox"/>				
Other (please specify)	<input type="checkbox"/>				

I would now like to ask you a few questions about your opinions on information related to drinking water in Newfoundland and Labrador.

27. Where do you currently get your information on drinking water?

[Interviewer: please check all that apply]:

- Newspaper
- Radio
- Television
- Flyer in the mail
- Poster at local business

Word of mouth

Internet website (please specify) _____

Other (please specify) _____

28. How important is it to you that you get more information on the following?

[Interviewer: Please check one box per row]:

	Very Important	Important	Neither Important nor Unimportant	Unimportant	Very Unimportant
Condition of pipes used to transport water from water treatment plant	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How often municipal water is tested	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

What municipal water is tested for	<input type="checkbox"/>				
Results of municipal water testing	<input type="checkbox"/>				
Treatment of municipal water	<input type="checkbox"/>				
Water treatment plant worker training	<input type="checkbox"/>				
Government regulation of water treatment	<input type="checkbox"/>				
Source of municipal water	<input type="checkbox"/>				

Reasons for boil orders	<input type="checkbox"/>				
Watershed Protection measures	<input type="checkbox"/>				
Other (please specify)	<input type="checkbox"/>				

29. If this information were to be provided in each of the following ways, how likely would you be to use them? [Interviewer: Please check one box per row]:

	Very Likely	Likely	Neither Likely nor Unlikely	Unlikely	Very Unlikely
Radio	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Television	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Newspaper	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Flyer/Brochure mailed to your home	<input type="checkbox"/>				
Newfoundland and Labrador Government website	<input type="checkbox"/>				
Other (please specify)	<input type="checkbox"/>				

Thank you, I would now like to ask you a few questions on boil water advisories.

30. Has your community water supply ever been issued a “Boil water advisory?”

[Interviewer: Please check one]:

Yes Yes – currently issued No

INTERVIEWER: if NO, please go to Question 36

31. How did you find out that the boil water advisory had been issued?

[Interviewer: Please check all that apply]:

Newspaper

Radio

Television

Flyer in the mail

Poster at local business

Word of mouth

Other (please specify) _____

32. For what household activities, if any, did you boil the water before using?

[Interviewer: Please check all that apply]?

Drinking

Cooking

Brushing teeth

Making ice cubes

Mixing juice

Making Baby formula

Not Applicable

Washing ready-to-eat fruit and vegetables

Other (please specify) _____

33. How did you find out that the advisory had been lifted? [Interviewer: Please

check all that apply]:

Newspaper

Radio

Television

Flyer in the mail

Poster at local business

Word of mouth

Other (please specify) _____

34. Were you satisfied with the information surrounding the boil order advisory?

[Interviewer: please select one]:

Yes

No

INTERVIEWER: If YES, please go to Question 35

If no, could you please briefly describe why you feel this way? [Interviewer:
please enter verbatim response as best as possible]:

35. Did you feel safe to use your tap water after the boil water advisory had been

lifted? [Interviewer: please select one]:

Yes

No

INTERVIEWER: If YES, please go to Question 36

If no, could you please briefly describe why you feel this way? [Interviewer:
please enter verbatim response as best as possible]:

We are nearing the end of our survey. The next few questions will provide us with an overall profile of respondents – this is important because it allows us to compare respondents of this survey to the general population of Newfoundland and Labrador. Again, please note that all responses are strictly confidential and voluntary.

36. Do you have internet access? [Interviewer: please check one]:

Yes

No

37. How many children do you have in each of the following age categories?

[Interviewer: Please write “0” if there are no children in a category]:

Children

Less than 5 years of age

5 to 12 years of age

12 to 18 years of age

38. How many people live in your household?

39. Are you, or is anyone in your household, employed in the drinking water industry? [Interviewer: please check one]:

Yes

No

40. What is your age? [Interviewer: Please choose one of the following]:

18 to 29
Years

30 to 39
years

40 to 49
years

50 to 59
years

60 to 69
years

70 years
or older

41. What is the highest level of schooling that you have completed? Please choose one of the following. [Interviewer: please check one]:

Grade school

Some high school

High school graduate

College or technical school graduate

University graduate

Post-graduate degree

Other (please specify) _____

42. What is your total household annual income, before taxes? Please choose one of the following. [Interviewer: please check one]:

Less than \$10,000

Between \$10,000 and \$14,999

Between \$15,000 and \$19,999

Between \$20,000 and \$29,999

Between \$30,000 and \$39,999

Between \$40,000 and \$49,999

Between \$50,000 and \$59,999

Between \$60,000 and \$69,999

Between \$60,000 and \$69,999

43. [INTERVIEWER: please record whether respondent is **male or female** – do not ask!].

Male

Female

44. **Is there anything you would like to tell us before we conclude the survey?**

[Interviewer: please enter verbatim response as best as possible]:

That was my last question. Thank you very much for your participation. The answers you provided will be combined with all other participants to give us information about the perceptions of drinking water throughout Newfoundland and Labrador. As I mentioned at the start of our conversation, your name will now be entered to win \$250. Thank you again for your time and co-operation.



